the review of income and wealth

Review of Income and Wealth
Series 63, Number 4, December 2017
DOI: 10.1111/roiw.12228

THE LONG RUN EFFECTS OF TAXES AND TAX COMPETITION ON TOP INCOME SHARES: AN EMPIRICAL INVESTIGATION

by Christian Frey*, Christoph Gorgas and Christoph A. Schaltegger

University of Lucerne

This paper provides empirical evidence on the long run effects of tax policy on income concentration in Switzerland. As Swiss cantons enjoy considerable autonomy with respect to income taxation, it is possible to study the impact of the cantonal income tax burden, as well as the influence of tax competition, on cantonal top income shares. Using panel regressions covering all Swiss cantons from 1917 to 2009 we find the expected negative effect of the tax burden on the cantonal top income share. Further, we find evidence that tax competition is a driving force behind the income shares of the top 1, 0.5 and 0.1 percent. Lower tax rates in neighbor cantons induce competitive pressure and ceteris paribus reduce top income shares in a canton. For the very top incomes tax competition seems to be an issue of the last 30 years.

JEL Codes: D31, H3, H73

Keywords: fiscal policy, income concentration, inequality, interjurisdictional differentials, tax induced

1. Introduction

The determinants of income distribution have attracted renewed attention in politics as well as in economic research in recent years. This is not surprising given the striking nature of certain headline numbers about the rise of the income share of the top income earners during the last three decades. In the U.S. for example the income share going to the top percentile of the income distribution has increased from about 8 percent in 1981 to 17.9 percent in 2014 according to the World Top Incomes Database by Alvaredo *et al*. (2015). This increase in income concentration seems to be part of a global trend. Possible explanations include economic globalization, skill-biased technological change, institutional and policy reforms, as well as changes in family formation and household structures (OECD, 2011). Piketty (2014) argues that with slowing growth rates (due to shrinking

Note: We are grateful for helpful comments from participants of the annual meeting of the Verein für Socialpolitik in Göttingen (2012), the Ifo-workshop on regional policy in Dresden (2012), the participants of the 2013 meeting of the European Public Choice Society in Zürich and seminar participants of the Universities of Lucerne, Lugano, ETH Zürich and St. Gallen. Further, we are thankful for helpful comments from participants of the 2014 meeting of the European Public Choice Society in Cambridge, the participants of the 4th SEEK Conference at the Center for European Economic Research in Mannheim and the participants of the congress of the International Institute of Public Finance 2014 in Lugano. Finally, we would like to thank the two anonymous referees for their helpful comments and suggestions. Their feedback helped us to revise and substantially improve the previous version of this paper.

*Correspondence to: Christian Frey, MA UZH University of Lucerne, Department of Economics, Frohburgstrasse 3, 6002 Lucerne, Room 3.A23, Switzerland. E-mail: christian.frey@unilu.cha.

population growth and slower technological progress) the ratio of capital to total income is increasing and suggests that this "return of capital" might not result in a equivalent decrease of the rate of return. As a consequence the income share of capital owner, and with it income inequality, might increase to levels maybe even higher than those observed in the 19th century. Whether or not Piketty (2014) is right, income inequality and its determinants will very likely remain a controversial topic in the immediate future.

Recent studies show that the development of top income shares differ considerably among industrialized countries (Atkinson, Piketty and Saez, 2011). This raises the question about the reasons for this cross country heterogeneity. It seems reasonable to assume that domestic tax policy is a significant driver of the trend in income concentration within a country. Piketty and Saez (2003) mention tax policy as a likely explanation for the secular trend of U.S. top income shares over the 20th century. Studies like Roine, Vlachos and Waldenström (2009) and others provide empirical evidence of the negative impact of the tax burden on top income shares.

Previous studies are mostly based on cross country data. Due to international differences in the definition of the income tax base, the data on income concentration and the effective tax burden are difficult to compare across countries. Atkinson and Leigh (2013) stress this problem. In this paper we instead employ data from sub-federal jurisdictions. Switzerland is a federalist country with far-reaching sovereignty rights of the 26 cantons, particularly with respect to fiscal policy. The federal income tax (Direkte Bundessteuer) is levied at the federal level but assessed and collected by the cantons. Additionally, the cantons levy their own income tax (Staatssteuer) on the same tax base as the federation. Hence, data about Swiss cantons has two big advantages. Due to the cantonal assessment of the federal income tax, consistent income data is available on a cantonal level.[1] Further, as cantons levy their own income tax, the tax burden varies considerably between the cantons as well as over time. This heterogeneity enables the assessment of the influence of tax policy on income concentration in the same jurisdiction. This may be called the conventional channel of the impact of tax policy on income concentration.

A question, which according to our knowledge has not been investigated so far, is whether tax competition between jurisdictions is a major driving force of the developments in income concentration. Following Feld and Reulier (2009) there are two preconditions for tax competition to be effective. One condition is the mobility of the tax base as a reaction to tax rate differentials. If this condition is fulfilled, and jurisdictions are autonomous in terms of their tax policy, they are under constant pressure to provide a relatively attractive tax environment for mobile factors. Hence, they will set tax rates strategically depending on the tax rates in competing jurisdictions in order to attract or retain the mobile tax base. This dynamic, strategic interaction process among jurisdictions is the second precondition for tax competition to take effect. However, fiscal interaction between jurisdictions can also occur without the mobility of factors, as it may be the result

[1]See Schaltegger and Gorgas (2011) for detailed description of the data about the cantonal income distribution based on tax statistics.

of pure yardstick competition (Feld and Reulier, 2009). If citizens assess the performance of their government against the yardstick of other jurisdictions, tax policy in a jurisdiction may depend on the tax setting in other jurisdictions even without a mobile tax base. But only if the first precondition is fulfilled, and the tax base is in fact mobile, actual tax competition may take place.

In this paper we analyze whether the existence of tax competition has an effect on top income shares. Of course tax competition may indirectly affect income concentration due to its influence on the level of the tax burden. The competitive pressure may induce jurisdictions to provide public goods more efficiently. A lower general tax burden may favor high incomes disproportionately. This indirect effect works via the conventional channel from tax policy to income concentration, as the local tax burden affects local top incomes. However, if tax competition is effective, income concentration in a certain jurisdiction may also be affected by the tax policy of competing jurisdictions. In a progressive tax system, top income earners may be able to reduce their tax burden significantly by taking residence in a low tax jurisdiction. Tax rate differentials therefore affect the decision especially of high income households where to take residence. Whether or not high income households take residence in a jurisdiction certainly affects the local income concentration. If tax competition is effective, we therefore expect to find a direct effect from the tax policy of competing jurisdictions on the local top income shares. Such an effect is clearly different from the conventional view of the relationship between tax policy and income concentration, as it only occurs in a tax competition environment. In a pure yardstick competition framework, such a direct effect cannot occur, as taxable factors are not mobile and only the local tax burden affects income concentration.

The cantonal tax autonomy in Switzerland enables a rather intense tax competition (Feld, 1999). A broad empirical literature on income sorting confirms that the tax burden influences the decision of Swiss households where to take residence. Especially high income households reside preferably in low tax jurisdictions. Further, Feld and Reulier (2009) provide evidence of strategic tax setting among cantons. The preconditions for an effective tax competition therefore apply in the case of Swiss cantons. Hence, the Swiss case is ideally suited to investigate not only the conventional effect of tax policy but also whether tax competition has direct effects on income concentration. Thus besides the effect of the local tax burden in a canton, this paper also investigates the impact of the tax rate in neighboring cantons on top income shares and by that the influence of tax competition between Swiss cantons. To our knowledge this has not yet been done before.

The empirical investigation of the long run effects of tax policy on cantonal income concentration over the 20^{th} century confirms the important role of tax competition for the top 1, 0.5 and 0.1 percent of the income distribution. In addition to a significantly negative effect of the local tax burden on top income shares, we find a significant and positive effect of the tax burden in neighbor cantons. The estimated effect is robust for different specifications and sub-periods. In the three decades since 1980 the impact of tax competition as a determinant of the top income shares even extends to the very top incomes (the top 0.01 percent).

The paper proceeds as follows. Section 2 provides a brief literature review of existing country and cross country studies regarding top income shares over the

20th century and the influence of tax policy. Further, we provide a short survey of the literature on Tiebout income sorting as well as the respective empirical evidence for Switzerland. As stated above, the mobility of factors is one of the preconditions for tax competition to take effect. Section 3 outlines the evolution of top incomes in Swiss cantons over the 20th century as well as the development of the cantonal tax burden on top incomes. We describe the federal tax system and the cantonal autonomy with regards to taxation. Further, we discuss the evidence on strategic tax setting among Swiss cantons and provide some descriptive evidence with respect to taxation of top incomes. In Section 4 the empirical method is presented followed by the results of the analysis in Section 5. The concluding remarks are offered in Section 6.

2. Literature Overview

2.1. *Top Income Shares*

In a seminal contribution about the long term evolution of income concentration Piketty (2001, 2003) constructs a new time series of top income shares in France over the 20th century based on tax statistics. The data shows a considerable decrease of the income share of the top decile during the 1930s and World War II. For the most part this decline can be attributed to the loss of capital income of the top percentile in the income distribution. Up until today the top income shares in France never recovered. Instead they stayed remarkably constant at a relatively low level since the end of World War II.

