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. Theoretically contradicting arguments ask for empirical evidence to obtain a better knowledge of this relationship. We rely on the institutional setting in Switzerland to study the issue empirically. According to our findings tax decentralization tends to reduce concentration in pre- and after-tax income without additional redistribution via progressive taxes. It is, however, crucial to consider the interdependence of decentralization and fragmentation as inequality decreasing effects of decentralization are counteracted by its interaction with fragmentation.

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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 notion by focusing on the influence of one set of constitutional provisions, i.e., fiscal federalism, on inequality.

Traditionally, the theory of federalism assigns (re-)distributional 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 (Oates, 1999). However, fiscal federalism may affect the distribution of income via a range of other channels contradicting the traditional view of pressure on the welfare state. Whether positive or negative effects dominate remains largely an empirical

question.

This paper examines the relationship between fiscal federalism and income inequality by exploiting institutional heterogeneity within Switzerland. Swiss cantons grant municipalities a varying degree of fiscal autonomy. At the same time, cantons also differ considerably regarding the distribution of income such that we can identify the impact of intertemporal changes in fiscal decentralization 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. We measure decentralization between state and local level by capturing tax revenues over which municipalities have actual autonomy. Importantly, we explicitly assess the interaction of fiscal decentralization with the level of fragmentation of cantons into municipalities. 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. However, this is not the result of additional redistribution via progressive taxes but the effects are apparent in pre-tax incomes already. 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 indicating that there is a level of fragmentation beyond which tax decentralization turns into adverse outcomes.

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 distribution of income we describe both inequality increasing as well as decreasing effects. Additionally, we consider arguments for an interdependence of fiscal decentralization with fragmentation. Finally, we refer to the existing empirical research on these questions.

2.1. Inequality Increasing Effects of Fiscal Decentralization

In the model by Tiebout (1956) local jurisdictions compete by offering a bundle of public goods for a certain tax price. Local jurisdictions will offer different bundles and therefore tend to attract specific groups of citizens. 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 of citizens enables high income earners to avoid progressive taxes and low income earners to move to jurisdictions with generous social benefits. Therefore, Musgrave (1959) recommends to allocate the redistributive function of the state to the level of government where mobility cost are highest.

Other 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. Certain public goods can have important distributional effects (e.g. social security, public safety, health provision, child care or basic schooling) and therefore decentralization may increase inequality indirectly through an inefficiently low level of such public goods. Problems of spillovers and externalities could still be solved either by intergovernmental grants according to Pigou (1920) or by contract arrangements between local governments in the tradition of Coase (1960).

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Fiscal decentralization may also amplify regional disparities as jurisdictions with certain geographic or socio-demographic disadvantages lag behind progressively in development. These problems can be alleviated to a certain degree by intergovernmental equalization payments to compensate for exogenous disparities.

2.2. Inequality Decreasing Effects of Fiscal Decentralization

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. Lower income groups, due to a higher dependency on public goods and basic services, presumably benefit most from efficiency in the public sector. Thus inequality may decrease as well.

Pauly (1973) argues that even redistribution itself can be a local public good. If pure altruism is the reason for citizens to support redistribution, this motive will depend on the perception of how much welfare is needed within their own community. Individuals might be much more sympathetic to the poor in their neighborhood than to strangers in completely different parts of the country. Even if the impetus for redistribution is more egoistic, for example the prevention of crime or the protection of real estate value, such motives are clearly geographically limited.

Furthermore, distributional preferences 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.

In theory, a central government could design welfare policy according to local conditions. Still, local authorities have a considerable information advantage (Oates, 2008). A central authority is likely to struggle to aggregate all the relevant information to

properly adapt social programs. Furthermore, political or legal reasons prevent central governments from treating individuals differently based on the jurisdiction they live in. Hence, centrally administered social benefits are almost necessarily uniform and thus to a certain degree inefficient.

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 generate knowledge about the distributional impact of different forms of public policy as well as on the effectiveness of specific redistribution policies (Oates, 1999). In a decentralized framework all jurisdictions benefit from this knowledge to improve the distributional impact of their activities.

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. The implemented redistribution policies may deviate from the actual preferences of voters. Decentralization introduces a competition element which restricts 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.

2.3. Interdependence between Decentralization and 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 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 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 may be undermined by higher fragmentation due to increasing negative spillovers.

Similar effects can occur for other 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.[2]

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 decomposing them with respect to revenue and expenditure as well as government lev-

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[2]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).

els. 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. As average regional incomes rise however, the inequality reducing effect of fiscal decentralization tends to diminish. 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. As local jurisdictions have no influence over these expenditures, the subnational share might overestimate actual fiscal decentralization. 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. Their results show however, that revenue decentralization increases income inequality. The effects are strongest for a measure that accounts exclusively for taxes over which local authorities have complete authority.

Besides the precise measurement of fiscal decentralization, fragmentation may also play a critical role as explained in the theoretical section above. Sturm and De Haan (2015) present evidence that countries with strong ethno-linguistic fractionalization exhibit less redistribution. Feld et al. (2010b) investigate the effect of different instruments of fiscal federalism in Switzerland on total government revenues. Based on a panel of Swiss cantons from 1980 to 1998 they find that revenue decentralization has a decreasing effect on the size of government. The authors also take into account the effect of fragmentation (measured by the number of municipalities in a canton) but find no significant effect.

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 it is common in the literature to employ 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$^{\text{th}}$ decile).

In this paper we contribute to the empirical literature in several ways. First, we capture fiscal federalism more precisely than previous studies which usually 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 and their municipalities. We thus capture tax revenues over which local governments have a high degree of autonomy. Importantly, we also explicitly assess as to how the impact of fiscal decentralization depends on fragmentation. Even though the number and the size of jurisdictions is theoretically relevant it has – to our knowledge – not yet been tested in the literature about the distributive impact of fiscal federalism.

Second, we capture the income distribution comprehensively. Contrary to previous studies which employ survey data this analysis exploits tax statistics.[3] 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.

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

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[3]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.

3. Data and Method

3.1. Institutional Background

Switzerland constitutionally guarantees widespread autonomy for its lower tiers of government with regard to both the expenditure and revenue side of the budget. The 26 cantons independently levy income, corporate or wealth taxes. Municipalities (Switzerland counts 2 222 local jurisdictions as of January 1st, 2018) individually decide upon a tax multiplier such that municipal tax rates are the product of the cantonal rate 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 20 % of total tax revenue, respectively, Switzerland ranks second behind Canada (subnational share of 56 %).[4]

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. The sub-national level has substantial impact regarding the income distribution also on the expenditure side.

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[4]OECD Revenue statistics as of September 19th, 2018.

Cantons and municipalities are responsible for 98% of health, 91% of education and 55% of social security spending (FFA, 2018).

3.2. Data

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 direct federal tax is levied by the cantonal tax authorities on their respective territory, the income data is available for each canton. At the same time, since it is a federal tax the income definition is consistent across all cantons. Schaltegger and Gorgas (2011) make use of 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.[5] 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). Redistribution is determined as the percentage reduction in different inequality measures due to the effect of progressive income taxes.

Fiscal decentralization can be measured by the share of public revenues and/or expenditures that accrue at the local level. Local expenditures, however, are often to a significant degree determined and financed by a higher tier of government. If municipal expenditures are not self-financed, fiscal decentralization may be overestimated by such

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[5]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.

a measure. Due to transfer and grant payments, total local revenues might similarly depend on the cantonal government. For these reasons, a more targeted measure is employed based on tax revenues solely determined by local authorities. These taxes are levied within their own territory and the receipts can be spent according to local preferences.

The decentralization measure (*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 as compared to the cantonal government. However, as tax revenues are the result of competition the measure is potentially biased. If tax competition among municipalities is very strong, an increase in local fiscal autonomy might not result in higher tax revenues at the local level. Hence, de jure fiscal autonomy of municipalities cannot be exploited due to competitive pressure. Nonetheless, an extension of local tax autonomy can only occur at the expense of the higher level of government, as taxation responsibilities are shifted from the cantonal level to municipalities. Ceteris paribus this results in lower tax revenues at the cantonal level. Therefore, an increase in de jure fiscal autonomy of municipalities will induce an increase in the ratio of local tax revenue to total cantonal tax revenue and our de facto measure of fiscal decentralization.

Moreover, we may assume fiscal equivalence according to Olson (1969) such that within each jurisdiction there is an equivalence between taxes paid and public goods provided. Since the principle of subsidiarity is deeply rooted in the history of the Swiss federation and also thoroughly applied in its institutional practice, this assumption is plausible in a Swiss context. If fiscal equivalence is fulfilled local autonomy can actually be measured by the local share of actual tax revenues.

Fragmentation of cantons 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 municipalities 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 5.1 we use this alternative fragmentation measure.

Besides variables for decentralization and fragmentation we account for the competitive and cooperative instruments of fiscal federalism on a cantonal level. As a measure of the cantonal tax burden we include 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 among Swiss cantons, we include a variable based on the top marginal tax rate in the neighboring cantons. 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 (*topmargtax_neighb*).

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 assess to what degree cantonal budgets depend on these transfers.
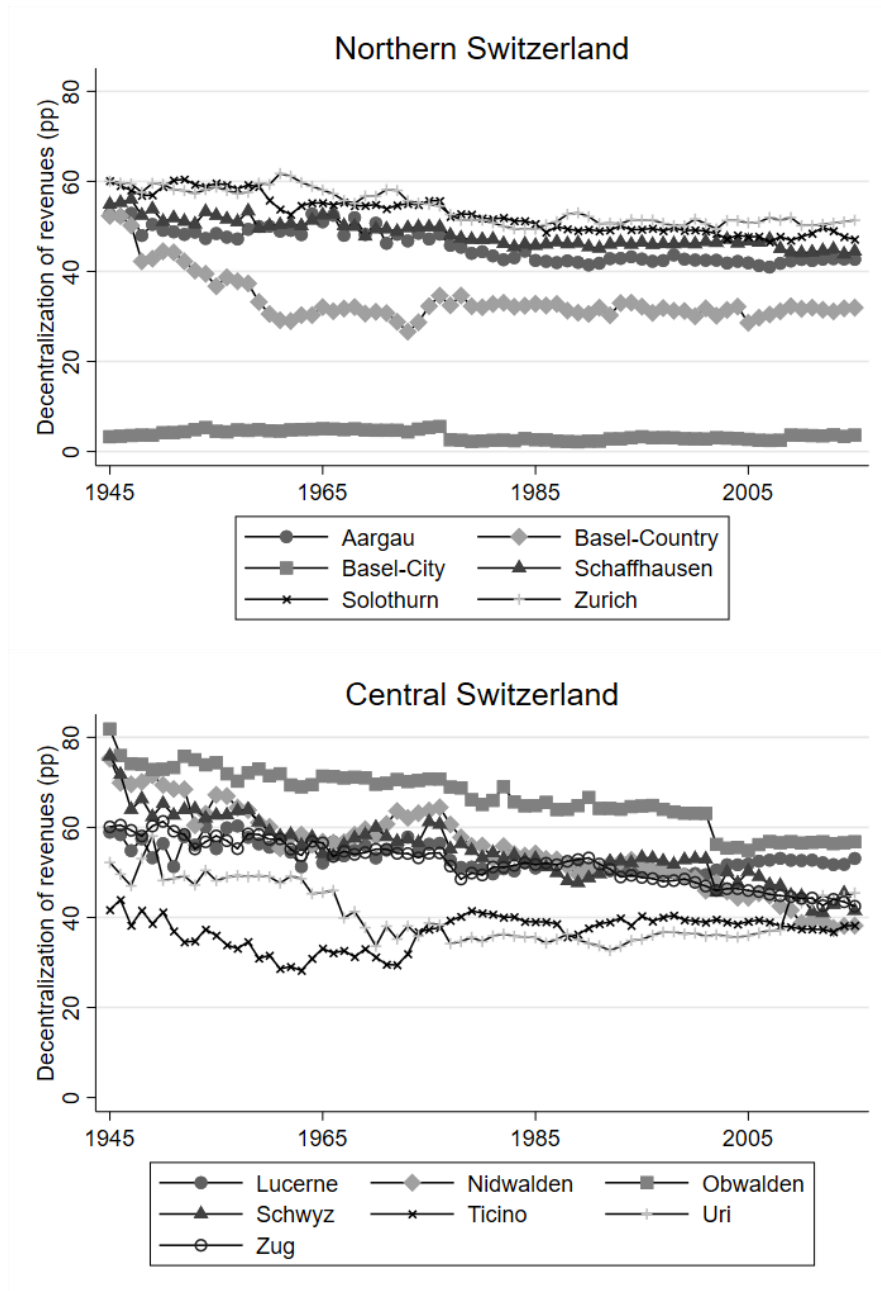
Figure 1a: Decentralization as the municipalities share of total cantonal tax revenues (pp)

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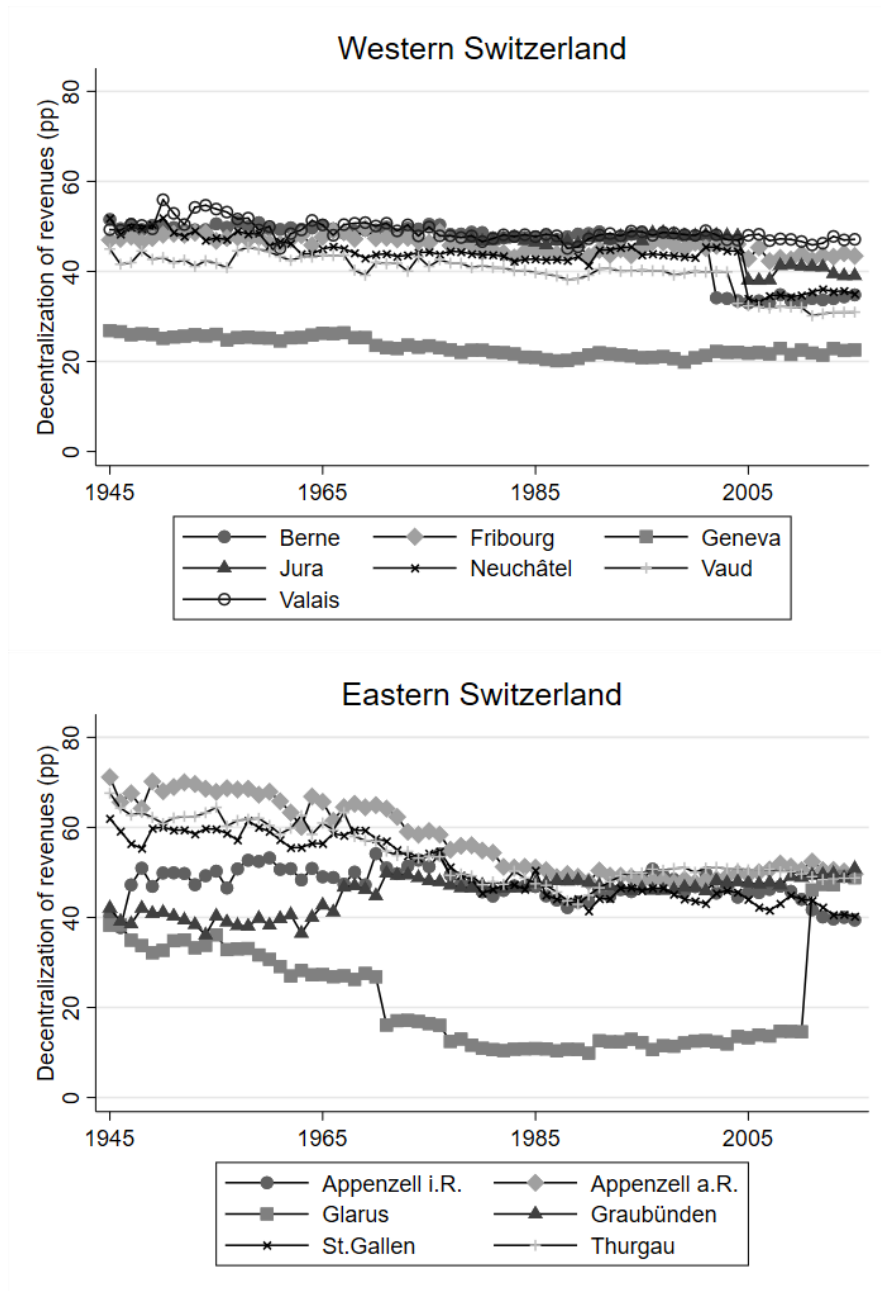
Figure 1b: Decentralization as the municipalities share of total cantonal tax revenues (pp)

16
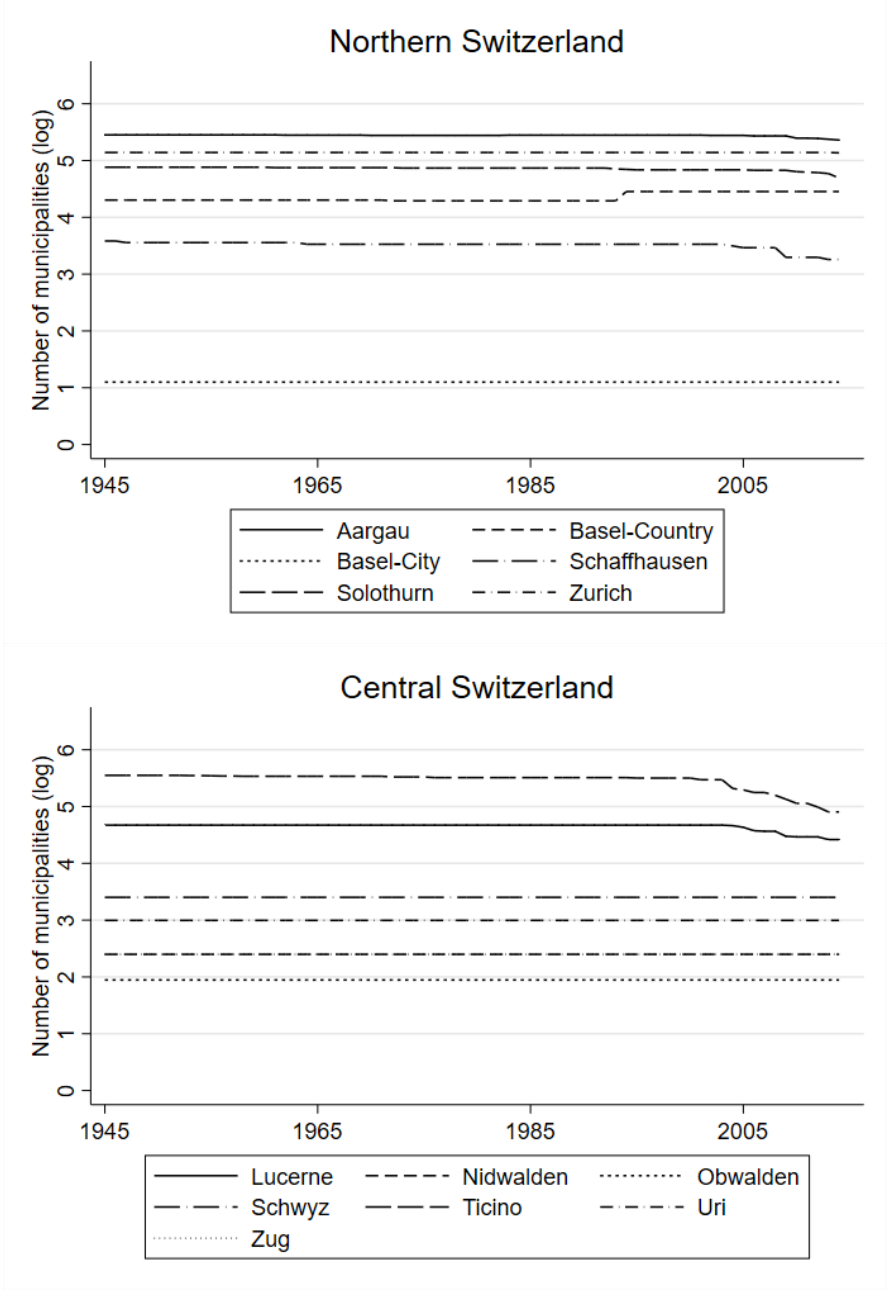
Figure 2a: Fragmentation of cantons (log number of municipalities)