Meanwhile time series on the development of top income shares have been assembled for up to 30 countries.[2] Atkinson, Piketty and Saez (2011) provide a review of the results. Almost all the investigated countries show a dramatic decline of top income shares in the first part of the 20th century. This collapse is largely caused by shocks to capital income during the World Wars and the great depression. In the aftermath of World War II there is no recovery for several decades. Since the 1980s however, an increase in income concentration can be observed mainly in English-speaking countries. Contrary to the development in the late 19th century this rise is associated with a surge in wage income of top earners. English-speaking countries thus reveal a distinct U-shaped pattern of income concentration over the 20th century. In contrast to Continental Europe which exhibits a rather constant development of top income shares since World War II (Atkinson and Piketty, 2010).

With this rich cross country dataset on the long run development of top income shares, it became feasible to empirically investigate determinants of income concentration like for example growth, financial development, international trade, sectoral shifts, demographic factors, government spending, and—the subject of this paper—tax policy. Studying top income shares in the U.S. from 1913 to 1998, Piketty and Saez (2003) argue that the negative effect of World Wars I and II on top income shares can be explained in part by the large tax hike

[2]The World Top Income Database by Alvaredo *et al.*: http://g-mond.parisschoolofeconomics.eu/topincomes, update 30.06.2015.

in order to finance the arms build-up. Moreover, they suggest that high and progressive income and estate taxes as well as substantial corporate taxation have prevented the accumulation of large fortunes in the aftermath of World War II. As in the late 19th and the beginning of the 20th century a significant part of the largest incomes were capital returns, Piketty and Saez (2003) stress the cumulative or dynamic effects of progressive capital taxation impeding the accumulation of wealth.

To date there exist several studies which have empirically assessed the impact of taxes on the development of top income shares. Saez (2004) confirms the suspected influence of tax policy on top income shares for the U.S. based on income tax return data from 1960 to 2000. It is shown that the reported income of the top 1 percent reacts significantly to changes in the marginal tax rate, whereas no significant effect can be found for the other groups of the income distribution. According to Saez (2004) the upward trend of top wage incomes since the 1970s can in part be explained by cuts in marginal tax rates. Similar conclusions are drawn by Saez and Veall (2005) for Canada, by Moriguchi and Saez (2008) for Japan and by Atkinson and Leigh (2008) for New Zealand. Concerning the case of Sweden, Roine and Waldenström (2008) show the relevance of the tax treatment of capital gains for the recent increase in top incomes.

Whereas the studies above assess the evolution of top incomes for a single country, others employ cross country panel regressions. Roine, Vlachos and Waldenström (2009) provide empirical evidence that an increased income tax progression reduces top income shares for an unbalanced panel of 16 countries over the 20th century. Sarkar and Tuomala (2010) empirically evaluate the impact of taxes on income inequality for Anglo-Saxon countries. They conclude that top marginal tax rates and government expenditure have an equalizing effect. Also Atkinson and Leigh (2013) focus on the Anglo-Saxon countries in their panel-based regression analysis. The results confirm that cuts in marginal tax rates can explain one third to one half of the rise in top income shares from 1970 to 2000.

While there are both single and cross country studies on the influence of the local tax burden on income concentration, to our knowledge no existing study assesses the influence of tax competition among neighboring jurisdiction. Further, the analysis of the influence of tax policy in the existing literature is restricted to the last few decades. In the present paper, we add to this literature by investigating the influence of local tax policy as well as tax competition over the 20th century in Switzerland.

2.2. *Tiebout income sorting*

In his seminal article Tiebout (1956) describes a model where individual households choose their residence according to the level of local public good provision and the respective tax price within a set of municipalities. Local jurisdictions thus find themselves in a competitive environment. They need to provide services efficiently in order to attract residents. Households choose to reside in a municipality with an optimal level of local public good provision according to their preferences. Therefore households with similar preferences would sort themselves into the same jurisdictions. *Endogenous segregation* is an important

property of models of competing jurisdictions in the tradition of Tiebout. It means that certain types of households tend to live together in jurisdictions with certain tax rates, certain house prices and certain levels of public good provision (Schmidheiny, 2006).

In the classic Tiebout model this segregation takes place according to household preferences regarding the local public good. However, the sorting of households may also occur according to differences in income. In theoretical multi-municipality models with local public goods Ellickson (1971) as well as Westhoff (1977) assume differences in income as one of the main reasons, why households choose a certain jurisdiction as their residence. As a consequence the Tiebout sorting process results in a tendency of income stratification among jurisdictions. There exist several theoretical explanations why high income households make other residential choices than low income households (see for example Ross and Yinger, 1999 and Schmidheiny, 2002). Depending on the nature of the public good, it may be that the rich value those goods more than poor households. On the other hand, depending on the design of the tax system the tax price may depend differently on income. Certainly other variables than income play a role when households choose the location of their residence. In theoretical models De Bartolome and Ross (2003) for example take commuting cost into account, while Schmidheiny and Hodler (2006) assume heterogeneity in preferences. In these models, while some degree of income sorting may occur, there is also some degree of income mixing.

In the U.S. the principal source of revenue for local jurisdictions are property taxes. Hence, most studies in this strand of literature analyze multi municipality models with property taxation. While representing the institutional reality in the U.S., this also helps to circumvent the technical problems of incorporating the housing market into income tax models (Schmidheiny, 2002).[3]

Schmidheiny (2006) proposes the progression of income taxes as a new theoretical explanation for income segregation among municipalities. In Switzerland municipalities may independently set a tax multiplier, the progressive tax schedule however is exogenously determined by the canton. Therefore any tax hike in a municipality falls disproportionately on richer households, which induces those households to move to low tax municipalities.

The predictions of the income segregation hypothesis have been tested empirically. For a short overview, we restrict ourselves to empirical evidence for Switzerland. As jobs are usually bound to a specific workplace, migration due to tax motives is mostly relevant within agglomerations i.e., between municipalities within commuting distance. Because of the considerable degree of fiscal autonomy of cantons, their relatively small size and the well developed transport infrastructure the predictions of the segregation hypothesis should also be relevant among Swiss cantons. This is confirmed by Feld and Kirchgässner (2001), who detect fiscally induced income stratification among the 26 Swiss cantons as well as the 137 largest Swiss cities. They find that especially high income households choose their residence according to the local income tax burden.

[3]Ross and Yinger (1999) for an extensive review of the literature of multi-municipality models with property taxation.

Schmidheiny and Hodler (2006) get a corresponding result for the Zurich metropolitan area. Due to the progression of the tax schedule, rich households are more likely to live in municipalities with low tax multipliers. Interestingly, in addition to the negative effect of the municipalities own tax rate Schaltegger *et al.* (2011) find a positive effect of the tax rate of neighboring municipalities on the share of high income residents. This is an indication of the effect of tax competition among local jurisdictions.

Studies based on aggregated data do have to cope with an inherent endogeneity problem. Tax rates are not exogenous as they depend on the characteristics and the choices of the local population. In order to tackle this problem, varying instrumental variable approaches are applied. Schmidheiny (2006) instead uses microdata on the migration behavior of individual households. From the perspective of a single household the tax rate of a municipality may be taken as exogenous. Based on household-level data from the Basel metropolitan area Schmidheiny (2006) confirms that rich households are significantly and substantially more likely to move to low tax jurisdictions than poor households.

Also Liebig *et al*. (2007) analyze the influence of municipality income tax rates on migration patterns within Switzerland based on microdata from the Swiss census. They evaluate the migration behavior of several subgroups according to age, nationality and education. Liebig *et al*. (2007) find that young college graduates are most sensitive to tax rate differences, while older as well as individuals with a lower education level are rather immobile. But even for young college graduates the extent of the tax motivated migration over a five year period is rather low (between 0.7 and 3.3 percent). As the census data does not contain any information on income, Liebig *et al*. (2007) are not able to directly test the hypothesis that the probability of tax motivated migration depends on the income level. They are mostly interested in the effect of age, nationality and education and use an imputed income variable as a control rather than a variable of interest. Hence, their results do not contradict previous findings. Instead they complement the results of previous studies based on aggregated data like. Feld and Kirchgässner (2001), Schmidheiny and Hodler (2006) and Schaltegger *et al*. (2011), which find evidence of tax induced residential choices of top income earners. Due to a progressive tax schedule, it may be profitable only for high income individuals to move to low tax jurisdictions. For the majority of the population however, other costs associated with taking residence in low tax jurisdictions (housing as well as commuting cost) probably dominate any gain from a lower tax burden. This asymmetry between high income households and the average population results in a tendency of segregation according to income.[4]

It seems important to contrast this paper from the literature on endogenous income sorting. The income sorting literature investigates the heterogeneity in the income distribution between jurisdictions, the homogeneity of households within

[4]It is important to note that because the income distribution is considerably skewed, even if only the very top incomes react to tax rate differentials, a competitive tax policy may still be profitable for a municipality. The top incomes may be large enough such that a tax cut can result in a revenue increase as the tax base expands considerably with some high income households taking residence. Frequent locational changes of significant share of the population are not a necessary condition for an effective tax competition.

jurisdictions or whether tax policy is an explanatory factor for the residential choices of households. Our analysis builds on this literature. The mobility of the tax base reacting to tax differentials is a precondition for tax competition to take effect. If the residence of tax payers does not depend on tax policy, any interaction between the tax policy of jurisdictions may be explained by pure yardstick competition. However, there is reasonable evidence of fiscally induced income stratification among Swiss cantons and municipalities. The residential decision of high income households depends significantly on the cantonal and local tax burden, which may be explained by the progression of income tax schedules. In such a tax competition environment we expect income concentration in a canton to depend not only on the local tax policy (the conventional view of the relationship between tax policy and income concentration), but also on the tax policy of competing cantons. As a result we expect lower tax rates in competing jurisdictions to lead to outmigration or less immigration of high income households and by that to a lower income concentration in a canton. A comparatively higher tax burden in competing jurisdictions however, may lead to an increased immigration of high income households and therefore to higher top income shares. In an empirical investigation we test whether these effects can be observed in the data on top income shares in Swiss cantons over the 20th century.