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Western Switzerland

Number of municipalities (log)

1945   1965   1985   2005

Berne	Fribourg	Geneva
Jura	Neuchâtel	Vaud
Valais		

Eastern Switzerland

Number of municipalities (log)

1945   1965   1985   2005

Appenzell i.R.	Appenzell a.R.
Glarus	Graubünden
St.Gallen	Thurgau
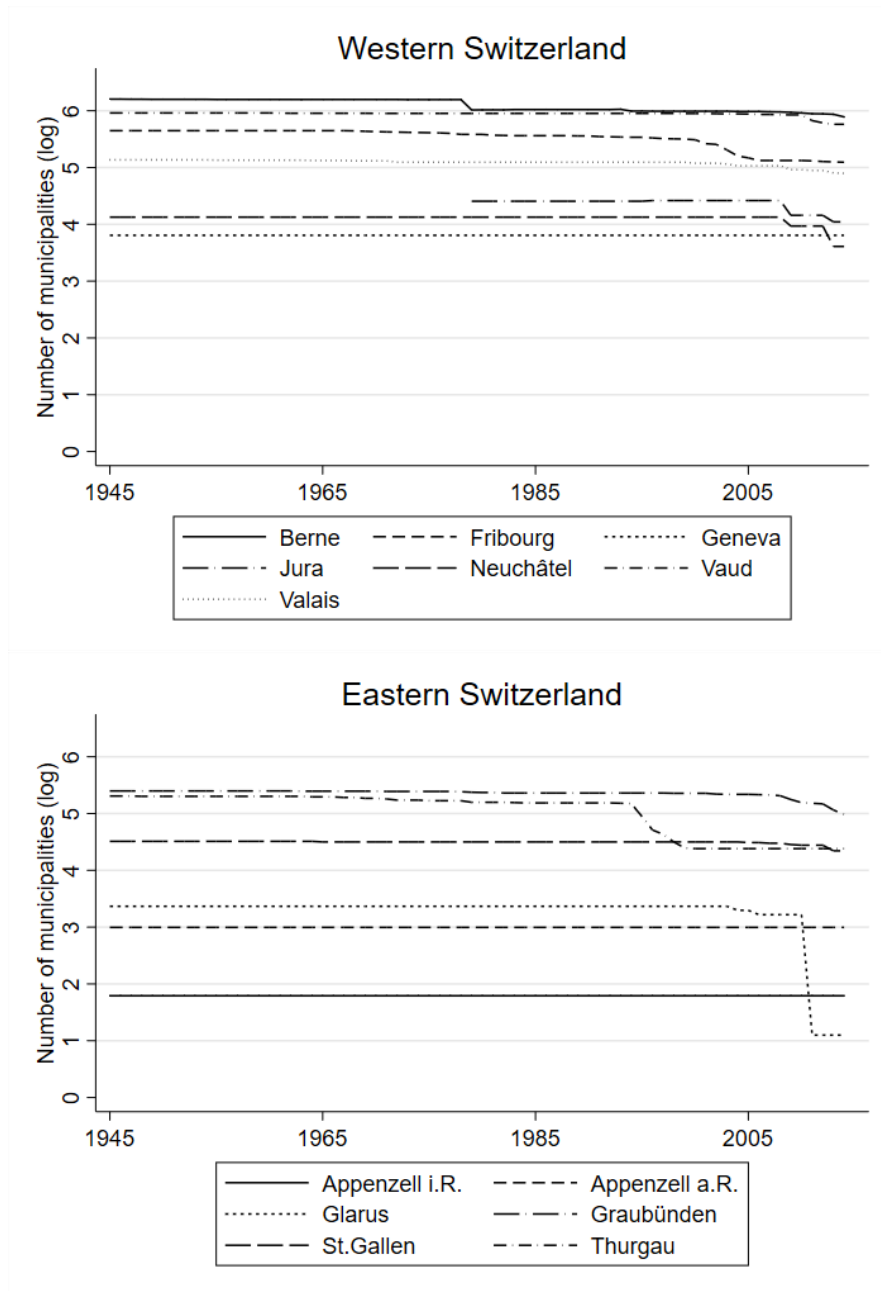
Figure 2b: Fragmentation of cantons (log number of municipalities)

3.3. Econometric Model

Based on this data we estimate the following model,

$$inequality_{i,t} = \beta_1 \; decentr_{i,t-1} + \beta_2 \; decentr * fragment_{i,t-1} + \beta_3 \; fragment_{i,t-1}$$
$$+ \; \boldsymbol{\gamma}' \boldsymbol{X}_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t}$$

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 due to the progressive tax system 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 top income shares for the top 10 %, top 5 %, top 1 %, top 0.5 % and the top 0.1 % of the income distribution). The corresponding redistribution measure is based on the reduction of the inequality after taxes relative to inequality before taxes, i.e., the percentage reduction in the inequality measure induced by the progressive tax system.

We also include an interaction term in order to assess the interdependence of our main instrument of federalism, decentralization of tax revenues ($decentr$), and fragmentation ($fragment$). We assume this interaction effect to be considerable. For fiscal decentralization to exert an effect one requires some level of fragmentation in the local tier of government. Similarly, one may argue that the effect of fragmentation is certainly limited if municipalities have pure administrative competencies and are not assigned any fiscal autonomy. 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 5.3).

Besides fiscal decentralization and fragmentation the model includes variables to represent the competitive and cooperative instruments of fiscal federalism as described in section 3.2. Further, we also include several control variables $\boldsymbol{C}_{i,t}$: the log of aggregate cantonal income per capita (inc_pc) as well as 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

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table A.4 in the appendix for descriptive statistics).

For all specifications we include fixed effects for both cantons (α_i) and tax periods (δ_t) in order to capture unobservable, constant cantonal features as well as identical effects on all entities in each tax period.[6] 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 verify non-stationarity. For our purposes Pesaran's (2007) t-test 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).

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

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[6]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.

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 right 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 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 un-

likely 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 3.3. 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 centralization. In addition, we report Wald tests for the joint significance of decentralization and fragmentation, respectively, including the interaction term at the bottom of table 1.

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. The resulting marginal effects of decentralization on the Gini coefficient are depicted in the left panel of figure 3. Compared to the effect on the top 10 % 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