3. Top Incomes And Tax Competition In Switzerland

3.1. *Top Income Shares in Switzerland*

Dell, Piketty and Saez (2007) are the first to assess income concentration in Switzerland over the long run. Their consistent time series based on income tax statistics indicates that Switzerland's top incomes decreased only relatively little during World War II. In fact, top income shares remained remarkably stable over the 20th century. Föllmi and Martínez (2013) extend the time series of top income shares in Switzerland and show a moderate increase in income concentration since the 1980s. The income share of the top 1 percent for example increased from 8.4 percent in 1981 to nearly 10.6 percent in the 2010.[5] However, in 1971 the top 1 percent income share reached about the same level. The very top incomes show a larger increase since 1981, but at the same time they are generally more volatile over time.

Schaltegger and Gorgas (2011) compile time series for top incomes at the sub-federal level over the period from 1917 to 2007. They detect a rather heterogeneous picture. Some cantons exhibit a U-shaped pattern, while others show a remarkably stable or even an increasing development of top income shares. In most cantons however, income concentration tended downwards. While at the aggregated level top incomes in Switzerland seem to be very stable in the 20th century, on the sub-federal level there emerges a considerable diversity.

Figure 1 depicts the median and interquartile range of the updated top income shares among the 26 Swiss cantons for each tax period from 1917 to 2009. The development of income shares is shown for the top 1, 0.5, 0.1 and 0.01

[5]According to the updated numbers of Föllmi and Martínez in the World Top Incomes Database.

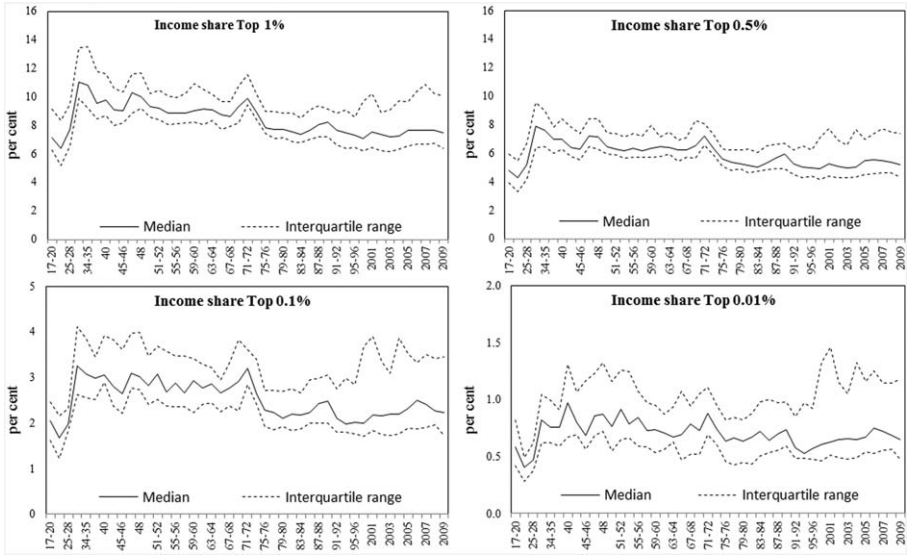

Figure 1. Top Income Shares, 26 Swiss Cantons, 1917–2009

percent of the income distribution.[6] The interquartile range among cantons is narrowing until the 1980s and widening again since. Particularly for the income shares of the top 0.1 and 0.01 percent heterogeneity among the cantons is considerably larger during the last three decades. On average the range in top income shares between cantons is almost 12 percentage points for the top 1 percent and about 4 percentage points for the top 0.01 percent.[7] These ranges are considerable and comparable to cross country differences. According to the World Top Incomes Database by Alvaredo *et al*. (2015) the income shares for the top 1 percent vary between 5.44 and 20.17 percent in 2009. Even though the cantons differ significantly with respect to top income shares, the income levels of the top earners are comparable across cantons. The income at the 90th percentile for all of Switzerland in 2009 is 116,600 Swiss Francs. This value differs among the cantons from a minimum of 82,200 Swiss Francs in the canton of Uri to 154,250 Swiss Francs in relatively wealthy Zug.

3.2. *The Federal Tax System in Switzerland*

The federal government levies a progressive income tax (Direkte Bundessteuer, DBG), a profit tax, a value added tax, a withholding tax on capital income and a stamp duty on financial transactions. However, it is important to note that

[6]The median value and the interquartile range were calculated to account for outliers.

[7]In some years the data shows very large differences between the cantons, with a maximum level of income concentration of 27 percent for the top 1 percent (Nidwalden in 1933) and a minimum of 3.9 percent (Neuchâtel in 1921). Cross country studies like Roine *et al*. (2009) also report values between 3 and 27 percent. One reason for the large differences within Switzerland may be that some cantons have quite small population sizes. In these cantons a relatively small change regarding the top income earners may cause a large effect with respect to income concentration.

the authority of the federal government to levy taxes goes only so far, as the voters explicitly authorize it in the federal constitution. The federal income tax is even subject to "sunset legislation" and has to be renewed regularly.

In contrast to the limited power to tax of the federal government, the cantons basically have all the taxing rights of a sovereign state, as long as their sovereignty is not explicitly limited by the federal constitution. Therefore, the cantons have a far-reaching autonomy for the taxation of personal income, wealth as well as corporate profits. According to Art. 129 para. 2 of the federal constitution tax tariffs, tax rates and tax exemptions are part of the cantonal competence, only restricted by the federal tax harmonization law, which dictates some general principles of taxation, and the prevailing legal practice by the federal court.

Comprehensive income taxation on the federal level was established in Switzerland in 1933. The tax base for personal income is defined as labor income including pension benefits as well as capital income. Before 1933, the tax base consisted of labor income only. Until today, private capital gains are with few exceptions not taxable in Switzerland (Art. 16 DBG). The federal income tax is assessed by cantonal tax authorities. Therefore, information about the tax base is available individually for all of the 26 cantons. Further, as all the cantonal tax authorities have to employ the definition of the tax base according to federal law (Art. 2 DBG), this income data is homogeneously defined. This is a considerable advantage of using Swiss cantonal data, as it enables cross-cantonal comparisons without measurement bias.

On top of the federal income tax cantons and municipalities levy their own. Cantonal tax schedules are mostly progressive, there are however considerable differences among cantons. In some cantons progressive income taxation was established not until some years after the start of our data series (1937 in Schwyz, 1922 in Nidwalden, 1920 in Glarus, 1919 in Bern, Geneva and Appenzell i. Rh.). Based on the cantonal tax schedules (including the tax multiplier of the municipalities and the church) we calculate the average cantonal tax burden for each of the considered top income classes in each year. Possibly, marginal tax rates would be a more appropriate indicator. However, over the whole time span of all 92 years the statistics of the Federal Tax Administration only provides data on the average tax rates.

Figure 2 depicts a general view of the long run development of the average income tax burden by cantonal, municipal and church taxes in the 26 cantons from 1917 to 2009. The Figure shows the median value and the interquartile range for the cantonal tax burden on the top 1, 0.5, 0.1 and 0.01 percent of income earners respectively.[8] Until the early 1980s Figure 2 reveals a significant increase in the tax burden for the top incomes. During the last 30 years of our

[8]Our measure of the cantonal tax burden includes income taxes only. However, cantons also impose wealth taxes. It is reasonable to assume that high income households are also relatively wealthy. Hence, taxes on wealth and inheritance should be included in order to determine the total tax burden. However, there is no data source available in order to determine the wealth status of households at the top of the income distribution. Far-reaching assumptions would be necessary to determine the wealth and inheritance tax burden of top income households. We abstain from making such assumptions. Instead we assume that individuals take actions to relocate, to restructure or to abstain from income generation, based on the tax burden on income and independently from the tax burden on wealth.

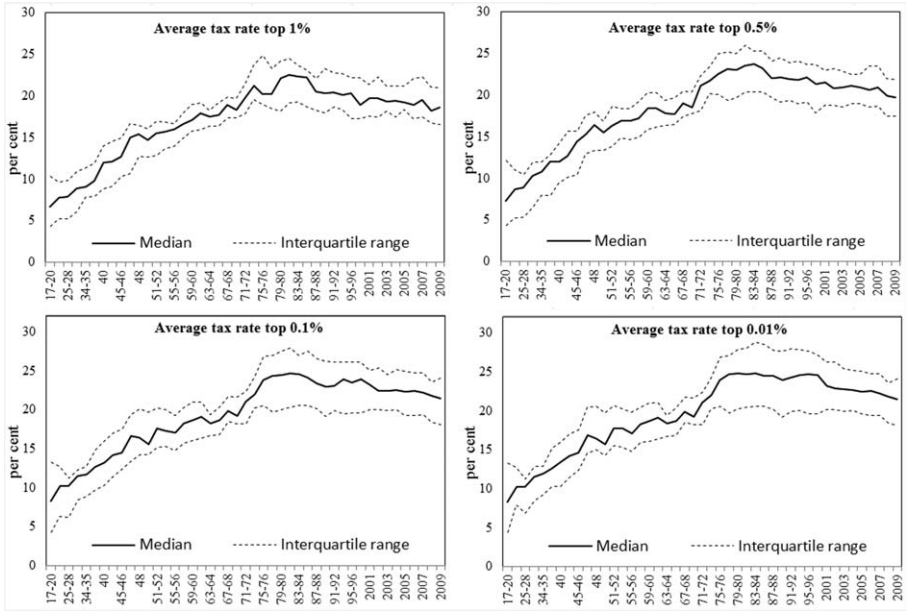

Figure 2. Income Tax Burden for Top Incomes, 26 Swiss Cantons, 1917–2009

time series we observe a slightly decreasing development.[9] The interquartile range shows an increased spread since the early 1980s. The largest variance among cantons can be observed for the top 0.01 percent.