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	-0.264**	-0.272**	-0.269***	-0.315***	-0.037
	(-0.96)	(-2.15)	(-2.46)	(-2.72)	(-3.52)	(-1.06)
fragmentationt-1	0.253	-2.906*	-3.096**	-4.618***	-4.773***	-0.970
	(0.28)	(-1.74)	(-1.99)	(-3.60)	(-3.82)	(-1.00)
decentr*fragmt-1		0.057**	0.050**	0.050**	0.068***	
		(2.43)	(2.18)	(2.45)	(3.42)	
inc_pc	-39.429***	-40.118***	-39.144***	-29.138***	-27.103***	-28.171***
	(-9.06)	(-9.87)	(-9.57)	(-6.54)	(-8.05)	(-7.71)
inc_pc2	5.367***	5.374***	5.121***	3.572***	3.048***	3.236***
	(8.35)	(9.17)	(9.42)	(5.89)	(7.45)	(6.61)
topmargtax			-0.230**	-0.179**	-0.184***	-0.200***
			(-2.02)	(-2.30)	(-3.38)	(-3.45)
topmargtax_neighb			0.235***	0.249***	0.170**	0.170**
			(2.58)	(2.66)	(2.36)	(2.15)
equalization_transfers				-0.186***	-0.165***	-0.184***
				(-2.89)	(-3.04)	(-3.32)
federaltax_share				0.034	0.030	0.009
				(0.92)	(0.87)	(0.27)
transfers_earmarked				0.000	0.002	0.001
				(0.01)	(1.16)	(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 Gini coefficient (above) and the top 10 percent income share (below) subject to fragmentation (pre-tax results)
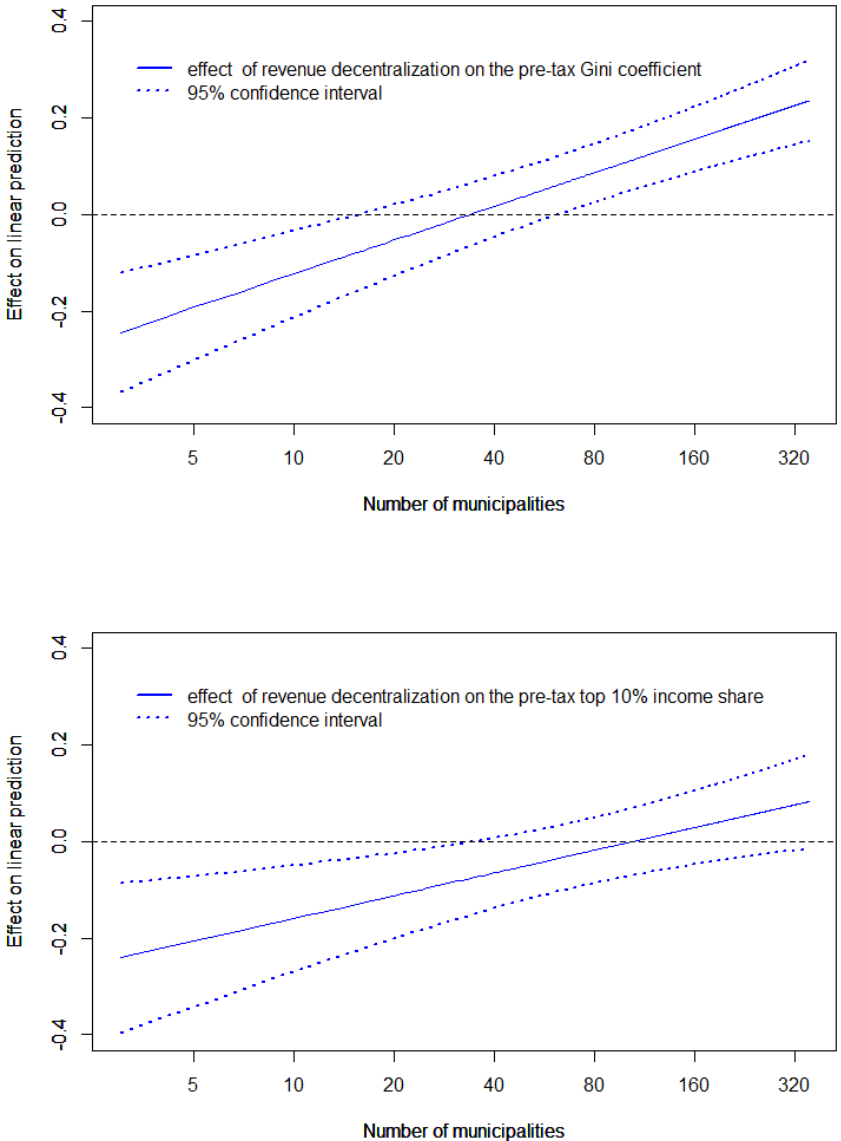
Table 2: Effect of decentralization on income inequality before taxes

	(1)	(2)	(3)	(4)	(5)	(6)
	gini	top10	top5	top1	top05	top01
decentralization(t-1)	-0.349***	-0.315***	-0.310***	-0.272***	-0.241**	-0.170**
	(-3.20)	(-3.52)	(-3.15)	(-2.72)	(-2.54)	(-2.29)
fragmentation(t-1)	-5.326***	-4.773***	-4.716***	-4.259***	-3.785***	-2.720***
	(-3.31)	(-3.82)	(-3.84)	(-3.61)	(-3.42)	(-3.10)
decentr*fragment(t-1)	0.096***	0.068***	0.067***	0.060***	0.052***	0.035***
	(3.66)	(3.42)	(3.38)	(3.18)	(2.97)	(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	34	104	97	92	105	112

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

t-statistics in parentheses $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

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 34 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 significant increasing effect on inequality. For the Gini coefficient the pivot value of a zero marginal effect is again quite low (41 municipalities per canton). Regarding the top income shares the pivot value is higher. 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.

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

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***	-0.286***	-0.278***	-0.236***	-0.204***	-0.137**
	(-3.20)	(-3.69)	(-3.31)	(-2.84)	(-2.59)	(-2.27)
fragmentation(t-1)	-5.071***	-4.358***	-4.422***	-3.855***	-3.335***	-2.262***
	(-3.31)	(-4.06)	(-4.21)	(-3.81)	(-3.54)	(-3.13)
decentr*fragment(t-1)	0.093***	0.059***	0.058***	0.051***	0.043***	0.027***
	(3.56)	(3.29)	(3.40)	(3.25)	(2.98)	(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	160

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

t-statistics in parentheses $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Figure 4: Effect of decentralization on the Gini coefficient (above) and the top 1 percent income share (below) subject to fragmentation (after-tax results)
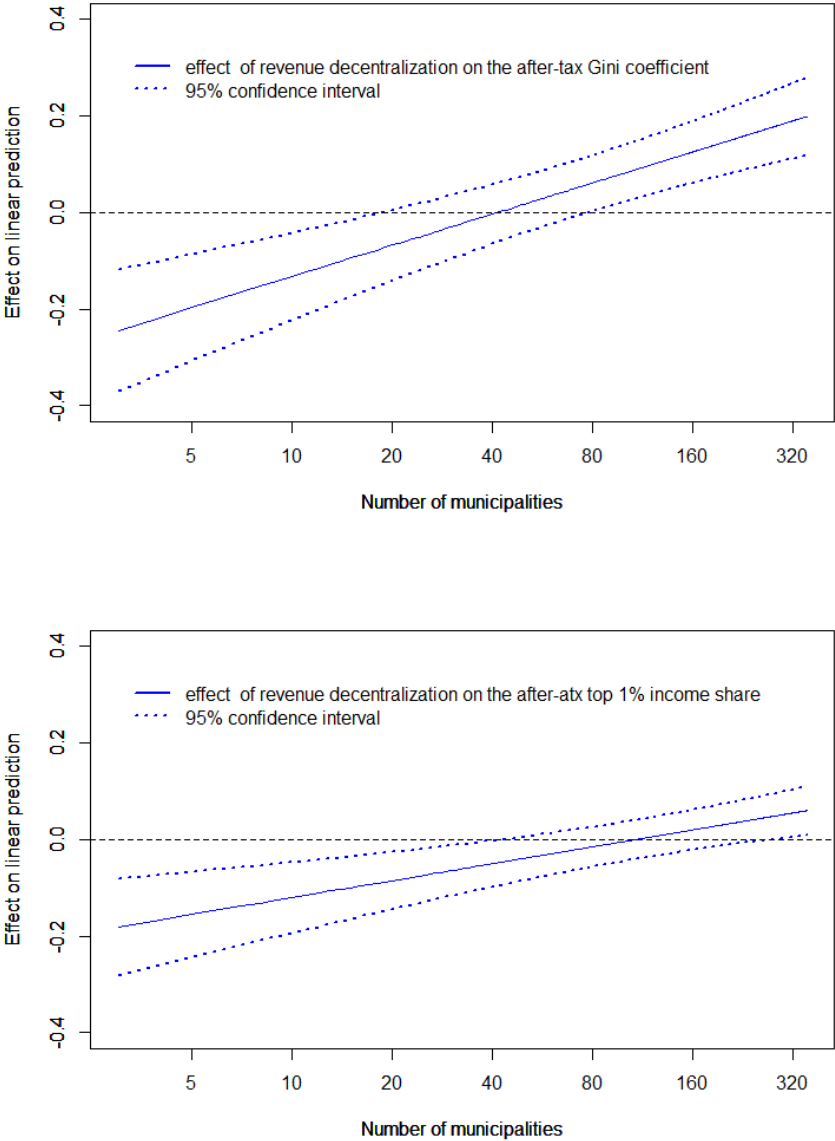
as a redistributive tax burden. The model is again based on our preferred specification in column 5 of table 1. The top marginal tax rate is omitted however, given its close link to the dependent variables of redistribution. Instead variables for the distribution of pre-tax incomes are included. Inequality 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 4 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.

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, 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). Table A.11 reports the estimation results regarding after-tax income inequality excluding these two cantons. The effects of decentralization and its interaction with fragmentation are highly consistent with previous results in table 3. Apparently, the decentralization patterns in Basel-City and Glarus do not drive our baseline results.

Table 4: 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	0.040	0.082	0.187	0.212	0.289
	(0.22)	(0.76)	(1.04)	(1.52)	(1.50)	(1.43)
fragmentation(t-1)	-0.280	1.280**	3.017***	5.382***	6.066***	7.789***
	(-0.49)	(2.14)	(2.93)	(2.99)	(2.91)	(3.17)
decentr*fragment(t-1)	-0.001	-0.003	-0.017	-0.044*	-0.053*	-0.076**
	(-0.18)	(-0.26)	(-0.99)	(-1.75)	(-1.85)	(-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 $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Figure 5: Effect of decentralization on redistribution at the top 10 percent (above) and the top 0.1 percent (below) subject to fragmentation
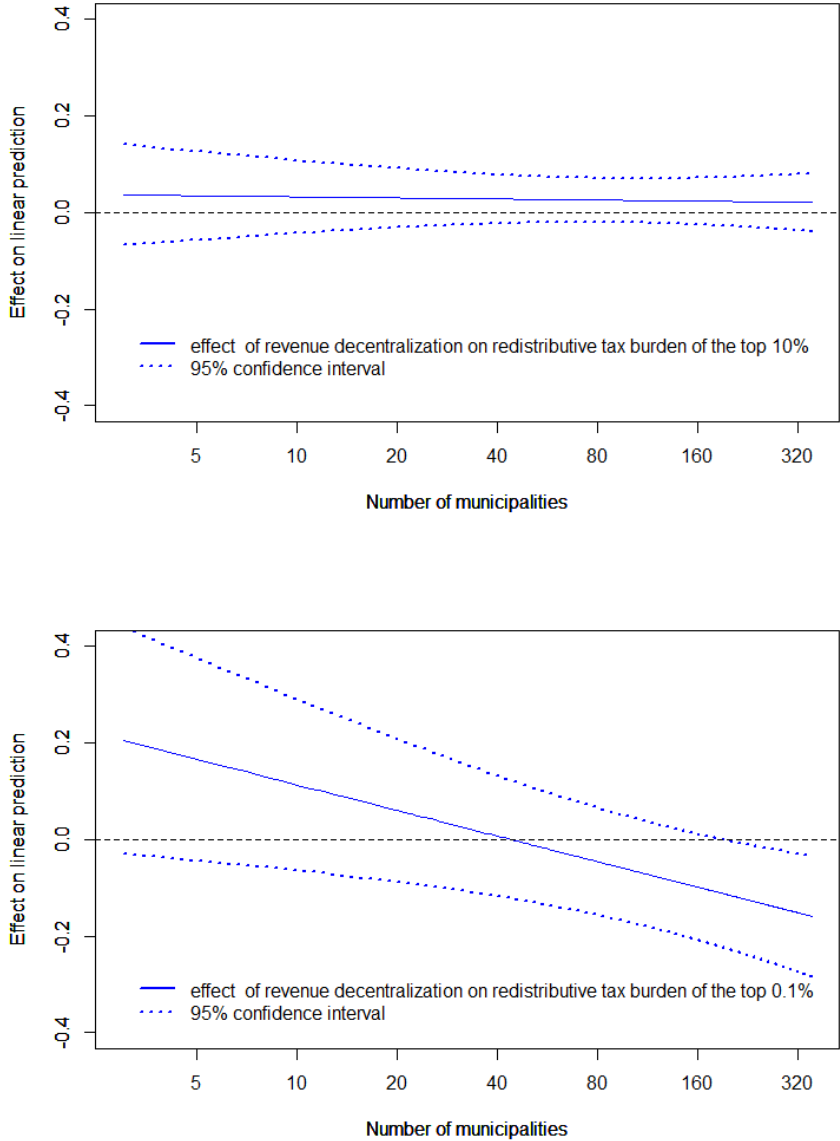
In the remainder of this section further robustness tests are executed. We estimate our model using an alternative measure for fragmentation and test spillover effects in a spatial autoregressive model. Finally, we employ an instrumental variable model to account for possible reverse causality of our dependent variables.

5.1. Alternative Measure for Fragmentation

So far fragmentation was 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.

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 ($fragment_size$) 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 5 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 6 shows the resulting marginal effect of tax decentralization on the Gini coefficient and the top 10% income share. 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 1181 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 2214 residents. This general pattern of results largely confirms the findings of the baseline estimations.

5.2. 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

Table 5: Effect of decentralization on inequality after taxes - with an alternative measure of fragmentation

	(1)	(2)	(3)	(4)	(5)	(6)
	giniat	top10at	top5at	top1at	top05at	top01at
decentralization(t-1)	-0.156**	-0.101	-0.119	-0.126*	-0.117*	-0.085*
	(-2.06)	(-1.24)	(-1.48)	(-1.81)	(-1.85)	(-1.89)
fragmentation_size(t-1)	-14.784**	-6.327	-8.405	-9.632*	-8.882*	-6.356**
	(-2.54)	(-0.95)	(-1.28)	(-1.84)	(-1.94)	(-2.00)
decentr*fragment_size(t-1)	0.345***	0.120	0.163	0.187**	0.171**	0.119**
	(3.03)	(0.96)	(1.35)	(1.98)	(2.06)	(2.15)
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)	0.746	0.700	0.582	0.438	0.394	0.317
Wald-Test decentr	13.2***	1.8	2.2	3.9	4.3	4.6*
Wald-Test fragment	9.2***	0.9	1.8	3.9	4.3	4.6*
pivot municip_pop	2214	1181	1370	1491	1462	1400

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

t-statistics in parentheses $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Figure 6: Effect of decentralization on the Gini coefficient (above) and the top 1 percent income share (below) subject to an alternative measure of fragmentation (after-tax results)
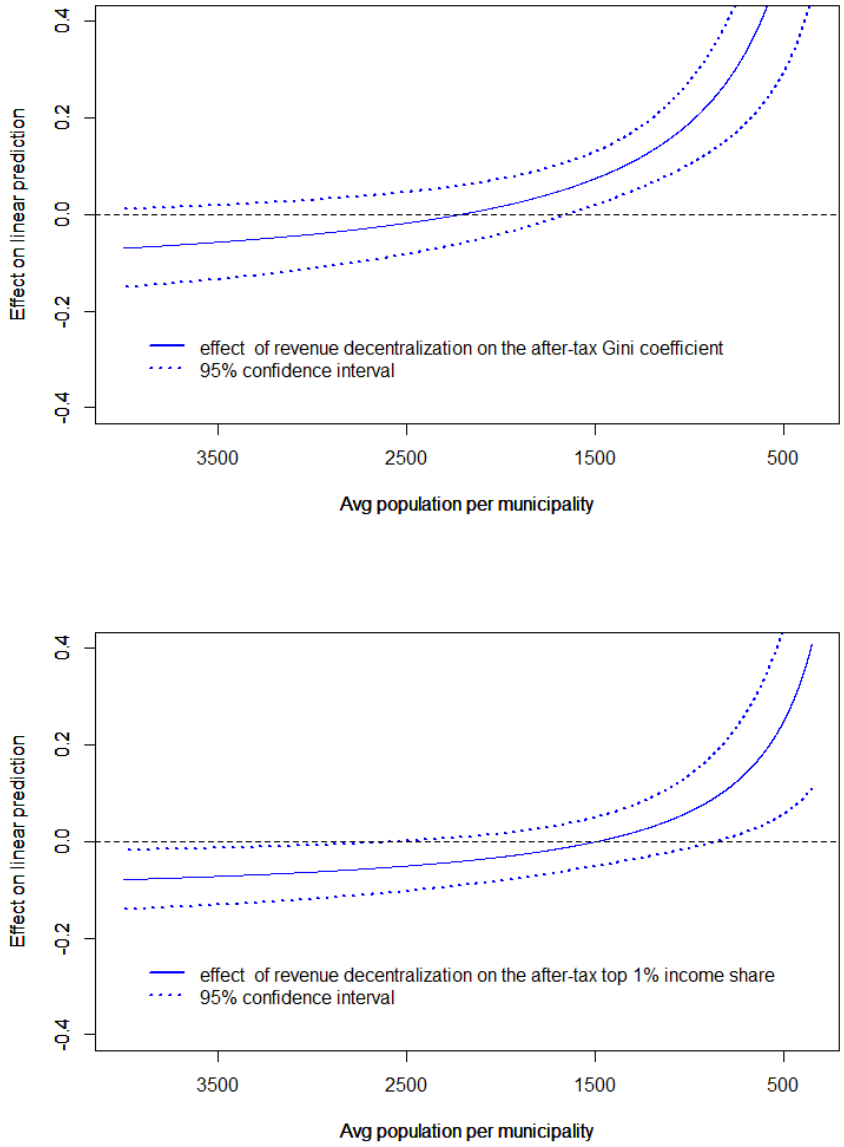
model with an autoregressive disturbance term

$$inequality_{it} = \rho * w_{ij} * inequality_{jt} + \beta_1 \; decentr_{i,t-1} + \beta_2 \; fragment_{i,t-1}$$
$$+ \beta_3 \; decentr * fragment_{i,t-1} + \boldsymbol{\gamma'X}_{it} + \alpha_i + \delta_t + \upsilon_{i,t}$$
$$\upsilon_{i,t} = \lambda * w_{ij} * \varepsilon_{j,t}$$

where w_{ij} denotes a spatial weighting matrix giving equal weight to all neighboring cantons j with a common border with canton i. ρ is the coefficient of spatial correlation in the dependent variable, and λ 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.

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 6. *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.