Local municipalities can raise a proportional surcharge on the cantonal tax rate. The cantons however determine the progressiveness of the tax schedule, which is highly relevant for top income earners. Figure 3 shows the combined cantonal and municipality income tax rate for an exemplary high income household without children in all the municipalities. Even though the municipalities have some autonomy, it is apparent from Figure 3 that the biggest differences in the tax burden occur along cantonal borders (the black lines). Apparently, the cantonal tax policy is very relevant for tax rate differentials between cantonal territories.

As described above, the Swiss cantons show a large degree of heterogeneity with respect to income concentration. Due to the tax autonomy, also the tax burden on top incomes varies considerably. The Swiss cantons thus seem ideal to investigate the influence of tax policy on income concentration.

Tax competition among Swiss cantons is mitigated by a tax harmonization law, which harmonizes the definition of the cantonal income tax base and thus restricts competition to the setting of tax rates. Further, there exists a so called "financial equalization" system. It consists of transfers between the federation and cantons as well as among cantons. As fiscal federalism might result in

[9]In this respect the Swiss development differs considerably from the U.S. and U.K., where a sharp decrease of the top marginal tax rates took place during the 1980s (Piketty, Saez and Stantcheva, 2014).

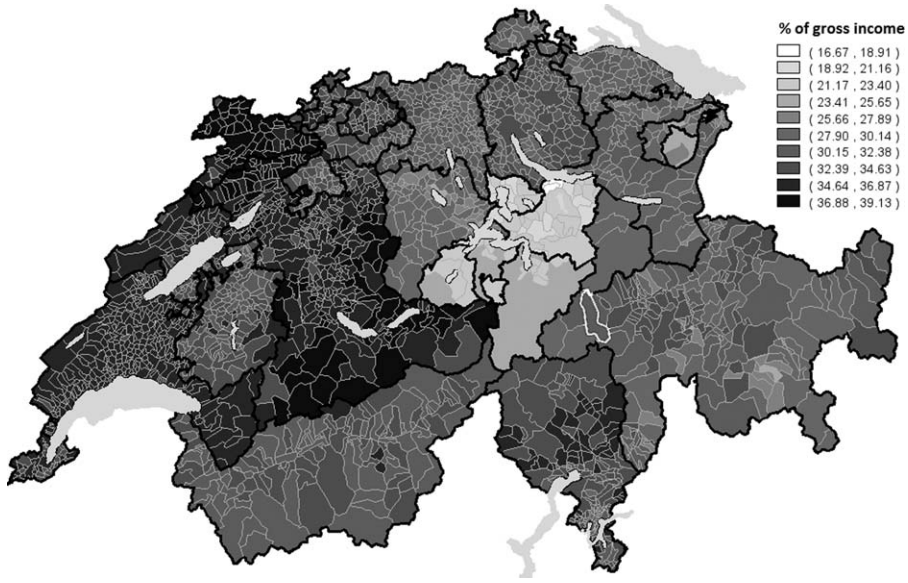

Figure 3. Cantonal and Municipality Tax Rate 2011 for a Married Couple without Children and a Gross Income of 1 Million SFr.

Source: Swiss Federal Tax Administration (2013): http://www.estv.admin.ch/dokumentation/00075/00076/00720/index.html?lang=de

spillovers or externalities, conventionally the economic literature focuses on intergovernmental grants as an efficient instrument for internalizing such inter-jurisdictional externalities (Gramlich, 1998 and Oates, 1999). A further reason for the system is fiscal equalization across jurisdictions in order to improve the fiscal capacity of poorer regions or those with specific fiscal burdens. The system of intergovernmental grants was introduced in 1959. In 2008 the mechanism was radically reformed in order to limit moral hazard of cantonal governments receiving grants previously depending on the level of the cantonal tax burden (Schaltegger and Frey, 2003).

3.3. *Strategic Tax Setting among Cantons*

Figure 3 shows several clusters of cantons with a similar level of tax burden on top incomes. This static pattern is confirmed in Figure 4, which illustrates the dynamic development of the tax burden on top incomes for four Swiss regions (Western, Northwestern, Central and Eastern Switzerland). The tax rates of cantons within a region evolve similarly, whereas between the regions there are substantial differences. The regions differ with respect to the development of tax rates over time as well as the general level of taxation. In Western Switzerland tax rates on the top income earners increase quite steadily until the 1980s. In Northwestern Switzerland the increase in the tax burden slowed considerably during the 1950s and 1960s, however in the 1970s the rates increased again quite strongly. In Central Switzerland the increasing trend stopped already in the 1960s. Since the

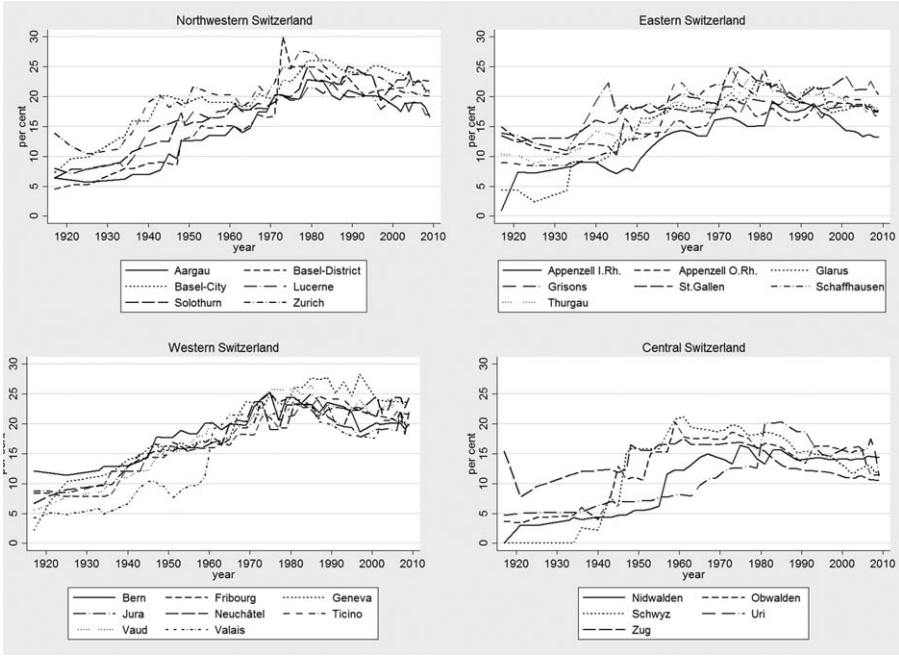

Figure 4. Development of Income Tax Burden on the Top 1 Percent in Western, Northwestern, Central and Eastern Switzerland

1980s tax rates tend to decrease in all the regions. This development is taking place on quite different levels however. In 2009 the cantonal tax burden on the top 1 percent is generally above 20 percent in Western as well as in several cantons in Northwestern Switzerland. At the same time, the tax burden is mostly below 20 percent in Eastern and even below 15 percent in Central Switzerland.

The observed pattern of relatively closely aligned tax rates on top incomes between cantons in the same region may be explained by similar local characteristics. Geographical requirements or the preferences of the local population with respect to the provision of public goods might be similar within regions. At the same time, this pattern may also occur due to tax competition between neighboring cantons. As presented above, the literature on income sorting provides empirical evidence that the choice of residence of high income households depends on the local tax burden (see section 2.2.). Hence, it seems likely that tax setting behavior of Swiss cantons is driven to some degree by tax competition. This hypothesis is confirmed by Feld and Reulier (2009), who provide evidence for strategic tax setting behavior among Swiss cantons. They show that the income tax burden in a canton depends on the tax rates applied in neighbor cantons. If this tax setting behavior is an attempt to attract or to retain mobile tax payers, it is certainly most relevant with respect to the tax burden on top income earners. On the one hand, according to the literature on income sorting top income

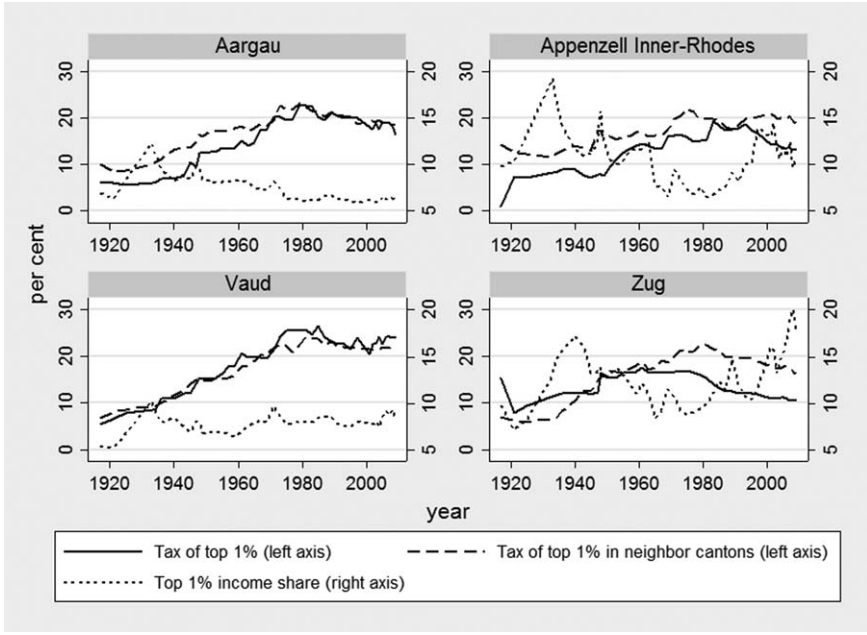

Figure 5. Income Shares of the Top 1 Percent and the Cantons Own as well as the Neighbor Canton's Tax Burden on the Top 1 Percent

earners react strongly to tax rate differentials. On the other hand, they represent a significant share of the tax base.

3.4. *Cantonal Tax Policy and Top Income Shares*

The aim of this paper is to determine the effect of the tax burden as well as tax competition on income concentration. Figure 5 provides some descriptive evidence with respect to this relation for four exemplary cantons (Aargau, Appenzell Inner-Rhodes, Vaud and Zug).[10] It shows the development of the income share of the top 1 percent in the respective canton. In the same plot Figure 5 depicts the cantons own as well as the neighbor cantons average tax burden on the top 1 percent.[11]

Aargau the first canton in Figure 5 shows a decreasing top income share from the 1930s until about 1980. During this time the cantons own tax burden on the top 1 percent increased considerably. Particularly, it increased faster than the average tax burden in its neighbor cantons. Since 1980 income concentration is quite stable in Aargau, while the canton's tax burden moves very much in line with the neighbor cantons.

A somewhat different development can be observed in Appenzell Inner-Rhodes the second canton in Figure 5. As in Aargau the top 1 percent income

[10]In Figure A1 in the Appendix the same plot is provided for all the cantons.
[11]As neighbor cantons we define all the cantons with a common border of the respective canton.

share decreased considerably from 1930 until 1980 (although from a higher level). At the same time the tax burden increased in absolute terms as well as relative to the neighbor cantons. Since about 1980 however and particularly since 1990 the cantonal tax burden decreases considerably relative to the neighbor cantons. During this time the top income share increases quite strongly.

The canton of Vaud the third canton in Figure 5 exhibits a very stable development of the top income share. This may be explained by the fact that the canton's tax burden on the top incomes moves very much in line with its neighbor cantons. This is not at all the case in Zug, the fourth canton in Figure 5. Until 1980 the tax burden increased quite considerably in its neighbor cantons. The canton of Zug thus consistently improved its relative position in terms of the tax burden. Since about 1980 the tax burden on top incomes is even decreasing and lies substantially below the level in neighbor cantons. In this period the top income share increased quite significantly in Zug.

These four examples show that the development of top income shares is quite diverse among Swiss cantons. The same is true regarding the tax burden on top incomes. It seems straightforward to expect a negative effect from the tax burden to the income share of top earners. However, as the examples show the relative position compared to the neighbor cantons seems to be relevant as well. Given a canton's tax burden, income concentration seems to increase (decrease) with higher (lower) neighbor tax rates. In the following this hypothesis is tested empirically.

4. Empirical Analysis

4.1. *Motivation*

The aim of this paper is to assess the impact of tax policy on income concentration. Theoretically there are three types of reactions of individuals to tax policy changes. An increase in the tax burden may cause a supply-side effect. Individuals may reduce their economic activity and instead increase leisure time. If however the income effect dominates, they may also increase activity. As another type of reaction, individuals may try to avoid taxation by restructuring their compensation package or to evade taxes by hiding income from the authorities (see also Piketty, Saez and Stantcheva, 2014). Finally, individuals may move their tax residence to another jurisdiction where the tax burden is lower. If the income effect is small, an increase in the tax burden for top income earners will cause a decrease in reported income of this group. Hence, according to the tax statistics the income share of top earners will decline.

Besides the impact of a canton's domestic tax policy on its top income shares this paper assesses the effect of tax competition. If tax competition is effective, top income shares may also be affected by the tax policy of other cantons. Given a certain tax burden for top incomes in a canton, a decreasing tax burden in competing cantons increases incentives to take up residence there. Several studies provide empirical evidence of the influence of taxes on the residential choice of high income households in Switzerland (Feld and Kirchgässner, 2001; Schmidheiny and Hodler, 2006; Schaltegger *et al.*, 2011). Of course the residential choice of top

income earners drives the top income share in a canton. Hence, due to tax competition it is a possible that income concentration in a canton depends on the tax policy of other cantons.

Because of progressive taxation the tax savings due to migration to another jurisdiction are quite large for high incomes. Following Schmidheiny (2006) we thus assume that the residential choice of high income individuals depends much more on the tax burden than is the case for middle and low income households. However, besides tax rate differentials cantons also differ with respect to the provision of public goods and social spending. Low income households thus might prefer high tax jurisdictions due to more favorable conditions regarding public goods and social spending. Thus, the residential choice of low income households might influence income concentration in a canton as well. However, as Liebig *et al*. (2007) find, the general population and especially individuals with low education levels are quite immobile and very rarely change residence due to fiscal motives. This might be due to the fact that the cost of a residential change are rather large compared to any possible gains.

For the definition of the tax competition variable we follow the literature on strategic tax competition and tax mimicking (see for example Heyndels and Vuchelen, 1998 or Feld and Reulier, 2009). For an overview of the empirical methods used in the tax mimicking literature see Brueckner (2003). We assume that the pressure of tax competition is determined by income tax rates in geographically adjacent cantons (*neighbor tax*). Such a weighting based on contiguity is commonly used in the tax mimicking literature (see Brueckner, 2003 as well as Revelli, 2003). For each canton the neighbor tax burden is calculated as the unweighted average of the tax burden in all the neighboring cantons.

4.2. *Method*

To investigate the impact of taxes on income shares we use a panel fixed-effects model (1) in order to account for cantonal as well as year-specific effects. In addition to this baseline specification, in order to account for a possible endogeneity bias in domestic tax policy, we also run instrumental variables estimations (2).

$$\text{(1)} \qquad \text{Top p\% income share}_{it} = \alpha_i + \mu_t + tax_{it}\beta_1 + tax_{nt-1}\beta_2 + X'_{it}\beta + \varepsilon_{it}$$

$$\text{(2)} \qquad \text{Top p\% income share}_{it} = \alpha_i + \mu_t + tax^{IV}_{it}\gamma_1 + tax_{nt-1}\gamma_2 + Z'_{it}\gamma + \varepsilon_{it}$$

$i = 1,\ldots, 26$ stands for the cantons and $t = 1917,\ldots, 2009$ for the observed tax periods. α_i accounts for the time-invariant cantonal fixed effects and μ_t for the cantonal-invariant year fixed effects with respect to the top p percent income shares. ϵ_{it} and ε_{it} are the respective error terms of the two models. The variables of interest are the tax rates. tax_{it} is the average cantonal tax burden for the top p percent income earners as explained in Section 3. tax_{nt-1} stands for the lagged average tax burden of all the direct geographical neighbor cantons of canton i for the top p percent of the income distribution. Following Feld and Reulier (2009) we lag the neighborhood tax variable by one period since we assume that

tax payers need at least one period to react to policy changes in other jurisdictions.[12]

X is a vector, which contains a series of control variables to account for the state of the economy, socio-demographic trends as well as political and institutional factors. It includes the cantonal *unemployment rate* in a given year, the employment share of the *tertiary sector*, cantonal per capita *expenditure* as well as the federal *transfers* to the cantons. Further control variables are the share of the working age *population (age 20 to 64)* and the *population density*. The variable *apartment construction* consists of the newly built single-family households, apartment buildings, residential and commercial buildings, and other buildings with apartments on the cantonal level. This could be relevant for top incomes, since housing conditions may be an important reason to migrate. Further we include the proportion of *foreigners*, the variable *crime*, which accounts for the share of convicted criminals in the resident population, and the variable *religion*, which measures the proportion of Protestants. As a political control variable we include the share of voters for the Social Democratic Party of Switzerland (*social democrats*) in the National elections.[13] Additionally, *X* includes dummy variables for the period of World War II (*WW II*, 1939 to 1945), the introduction of the *federal insurance for the old aged and survivors* (1948) and the introduction of a continuous *direct federal tax* (1940).

We include two additional variables to account for institutional changes concerning the system of taxation and public finances between the cantons and the federation. The first one is a dummy variable that accounts for the actual cantonal implementation of the tax harmonization law. The new rules were written into law in 1993. However, the cantons implemented them in different years between 1995 and 2003 (*federal tax harmonization*). The second dummy variable accounts for the complete overhaul of the financial equalization mechanism (*new financial equalization*) among Swiss cantons and the federation put in place in 2008. *Z* includes the same control variables as *X* except for these two institutional changes, since they are employed as excluded instruments in the instrumental variable model.

To show the stationarity of the 26 time series for the top income shares for the different periods (1917–2009, 1933–2009 and 1981–2009) we performed the Fisher-type test for each panel (Table A1 in the Appendix). Results for level-data, level-data with trend and level-data with a lag show that the null hypothesis of a unit root in all the panels can be rejected. The pairwise correlation of all used variables also shows that there is no strong multicolinearity (Table A2 in the Appendix).