5.3. Instrumental Variable Approach

The identification of the effect of fiscal federalism on income inequality is likely to be affected by endogeneity problems. Particularly, we cannot rule out a potential causal effect in the reverse direction. A reform of fiscal centralization may be induced by a political reaction to developments in inequality. Besides political effects, there might also be a mechanical relationship. If high income individuals migrate to a certain canton and take residence in low tax municipalities, tax revenues will increase relatively more at the cantonal than at the municipal level, due to the below average municipal tax rate. Thus, decentralization measured by the share of municipalities from total cantonal tax revenue will decrease. As stated above, our baseline estimation relies on the assumption of fiscal equivalence between taxes paid and goods provided within a canton (Olson, 1969). If the assumption holds, the canton and the municipality in question will be able

Table 6: Effect of decentralization on inequality after Taxes - Spatial error model

	(1)	(2)	(3)	(4)	(5)	(6)
	giniat	top10at	top5at	top1at	top05at	top01at
decentralization(t-1)	-0.336**	-0.286***	-0.276***	-0.233**	-0.200**	-0.133*
	(-2.50)	(-2.84)	(-2.72)	(-2.41)	(-2.21)	(-1.96)
fragmentation(t-1)	-4.830**	-4.417***	-4.447***	-3.812***	-3.258***	-2.178**
	(-2.51)	(-2.86)	(-2.93)	(-2.75)	(-2.58)	(-2.33)
decentr*fragment(t-1)	0.095***	0.058**	0.057***	0.050***	0.042**	0.027**
	(3.07)	(2.56)	(2.67)	(2.59)	(2.40)	(2.13)
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	-0.131**	0.073	0.059	0.009	-0.021	-0.059
	(-2.09)	(1.12)	(1.05)	(0.19)	(-0.44)	(-1.16)
Variance sigma2_e	5.185***	3.754***	3.407***	2.690***	2.320***	1.447***
	(8.40)	(5.02)	(4.26)	(3.66)	(3.53)	(3.20)
N	1025	1025	1025	1025	1025	1025
R^2 (within)	0.767	0.740	0.637	0.504	0.462	0.388
Wald-Test decentr	11.0***	8.2**	7.5**	6.8**	5.9*	4.7*
Wald-Test fragment	9.5***	8.3**	9.0**	8.0**	6.9**	5.6*

Standard errors clustered for canton; corrected for spatial autocorrelation

t-statistics in parentheses $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

to lower the tax burden by the additional revenue provided by the wealthy immigrants, thus neutralizing the mechanical effect on decentralization. However, as this reaction might occur with some delay our variable of interest might not be fully exogenous.

To address possible endogeneity of tax decentralization we implement an instrumental variable model. Valid instruments need to be both correlated with tax decentralization and orthogonal to the error term of our main regression. Candidate instruments are significant policy reforms in the federal and cantonal system of public finances which affect decentralization differently in cantons but have identical effects on 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, the cantons were given ample freedom regarding the timing of the necessary tax reforms. As a result, cantons implemented 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 essentially reduced tax competition between cantons to the tax schedule. The restricted 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 due to cantonal tax laws. 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 7). The instrument seems to be relevant.

While the cantons were forced by federal law to harmonize the tax base, cantonal autonomy concerning the tax schedule and progressivity was not affected by tax harmonization. Hence, the law does not affect the income distribution directly and the exclusion restriction is satisfied. This is confirmed by including the tax harmonization variable in our model in addition to tax decentralization as it does not improve the explanatory power of our model of inequality. Finally, as the new rules were determined

at the federal level, we may exclude any reverse effects from inequality within cantons.

Another potential source of exogenous variation of decentralization is physical geography (Canavire-Bacarreza et al., 2017). In geographically diverse countries distinct parts of the population may live under completely different geographical conditions. As a result, preferences and needs for public goods and services can differ considerably among the respective local populations. Demand for public or private transport infrastructure depends considerably on the natural environment to which a population is exposed. The optimal organization 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 clearly more pronounced relative to a situation in which the population lives under very homogeneous conditions. 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' do not live at the same altitude, 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 geographical area as well as the interaction between area and the weighted altitude distances.

Obviously, physical geography itself is fixed across time and does not help identifying intertemporal effects of decentralization. Over time, however, it also determines the conditions for settlement development and the dispersion of the population. In Switzerland one can observe for example an increasing urbanization, the growth of agglomerations, stagnation in small rural communities and a depletion of remote valleys in the alpine regions. Such dynamics induce a significant intertemporal variance regarding the geographical living conditions of the average population in a canton.

We intend to capture this variation by employing an intertemporal version of the geographical fragmentation measure of Canavire-Bacarreza et al. (2017) to the case

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of Swiss cantons. 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. Specifically, the measure is calculated as follows:

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

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.[7] This factor is added up for all combinations of municipalities within a canton. Furthermore, the measure is weighted by canton c's area normalized by the canton with the largest area. This allows us to account for the horizontal distances between municipalities.[8]

The measure is depicted in figures 7a and 7b. The intertemporal variation results from the fact that municipalities within a canton exhibit differences in population growth. In other words, if population growth is independent of where people live, i. e., it occurs at the same rate in every municipality, geographical fragmentation remains constant. The cantons of Zurich and Geneva for example show a distinctive decreasing development since about 1950. This can be explained by disproportional population growth of one major city, thus decreasing the altitude distances between individuals in the aggregated population. In contrast, the cantons of Graubünden and Basel-Country show an increasing geographical fragmentation after 1950, as municipalities of high as well as low altitudes grew disproportionally.

We use this geographical fragmentation measure as a second instrument. Geograph-

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[7]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.

[8]Graubünden is the largest canton with respect to the overall area comprising $7\,105$ km^2.

ical asymmetries within a canton increase the heterogeneity of preferences and needs for public good provision. 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 7). This instrument is clearly relevant.[9]

Regarding the exclusion restriction we face a challenge common to the empirical literature on decentralization or economic and political institutions in general. Any such institutional arrangement is the result of very complex historical and societal processes severely complicating the search for a truly exogeneous 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 may cause a bias. Some phenomena may, for example, render mountainous municipalities more attractive for mobile high-net-worth individuals. Thus, cantons with such municipalities exhibit higher income inequality. At the same time, as the rich move to peripheral, elevated municipalities geographical fragmentation of a canton might increase as well. In this case geographical fragmentation would be affected only to a small or even insignificant extent, since high-net-worth individuals represent only a tiny fraction of the total population. However, to account for similar mechanisms 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 aging 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.

Moreover, we are confident to be able to eliminate reverse effects from changes in inequality to geographical fragmentation. An increase in inequality might induce higher land prices and thus gentrification of cities or other attractive housing areas, but this means just the replacement of one population by another and is very unlikely to affect the average altitude differences among the population.

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[9]Reduced form results are reported in table A.12 in the appendix.

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 tables 8 and 9. 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. 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 7: IV approach: First Stage