4.3. *Identification Strategy*

The aim of this analysis is to assess the effect of the cantonal tax burden on top income shares. However, it is likely that a larger share of high income earners

[12]Furthermore, we follow Baum, Schaffer and Stillman (2003) and implement in our IV-estimates no degrees of freedom correction.

[13]National elections are held after a period of four years. That is why we took the values of the previous election to the national council. A similar procedure can be found in Leigh (2007).

Table 1

Baseline Regressions For Cantonal Income Concentration

	1917–2009				1933–2009				1981–2009			
Variables	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%
Tax top 1%	−0.127***				−0.128***				0.0773			
	(−4.75)				(−4.60)				(1.15)			
Neighbor tax top 1% (t-1)	0.121***				0.106**				0.320***			
	(2.87)				(2.46)				(2.74)			
Tax top 0.5%		−0.158***				−0.161***				−0.0265		
		(−7.19)				(−6.97)				(−0.39)		
Neighbor tax top 0.5% (t-1)		0.117***				0.109***				0.344***		
		(3.46)				(3.12)				(2.68)		
Tax top 0.1%			−0.110***				−0.118***				−0.158***	
			(−7.37)				(−7.48)				(−2.79)	
Neighbor tax top 0.1% (t-1)			0.0510**				0.0519**				0.204*	
			(2.31)				(2.27)				(1.92)	
Tax top 0.01%				−0.0549***				−0.0586***				−0.116***
				(−6.34)				(−6.40)				(−2.88)
Neighbor tax top 0.01% (t-1)				0.00579				0.00776				0.173**
				(0.46)				(0.59)				(2.13)
Unemployment rate	−0.366***	−0.256***	−0.171**	−0.0719*	−0.373***	−0.265***	−0.182**	−0.0775*	−0.0601	−0.0536	−0.0236	0.0266
	(−3.54)	(−2.83)	(−2.50)	(−1.73)	(−3.31)	(−2.68)	(−2.43)	(−1.69)	(−0.31)	(−0.29)	(−0.16)	(0.25)
Sector	0.0153	−0.00346	−0.00375	−0.0163	0.0234	0.00745	0.00780	−0.0102	0.144**	0.106*	0.0610	0.0358
	(0.59)	(−0.15)	(−0.22)	(−1.57)	(0.86)	(0.31)	(0.43)	(−0.92)	(2.36)	(1.87)	(1.26)	(1.05)
Population (20–64 age)	−0.0941*	−0.0777	−0.0833**	−0.0244	−0.0829	−0.0861*	−0.0925**	−0.0279	0.00741	0.0158	0.0307	0.0317
	(−1.71)	(−1.61)	(−2.29)	(−1.11)	(−1.43)	(−1.69)	(−2.39)	(−1.18)	(0.07)	(0.15)	(0.37)	(0.53)
Crime	0.463	0.913	0.500	0.0116	0.630	0.834	0.343	−0.0967	−2.559	−2.080	−1.064	−0.367
	(0.60)	(1.36)	(0.99)	(0.04	(0.78)	(1.18)	(0.64)	(−0.30)	(−1.58)	(−1.36)	(−0.86)	(−0.41)
Foreigner	0.253***	0.222***	0.131***	0.0493***	0.257***	0.222***	0.126***	0.0464***	0.418***	0.378***	0.280***	0.200***
	(7.06)	(7.09)	(5.55)	(3.43)	(6.69)	(6.58)	(4.93)	(2.98)	(4.64)	(4.46)	(4.07)	(4.05)
Religion	0.0511***	0.0577***	0.0494***	0.0291***	0.0522***	0.0576***	0.0479***	0.0286***	0.100***	0.0775***	0.0300	0.00715
	(4.35)	(5.58)	(6.27)	(6.07)	(4.25)	(5.29)	(5.76)	(5.63)	(3.88)	(3.20)	(1.47)	(0.49)
Population density	0.00217***	0.00130***	0.000504*	0.000121	0.00214***	0.00128***	0.000489	0.000118	0.00741***	0.00675***	0.00410**	0.00274**
	(4.98)	(3.43)	(1.75)	(0.70)	(4.58)	(3.12)	(1.57)	(0.62)	(3.00)	(2.87)	(2.16)	(1.99)
Social Democrats	−0.0230***	−0.0176***	−0.00948*	−0.00327	−0.0200***	−0.0149**	−0.00704	−0.00195	0.00663	0.00549	0.00358	0.00438
	(−3.13)	(−2.74)	(−1.95)	(−1.11)	(−2.68)	(−2.27)	(−1.41)	(−0.64)	(0.61)	(0.53)	(0.43)	(0.74)
Expenditure	0.0000212	0.0000293	0.0000444	0.0000558**	0.0000290	0.0000287	0.0000456	0.0000576**	0.000230**	0.000218**	0.0000777	0.0000358
	(0.37)	(0.59)	(1.18)	(2.46)	(0.49)	(0.56)	(1.17)	(2.43)	(2.17)	(2.21)	(0.95)	(0.62)
Transfers	−0.0000777	−0.0000448	−0.00000988	−0.0000691	−0.0000668	−0.0000373	−0.0000149	−0.0000792	−0.000542***	−0.000515***	−0.000367**	−0.000250**
	(−0.62)	(−0.41)	(−0.12)	(−1.37)	(−0.52)	(−0.33)	(−0.18)	(−1.54)	(−2.70)	(−2.72)	(−2.39)	(−2.27)

Table 1 *Continued*

	1917–2009				1933–2009				1981–2009			
Variables	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%
Apartment construction	0.585*	0.464	0.205	0.110	0.505	0.420	0.164	0.0931	−0.147	−0.230	−0.470	−0.426
	(1.67)	(1.51)	(0.88)	(0.77)	(1.41)	(1.33)	(0.68)	(0.63)	(−0.21)	(−0.35)	(−0.87)	(−1.10)
WW II	−1.196**	−0.958**	−0.664*	−0.202	−1.215**	−0.970**	−0.686*	−0.215				
	(−2.25)	(−2.06)	(−1.88)	(−0.94)	(−2.29)	(−2.07)	(−1.93)	(−0.99)				
Federal old age insurance	−3.814***	−2.123*	−0.599	0.624	−4.042***	−2.316*	−0.807	0.494				
	(−2.83)	(−1.80)	(−0.67)	(1.15)	(−2.92)	(−1.91)	(−0.87)	(0.88)				
Direct Federal Tax	−1.024*	−0.995**	−0.697*	−0.227	−1.031*	−1.007**	−0.719**	−0.238				
	(−1.85)	(−2.07)	(−1.93)	(−1.04)	(−1.87)	(−2.08)	(−1.98)	(−1.07)				
Tax harmonisation	0.0149	−0.00510	0.0725	0.0965	−0.0182	−0.0431	0.0495	0.0878	0.200	0.204	0.112	0.0355
	(0.02)	(−0.01)	(0.17)	(0.37)	(−0.03)	(−0.08)	(0.11)	(0.33)	(0.34)	(0.37)	(0.25)	(0.11)
New financial equalization	−0.407	−0.462	−0.223	−0.106	−0.420	−0.468	−0.228	−0.109	−0.633	−0.680	−0.686*	−0.438
	(−0.77)	(−1.00)	(−0.64)	(−0.50)	(−0.80)	(−1.01)	(−0.65)	(−0.51)	(−1.30)	(−1.48)	(−1.84)	(−1.63)
N	1120	1120	1120	1120	1070	1070	1070	1070	468	468	468	468
R^2	0.135	0.145	0.129	0.111	0.133	0.141	0.126	0.108	0.152	0.136	0.121	0.103
F	9.006	9.738	8.521	7.190	8.444	9.020	7.956	6.646	4.928	4.302	3.777	3.150

Notes: t statistics in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2

Instrumental Variables Estimation For Cantonal Income Concentration

	1917–2009				1933–2009				1981–2009			
Variables	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%
Tax top 1%	−0.312				−0.284				0.198			
	(−1.63)				(−1.44)				(0.60)			
Neighbor tax	0.149**				0.129**				0.219*			
top 1% (t-1)	(2.52)				(2.24)				(1.91)			
Tax top 0.5%		−0.263**				−0.260**				0.0114		
		(−2.18)				(−2.06)				(0.05)		
Neighbor tax		0.136***				0.127***				0.248**		
top 0.5% (t-1)		(3.04)				(2.79)				(2.00)		
Tax top 0.1%			−0.193**				−0.199**				0.0117	
			(−2.33)				(−2.29)				(0.06)	
Neighbor tax			0.0607**				0.0622**				0.176*	
top 0.1% (t-1)			(2.32)				(2.29)				(1.76)	
Tax top 0.01%				−0.0796*				−0.0830*				−0.0127
				(−1.81)				(−1.79)				(−0.10)
Neighbor tax				0.00923				0.0116				0.167**
top 0.01% (t-1)				(0.62)				(0.74)				(2.23)
First Stage; Excluded Instruments:												
Tax harmonization	−1.561***	−1.917***	−1.898***	−2.059***	−1.086**	−1.689***	−1.985***	−2.330***	−0.0252	−0.677**	−0.830***	−1.231***
	(−2.66)	(−3.08)	(−2.73)	(−2.84)	(−2.26)	(−3.32)	(−3.54)	(−3.97)	(−0.07)	(−2.14)	(−2.64)	(−3.88)
New financial equalization	−1.149**	−1.776***	−2.091***	−2.450***	−1.556***	−1.888***	−1.867***	−2.024***	−1.400***	−1.751***	−1.437***	−1.467***
	(−2.37)	(−3.45)	(−3.67)	(−4.11)	(−2.68)	(−3.07)	(−2.74)	(−2.84)	(−3.94)	(−5.35)	(−4.42)	(−4.46)
N	1120	1120	1120	1120	1070	1070	1070	1070	468	468	468	468
F test of excluded Instruments	10.35***	17.42***	17.04***	20.03***	9.92***	16.58***	16.28***	19.07***	8.04***	19.23***	15.88**	20.69***
Sargan test	1.185	1.220	0.668	0.423	1.058	1.166	0.679	0.431	2.049	2.122	1.307	0.618
(p-value)	(0.276)	(0.269)	(0.414)	(0.515)	(0.304)	(0.280)	(0.410)	(0.512)	(0.152)	(0.145)	(0.253)	(0.432)
Kleibergen-Paap LM-Test	21.31	35.40	34.66	40.50	20.44	33.70	33.12	38.57	16.46	37.40	31.34	39.99
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: t statistics in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

enables cantonal governments to set low tax rates due to the availability of a larger tax base. Hence, the domestic tax variable tax_{it} is endogenous to the top income share. To address this identification problem, we employ an instrumental variable approach (IV). In order to be valid the instrument must be correlated with domestic tax policy but uncorrelated to the error term, i.e., there must not be any direct effect on cantonal top income shares.

Admittedly, finding a suitable instrument for determinants fluctuating over 92 years is not an easy task. Over such a long time span influences are often interdependent. Our strategy is to determine institutional changes in the federal system of taxation and public finance, which we can assume not to influence individual cantonal top income shares directly (*exclusion restriction*). It is quite obvious that a major institutional change in the public finance system between the cantons and the federation causes some reaction regarding cantonal tax policy. Hence, such an instrument would clearly be relevant, as it would be strongly correlated with cantonal tax rates. Since we assume a change in the federal system, we can also assume strict exogeneity from the perspective of a single canton. This allows us to rule out any reverse effect from individual cantonal tax policy to the change in the federal tax system.

We find two major institutional changes in the system of taxation and public finances between the cantons and the federation to be suitable and valid instruments. First, the implementation of the cantons of the tax harmonization law, which was adopted in 1993 on the federal level. This law set in place a new framework regarding the harmonization of the tax base among cantons while leaving them full autonomy regarding the tax rates. On the cantonal level the law was implemented in different years between 1995 and 2003 depending on the canton. The necessary adjustments to comply with the new tax harmonization law certainly had some effect on cantonal tax rates.

As a second valid instrument we propose the complete overhaul of the financial equalization mechanism among Swiss cantons and the federation in 2008. This reform substantially changed the incentives regarding cantonal tax setting. While in the old equalization system the transfer payments to the cantons depended on cantonal level of taxation, in the new system only the tax base is relevant. Hence, a high level of taxation does not lead to increased transfer payments anymore. As a result incentives for a competitive cantonal tax policy are improved. It is very likely that also this reform influenced cantonal tax policy, while at the same time there seems to be no direct effect on cantonal top income shares.

4.4. *Spatial Autocorrelation*

In addition to the endogeneity problem of cantonal tax rates with respect to the top income shares, we address two other possible issues. Spatial autocorrelation might bias our estimate for the tax competition variable, which is based on the average tax rates of all the cantons with a direct border (neighbor cantons). First, following Schaltegger *et al*. (2011) we account for the possibility of clustering effects in cantonal top income shares. The attractiveness of a canton as a domicile for high income earners may result in spillover effects, which increase the attractiveness of neighbor cantons as well. Possible spillover factors might be changes in the economic or the socio-demographic structure affecting also

neighbor cantons. Spillovers like these might result in clustering of top incomes in certain regions, where several adjacent cantons have high top income shares. If such spillover effects exist, they would bias our estimation of the effect of tax rates on top income shares. The top income shares in one canton would in fact be endogenous to the top income share of its neighbor cantons. A second issue is the possibility of omitted spatial variables. It might be for example that top incomes disproportionately prefer taking residence in mountainous regions. Hence, such an omitted variable would spill over across units of observation and cause spatially correlated error terms.

We specify our model following Anselin and Bera (1998). To check for spatial correlation it is necessary to assume a certain spatial structure of correlation among the observations. We employ the same structure based on contiguity, which we already used to determine the tax competition variable. Hence, we use a spatial weighting matrix W which gives the same weight to all the neighbor cantons.

Estimating first a spatial autoregressive model with a spatially lagged dependent variable as well as an autoregressive disturbance term (SAC-model), we find that we can exclude a spatial lag of the dependent variable. Hence the problem of endogeneity of top income shares with respect to the income shares of neighbor cantons seems not to be relevant in our case. However, the results show that we need to account for the possibility of spatially correlated error terms due to omitted spatial variables. Therefore, we employ the following spatial error model (SEM):

$$y_{it} = \alpha_i + \mu_t + tax_{it}^{IV}\delta_1 + tax_{nt-1}\delta_2 + Z'_{it}\delta + \varepsilon_{it} \tag{3}$$

$$\varepsilon_{it} = \lambda[W\varepsilon_t]_i + \xi_{it} \tag{4}$$

Model (3) is based on the IV-model. Additionally, we specify a spatial process for the error term (4), where λ is the autoregressive coefficient and $[W\varepsilon_t]_i$ is the ith element of the spatial weights matrix applied to the vector containing the error terms of all the cantons at time period t. λ may be interpreted as a nuisance parameter reflecting spatial autocorrelation due to omitted spatial variables. ξ is in turn stands for the uncorrelated error term.

Estimation of such a model by OLS would result in inefficient estimates. We thus employ a maximum likelihood framework (see Belotti *et al.*, 2013).

A test of Moran's I in the residuals of the model for each cross-section confirms with reasonable confidence that there is no further spatial correlation after adjustment in the error term.

5. Results

5.1. *Baseline Regression*

The results of our regression analysis are presented for three different time periods in order to check for their robustness. First, we provide the results

over the whole available time span from 1917 to 2009. Second, we restrict the sample to period of comprehensive income taxation in Switzerland (i.e., including capital income) from 1933 to 2009. The third sub-period is specified from 1981 to 2009 in order to evaluate the developments of the last three decades, where we observe an increased spread between cantons with respect to the tax burden on top incomes (see Figure 2). Further, we provide the results of all the specifications for the top 1, 0.5, 0.1 and 0.01 percent of the income distribution.

Table 1 reports the results of our baseline model. The variables of interest are the cantonal tax burden on the respective top incomes and the average tax burden in the neighbor cantons. The results show that the cantonal tax burden has a significantly negative impact on all the top income shares in the time periods 1917 to 2009 and 1933 to 2009. Interestingly, since 1981 the negative effect of the tax burden concentrates on the top 0.1 and the top 0.01 percent income shares.

Further, the results of our baseline estimations show significantly positive effects of the neighbor tax rates on the cantonal top income shares. We observe significant effects for the top 1, 0.5 and 0.1 percent. Since 1981 the effect of neighbor tax rates extends also to the top 0.01 percent.

In Table 1 we also report the estimated coefficients for the control variables. The unemployment rate as well as the vote share of social democrats show a significantly negative effect on cantonal top income shares, the effects do not extend to the sub-period since 1981. In the last three decades however, the federal transfers to the cantons seem to negatively impact cantonal top income shares. Also the introduction of a continuous direct federal tax in 1940 and the period of World War II have a significantly negative effect on top incomes. The share of foreigners, the share of Protestants (*religion*) as well as the population density seems to have positive effects on top income shares. These effects are driven by the more urban cantons like Basel City, Geneva and also Zurich, which exhibit a more international and Protestant population and at the same time seem to be attractive locations for top income earners. The institutional changes in the federal system of taxation and public finances (*Tax harmonization* and *New financial equalization*) do not influence cantonal income concentration directly.

5.2. *IV-Model*

The results of the instrumental variables model are provided in Table 2. The first-stage regressions are presented in the lower part of the table and confirm the relevance of the instruments used. As expected, both institutional changes in the federal system of taxation and public finances have a significant impact on cantonal tax rates. The harmonization of the tax base among cantons resulted in significantly lower tax rates on top incomes. The formal tax harmonization restricts the opportunities of the cantons regarding the definition of the tax base, e.g., special rules for important tax payers. Hence, with this law tax competition between the cantons seems to have shifted to the tax rate. The overhaul of the financial equalization mechanism also has a significantly negative effect on tax rates. As

expected, the reform seems to have improved incentives for an attractive tax policy by the cantons.

Several test statistics support the validity of our instruments. According to the F-test of excluded instruments our instrumental variables are highly significant. We also tested whether our instruments are weak. As the size of the Cragg-Donnald F-statistic is mostly above the critical values compiled by Stock and Yogo (2005), we can exclude weak identification.[14] The results of the Sargan test of the overidentifying restrictions show that the null hypothesis that our instruments are truly exogenous is not rejected, indicating that our instruments are valid. Further, the Kleibergen-Paap LM-Test indicates that we can reject underidentification by our instruments in all specifications.

The general results of our baseline regressions are confirmed in the IV-model. Taxes play a prominent role for cantonal income concentration. Over the whole period since 1917 as well as in the sub-period from 1933 to 2009 the shares of cantonal top income shares are negatively affected by a domestic tax burden. The effects are significant for the top 0.5, 0.1 and 0.01 percent. At the same time, higher neighbor tax rates exert a positive effect on a canton's income concentration. As in the baseline model the significance of the positive effect of neighbor tax rates does not extend to the very top income earners (top 0.01 percent), but is significant for the top 1, 0.5 and 0.1 percent of the income distribution. Also, the results for the period from 1981 to 2009 differ to some extent from the other periods. In the IV-model we do not discover a significant impact of a canton's own tax burden in the last three decades. On the other hand, as in the baseline specification the positive effect of neighbor tax rates is significant for all the top incomes even the top 0.01 percent.