	decentralization(t-1)
tax-harmonization(t-1)	-2.904***
	(-5.86)
gfrag_area_l1	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 $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$
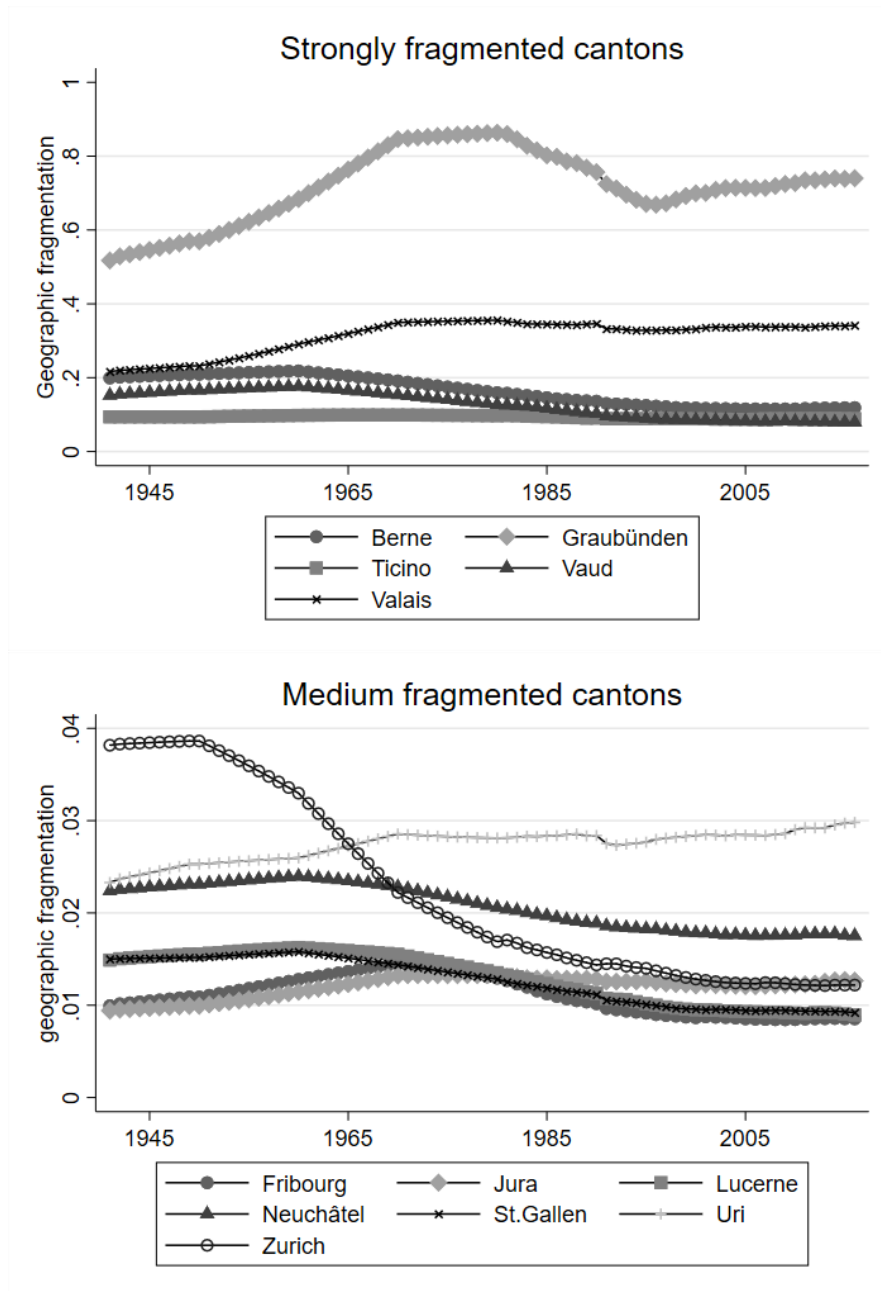
Figure 7a: Geographical fragmentation of the cantonal population
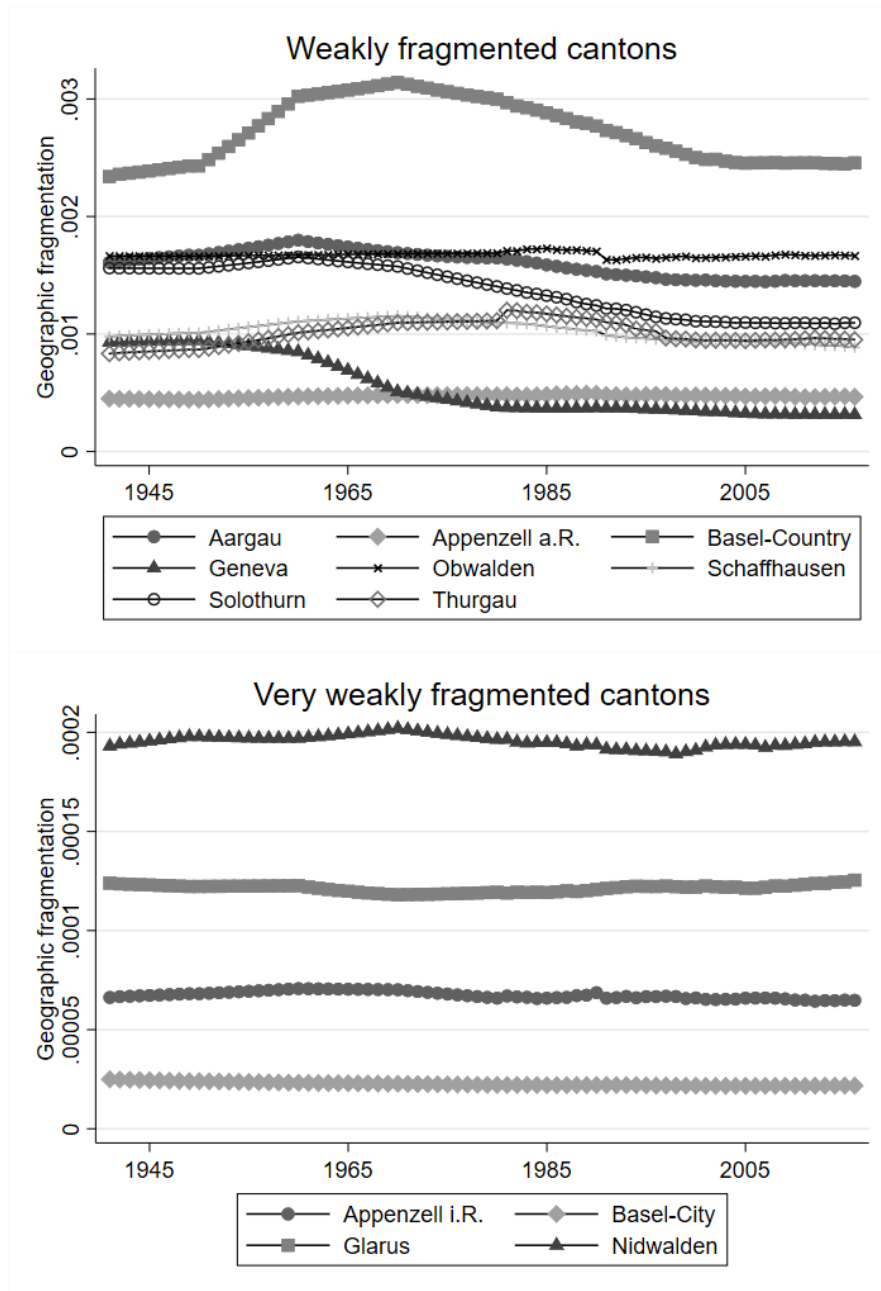
Figure 7b: Geographical fragmentation of the cantonal population

Table 8: 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**	-0.552	-0.777**	-0.762***	-0.657***	-0.437***
	(-2.14)	(-1.46)	(-2.26)	(-2.75)	(-2.78)	(-2.65)
fragmentation(t-1)	-15.989**	-8.305*	-10.945**	-10.630***	-9.162***	-6.144**
	(-2.15)	(-1.79)	(-2.38)	(-2.64)	(-2.61)	(-2.43)
decentr*fragment(t-1)	0.255**	0.139**	0.175**	0.165***	0.140***	0.090***
	(2.28)	(2.06)	(2.53)	(2.84)	(2.81)	(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**

Standard errors clustered for canton and period

t-statistics in parentheses $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 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**	-0.392	-0.652**	-0.663***	-0.561***	-0.353**
	(-2.13)	(-1.24)	(-2.26)	(-2.73)	(-2.71)	(-2.53)
lmuni_l1	-15.415**	-6.251	-9.425**	-9.331**	-7.893**	-4.990**
	(-2.07)	(-1.62)	(-2.37)	(-2.57)	(-2.52)	(-2.31)
decentr*fragment(t-1)	0.243**	0.105*	0.145**	0.139***	0.116***	0.070**
	(2.21)	(1.80)	(2.44)	(2.76)	(2.70)	(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	3.2	2.7	2.4	2.4	2.4
(p-val)	(0.07)	(0.20)	(0.25)	(0.30)	(0.30)	(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 $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

6. Conclusion

A theoretical prediction regarding the direction of the impact of fiscal federalism on income inequality is not straightforward. On the one hand Tiebout income sorting, spillover effects, increasing regional disparities, tax competition and economies of scale may increase inequality. Opposite effects, on the other hand, could result from increased efficiency of public goods provision, adaptation to local preferences and costs, laboratory federalism, yardstick competition, increased political accountability and information advantages. 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 well-suited institutional setting to empirically assess the effect of institutions such as fiscal federalism on inequality. Swiss 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 tax decentralization tends to diminish concentration in pre- and after-tax incomes if fragmentation is low. Notably, we also find a significant interaction effect of tax decentralization with fragmentation. As a result, for higher levels of fragmentation we find no significant effect of tax decentralization or even an increasing marginal effect on inequality. If the number of local jurisdiction in a canton is high, municipalities struggle to effectively reduce income inequality.

The 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 altitude asymmetries among municipalities.

The results also hold for an alternative measure of fragmentation. While the number of jurisdictions might account for the competitive pressure, fragmentation may also be

defined as the inverse of the average population size of municipalities. Like before, our results show that if municipalities, on average, exceed a certain population size, tax decentralization tends to decrease inequality. However, if municipalities are too small – and thus fragmentation is high – we find no significant or even an increasing effect of tax decentralization on inequality. This is not only the result of competitive pressure but also the lack of size that affects municipalities' capacities to effectively address inequality. 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 fragmentation when assessing the impact of fiscal decentralization. We empirically confirm the theoretical prediction that the number as well as the size of local jurisdictions is quite 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.

Our findings in part confirm the propositions of the traditional theory of federalism, in the sense that we find inequality increasing effects if fragmentation is high. However, our results also show that there are important inequality decreasing effects of fiscal federalism. Local governments apparently play a significant role when ensuring an equitable income distribution. It seems that predicaments based on the traditional theory of federalism that redistribution is the sole responsibility of the central government have to be questioned. If fragmentation is limited and municipalities exhibit a certain size they appear to reduce inequality more effectively than cantons.

Quite interestingly, this inequality reducing effect is not – according to our results – the consequence of increased redistribution but is already incorporated in more evenly distributed pre-tax incomes. Hence, tax decentralization may reduce inequality of after-tax income quite efficiently without the inefficiencies related to redistribution via taxes.

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Appendix A. Descriptives

Table A.10: 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
fragment	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.11: 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***	-0.321***	-0.320***	-0.272***	-0.237***	-0.159**
	(-3.59)	(-4.09)	(-3.76)	(-3.14)	(-2.84)	(-2.44)
fragmentation(t-1)	-3.235	-2.801*	-2.466	-1.953	-1.692	-1.085
	(-1.40)	(-1.79)	(-1.58)	(-1.49)	(-1.43)	(-1.27)
decentr*fragment(t-1)	0.088***	0.059***	0.058***	0.050***	0.043***	0.028**
	(3.45)	(3.34)	(3.34)	(3.07)	(2.82)	(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 religion					
N	984	984	984	984	984	984
R^2 (within)	0.746	0.700	0.582	0.438	0.394	0.317
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 $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

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Table A.12: IV-model - Reduced Form

	(1)	(2)	(3)	(4)	(5)	(6)
	gini	top10	top5	top1	top05	top01
taxharm(t-1)	3.757***	2.235**	2.706***	2.356**	1.880**	0.998
	(2.80)	(2.32)	(2.79)	(2.57)	(2.18)	(1.41)
taxharm*fragment(t-1)	-1.136***	-0.718***	-0.813***	-0.732***	-0.611***	-0.379***
	(-6.13)	(-4.51)	(-5.11)	(-5.04)	(-4.53)	(-3.57)
geofrag(t-1)	98.544**	96.093*	76.467*	48.363*	34.955	13.346
	(2.03)	(1.79)	(1.79)	(1.82)	(1.61)	(0.96)
geofrag*fragment(t-1)	-19.777**	-18.078*	-14.714*	-9.415*	-6.891*	-2.790
	(-2.26)	(-1.82)	(-1.86)	(-1.93)	(-1.74)	(-1.12)
fragmentation(t-1)	0.068	-0.439	-0.410	-0.468	-0.468	-0.439
	(0.11)	(-0.79)	(-0.74)	(-0.94)	(-1.05)	(-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.13: 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	-0.264**	-0.272**	-0.269***	-0.315***	-0.037
	(-0.96)	(-2.15)	(-2.46)	(-2.72)	(-3.52)	(-1.06)
fragmentation(t-1)	0.253	-2.906*	-3.096**	-4.618***	-4.773***	-0.970
	(0.28)	(-1.74)	(-1.99)	(-3.60)	(-3.82)	(-1.00)
decentr*fragment(t-1)		0.057**	0.050**	0.050**	0.068***	
		(2.43)	(2.18)	(2.45)	(3.42)	
inc_pc	-39.429***	-40.118***	-39.144***	-29.138***	-27.103***	-28.171***
	(-9.06)	(-9.87)	(-9.57)	(-6.54)	(-8.05)	(-7.71)
inc_pc2	5.367***	5.374***	5.121***	3.572***	3.048***	3.236***
	(8.35)	(9.17)	(9.42)	(5.89)	(7.45)	(6.61)
topmargtax			-0.230**	-0.179**	-0.184***	-0.200***
			(-2.02)	(-2.30)	(-3.38)	(-3.45)
topmargtax_neighb			0.235***	0.249***	0.170**	0.170**
			(2.58)	(2.66)	(2.36)	(2.15)
equalization_transfers				-0.186***	-0.165***	-0.184***
				(-2.89)	(-3.04)	(-3.32)
federaltax_share				0.034	0.030	0.009
				(0.92)	(0.87)	(0.27)
transfers_earmarked				0.000	0.002	0.001
				(0.01)	(1.16)	(0.47)
population					2.517**	1.751
					(2.29)	(1.53)
unempl					-0.167	-0.199
					(-0.54)	(-0.69)
active_population					35.624***	39.160***
					(2.87)	(3.10)
left					-0.002	0.005
					(-0.25)	(0.45)
crime					4.442**	4.787***
					(2.49)	(2.70)
foreigners					0.398***	0.347***
					(3.98)	(3.08)
religion					0.013	0.023
					(0.42)	(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.14: 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***	-0.315***	-0.310***	-0.272***	-0.241**	-0.170**
	(-3.20)	(-3.52)	(-3.15)	(-2.72)	(-2.54)	(-2.29)
fragmentation(t-1)	-5.326***	-4.773***	-4.716***	-4.259***	-3.785***	-2.720***
	(-3.31)	(-3.82)	(-3.84)	(-3.61)	(-3.42)	(-3.10)
decentr*fragment(t-1)	0.096***	0.068***	0.067***	0.060***	0.052***	0.035***
	(3.66)	(3.42)	(3.38)	(3.18)	(2.97)	(2.68)
inc_pc	26.252***	-27.103***	-13.377***	1.550	3.610	4.495*
	(6.41)	(-8.05)	(-3.79)	(0.45)	(1.12)	(1.74)
inc_pc2	-2.994***	3.048***	1.500***	-0.214	-0.456	-0.539
	(-5.31)	(7.45)	(2.96)	(-0.41)	(-0.92)	(-1.34)
topmargtax	-0.039	-0.184***	-0.180***	-0.147***	-0.129***	-0.086***
	(-0.81)	(-3.38)	(-3.66)	(-3.61)	(-3.48)	(-3.14)
topmargtax_neighb	0.184***	0.170**	0.152**	0.130***	0.122***	0.090***
	(2.67)	(2.36)	(2.41)	(2.60)	(2.66)	(2.75)
equalization_transfers	-0.130***	-0.165***	-0.182***	-0.157***	-0.136***	-0.101***
	(-2.74)	(-3.04)	(-3.12)	(-3.04)	(-2.91)	(-2.85)
federaltax_share	0.066***	0.030	0.043	0.054	0.056	0.041
	(2.62)	(0.87)	(1.16)	(1.45)	(1.52)	(1.41)
transfers_earmarked	0.004	0.002	0.002	0.004**	0.005**	0.005***
	(1.41)	(1.16)	(1.21)	(2.04)	(2.50)	(2.98)
active_population	5.845***	2.517**	2.700**	2.455**	2.067**	1.273*
	(2.58)	(2.29)	(2.32)	(2.22)	(2.10)	(1.76)
unempl	0.141	-0.167	-0.337	-0.470	-0.474*	-0.401
	(0.51)	(-0.54)	(-1.06)	(-1.55)	(-1.67)	(-1.63)
popact	-6.474	35.624***	22.017*	4.264	1.262	-1.276
	(-0.32)	(2.87)	(1.68)	(0.34)	(0.11)	(-0.15)
left	0.005	-0.002	-0.006	-0.010**	-0.010***	-0.009
	(0.36)	(-0.25)	(-0.77)	(-2.15)	(-3.30)	(.)
crime	2.952	4.442**	3.946**	2.520*	2.022	1.266
	(1.57)	(2.49)	(2.34)	(1.76)	(1.63)	(1.40)
foreigners	0.410***	0.398***	0.381***	0.338***	0.306***	0.213***
	(3.63)	(3.98)	(4.06)	(4.50)	(4.55)	(4.46)
religion	-0.037	0.013	0.021	0.023	0.021	0.014
	(-1.35)	(0.42)	(0.68)	(0.85)	(0.89)	(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.15: 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***	-0.286***	-0.278***	-0.236***	-0.204***	-0.137**
	(-3.20)	(-3.69)	(-3.31)	(-2.84)	(-2.59)	(-2.27)
fragmentation(t-1)	-5.071***	-4.358***	-4.422***	-3.855***	-3.335***	-2.262***
	(-3.31)	(-4.06)	(-4.21)	(-3.81)	(-3.54)	(-3.13)
decentr*fragment(t-1)	0.093***	0.059***	0.058***	0.051***	0.043***	0.027***
	(3.56)	(3.29)	(3.40)	(3.25)	(2.98)	(2.60)
inc_pc	23.270***	-27.652***	-14.464***	-0.113	2.004	3.264
	(5.55)	(-8.92)	(-4.36)	(-0.04)	(0.69)	(1.45)
inc_pc2	-2.639***	3.132***	1.659***	0.013	-0.238	-0.378
	(-4.74)	(8.35)	(3.44)	(0.03)	(-0.53)	(-1.08)
topmargtax	-0.053	-0.215***	-0.203***	-0.159***	-0.137***	-0.087***
	(-1.07)	(-4.18)	(-4.38)	(-4.16)	(-4.02)	(-3.60)
topmargtax_neighb	0.146**	0.136**	0.121**	0.107**	0.100***	0.073***
	(2.03)	(2.14)	(2.23)	(2.56)	(2.62)	(2.74)
equalization_transfers	-0.107**	-0.144***	-0.163***	-0.138***	-0.117***	-0.084***
	(-2.26)	(-2.75)	(-2.93)	(-2.89)	(-2.75)	(-2.69)
federaltax_share	0.069***	0.030	0.041	0.050	0.050	0.036
	(2.81)	(0.93)	(1.22)	(1.50)	(1.53)	(1.42)
transfers_earmarked	0.006**	0.003*	0.003	0.004**	0.004***	0.004***
	(2.22)	(1.66)	(1.62)	(2.19)	(2.65)	(3.25)
population	5.774***	1.792*	1.830*	1.734**	1.408**	0.800
	(2.69)	(1.83)	(1.92)	(2.11)	(1.98)	(1.58)
unempl	0.037	-0.125	-0.289	-0.428	-0.429*	-0.348
	(0.14)	(-0.44)	(-0.99)	(-1.57)	(-1.68)	(-1.62)
active_population	-6.941	37.824***	24.788**	7.502	4.585	1.339
	(-0.36)	(3.35)	(2.10)	(0.68)	(0.46)	(0.18)
left	0.007	-0.000	-0.004	-0.008**	-0.009***	-0.008***
	(0.50)	(-0.00)	(-0.54)	(-2.13)	(-3.21)	(-5.66)
crime	1.376	3.259**	2.813*	1.620	1.301	0.795
	(0.74)	(2.03)	(1.86)	(1.31)	(1.22)	(1.05)
foreigners	0.403***	0.342***	0.321***	0.274***	0.246***	0.164***
	(3.50)	(3.79)	(3.87)	(4.17)	(4.19)	(4.03)
religion	-0.035	0.016	0.022	0.021	0.018	0.013
	(-1.20)	(0.58)	(0.77)	(0.88)	(0.90)	(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 $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$