5.3. *Spatial Error Model*

The results of the spatial error model (SEM) are presented in Table 3. The significance of the Lamda coefficient indicates that there is in fact spatial correlation in the error term. However, the general results found in the baseline and the IV-model are robust to this change in the specification. The domestic tax burden has a significantly negative effect on the top income shares in a canton in the periods from 1917 and from 1933 to 2009. As in the IV-model we find significant effects for the top 0.5, 0.1 and 0.01 percent. Further, also in the spatial error model we find significantly positive effects of neighbor tax rates on a cantons' top income share over the whole period since 1917. As in the previous specifications the effect is restricted to the lower top income earners (top 1, 0.5 and 0.1 percent).

Consistent with the previous specifications in the period since 1981 the results differ to some extent. In the last three decades of our dataset we do not find significant effects of the cantons' domestic tax burden on income concentration. At the same time the positive effects of neighbor tax rates on cantonal top income shares extends also to the very top income earners.

[14]Only the model for the top 1 percent in the period from 1981 to 2009 has a maximal rejection rate greater than 15 percent if the true significance level is 5 percent.

Table 3

Spatial Error Model Regressions For Cantonal Income Concentration

	1917–2009				1933–2009				1981–2009			
Variables	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%
Tax top 1%	−0.189				−0.197				0.262			
	(−1.13)				(−1.23)				(1.02)			
Neighbor tax	0.139**				0.0859*				0.306***			
top 1% (t-1)	(2.53)				(1.71)				(2.68)			
Tax top 0.5%		−0.203*				−0.221**				0.0804		
		(−1.91)				(−2.11)				(0.40)		
Neighbor tax		0.126***				0.0831**				0.292**		
top 0.5% (t-1)		(2.96)				(2.05)				(2.27)		
Tax top 0.1%			−0.144**				−0.160**				0.0842	
			(−2.25)				(−2.43)				(0.44)	
Neighbor tax			0.0515**				0.0311				0.216*	
top 0.1% (t-1)			(2.10)				(1.26)				(1.76)	
Tax top 0.01%				−0.0914***				−0.104***				0.0425
				(−2.62)				(−2.72)				(0.34)
Neighbor tax				0.00584				0.00141				0.178**
top 0.01% (t-1)				(0.42)				(0.10)				(2.10)
Spatial lambda	−0.0888*	−0.151***	−0.212***	−0.198***	−0.201***	−0.261***	−0.288***	−0.225***	−0.169**	−0.152**	−0.149**	−0.149**
	(−1.74)	(−2.96)	(−4.21)	(−4.21)	(−3.74)	(−4.91)	(−5.58)	(−4.65)	(−2.34)	(−2.10)	(−2.03)	(−2.04)
N	1120	1120	1120	1120	1070	1070	1070	1070	468	468	468	468
R^2	0.012	0.000	0.009	0.023	0.004	0.001	0.019	0.037	0.002	0.000	0.003	0.010

Notes: t statistics in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Conclusion

This paper investigates the impact of income taxes and tax competition on top income shares at the sub-federal level in Switzerland over the 20th century. Previous studies are mostly based on cross-country data. However, due to international inconsistencies in the definition of the income tax base, the top income shares and the effective tax burden are difficult to compare across countries. Based on income tax statistics for the 26 Swiss cantons, the panel data used in this paper consists of homogeneously defined income data. In addition, with a time span of 92 years the dataset allows to take a long term perspective. The far-reaching tax autonomy of Swiss cantons enables the analysis of the influence of tax rates on income concentration. Further, we are also able to analyze the role of tax competition in the determination of top income shares. Since the residential choices of high income individuals depend on tax rate differentials (as shown by previous research), cantons find themselves in a competitive environment. To our knowledge the effect of tax competition on income concentration has not yet been empirically tested before.

In an international context Switzerland exhibits remarkably stable top income shares since 1933. On the cantonal level however, rather heterogeneous developments of income concentration can be observed. As shown in this paper, this cantonal heterogeneity is significantly influenced by cantonal tax policy as well as tax competition between cantons. As one would expect a higher domestic tax burden ceteris paribus decreases income concentration in a canton. This result is in line with the theoretical effects of behavioral reactions to a higher tax burden (labor supply incentives, tax planning and tax avoidance).

Further, we find evidence that also tax competition is a significant factor for cantonal top income shares over the period from 1917 to 2009 (top 1, 0.5 and 0.1 percent). Higher tax rates in neighbor cantons exert an increasing effect on top income shares of a canton. Over the whole period we do not find this effect to be significant for the top 0.01 percent in the income distribution. The highest income seems to be influenced more by the level of the domestic tax burden over the 20th century.

However, this pattern is not perfectly stable over time. In the last three decades of our sample (from 1981 to 2009) we discover a compelling change with respect to the influence of tax policy on top incomes. While we do not discover a significant impact of a canton's domestic tax burden any longer, the positive effect of neighbor tax rates now extends even to the very top incomes. Differences in tax rates between cantons now seem to exert a stronger effect on cantonal top income shares than the level of the domestic tax burden.

These findings might be explained by the development of cantonal tax policy over the 20th century as depicted in Figure 2. On average the level of cantonal income tax rates increased steadily for several decades since the beginning of the century. Around 1980 this trend came to an end. The cantonal tax burden on top incomes is on average fairly stable or even slightly decreasing since. However, at the same time we observe a widening of intercantonal differences with respect to the income tax rates for top incomes, especially so for the very top income earners (the top 0.01 percent). Even after 1980 some cantons (i.e., high tax cantons like

Bern, Geneva, Jura, Neuchâtel) continued to increase the tax burden for some years and reacted with some delay to the change in the general trend (see Figure A1 in the Appendix). As a result, the spread between high and low tax cantons increased. The elevated intercantonal tax differentials may have increasingly influenced the residential decisions of high income households. This effect might explain the expansion of the influence of the tax competition on all—even the very top—income shares during the last three decades. An additional explanation might be the generally increased mobility of high incomes due to the technological development. Communication as well as commuting cost considerably decreased over the 20th century. This might strengthen tax competition as the flexibility of high incomes and thus the mobility of the tax base increases.

As our analysis is based on tax statistics our income variable consists of declared income. Naturally, there might be differences between the actual earnings and the income declared in tax returns. Several forms of "irregular income" (e.g., fringe benefits or gains from insider trading) are not included in our income variable. Capital gains are generally not considered as taxable income in Switzerland. Further, there is of course a certain degree of tax avoidance as well as tax evasion. High income households receive a larger share of their income from portfolio investments and self-employment. Thus, according to Feenberg and Poterba (1993) they have more opportunities to engage in legal tax avoidance and also have some discretion about how much of their income they report in tax returns. If the very top income households (the top 0.01 percent) have these opportunities to a larger degree, then tax competition seems to be somewhat less relevant for this income group. It would rather be the local tax burden, which determines to what degree the opportunities of tax avoidance are exploited. Such an effect might be an explanation for our finding that the tax competition effect is not significant for the very top income households. However, these opportunities have diminished in the last three decades, due to stricter accounting standards, tougher tax audits, the more rigorous prosecution of insider trading and generally improved transparency with respect to income and taxation. This might explain, why we find the effect of tax competition expanding even to the very top income earners since 1981. However, as our analysis is based on tax statistics, we are not able to determine long term changes in tax avoidance. Further research is necessary to answer this question.

References

Alvaredo, F., A. B. Atkinson, T. Piketty, and E. Saez, The World Top Incomes Database, http://g-mond.parisschoolofeconomics.eu/topincomes, 23 July, 2015.

Anselin, L. and A. Bera, "Spatial Dependence in Linear Regression Models with an Introduction to Spatial Econometrics," in A. Ullah and D. Giles, eds., *Handbook of Applied Economic Statistics*, 247–89, Marcel Dekker, New York, 1998.

Atkinson, A. B., T. Piketty and E. Saez, "Top Incomes in the Long-Run of History," *Journal of Economic Literature*, 49, 3–71, 2011.

Atkinson, A. B. and T. Piketty, *Top Incomes: A Global Perspective*, Oxford University Press, Oxford and New York, 2010.

Atkinson, A. B. and A. Leigh, "Top Incomes in New Zealand 1921–2005: Understanding the Effects of Marginal Tax Rates, Migration Threat, and the Macroeconomy," *Review of Income and Wealth*, 54, 149–65, 2008.

Atkinson, A. B. and A. Leigh, "The Distribution of Top Incomes in Five Anglo-Saxon Countries over the Long Run," *Economic Record*, 89, 31–47, 2013.
Baum, C. F., M. E. Schaffer and S. Stillman, "Instrumental variables and GMM: Estimation and testing," *Stata Journal*, 3, 1–31, 2003.
Belotti, F., G. Hughes and A. P. Mortari, "xsmle – A Command to Estimate Spatial Panel Models in Stata," *German Stata Users' Group Meetings 2013*, 09, 2013.
Brueckner, J. K., "Strategic Interaction Among Governments: An Overview of Empirical Studies," *International Regional Science Review*, 26, 175–88, 2003.
Congressional Budget Office (CBO), "Trends in the Distribution of Household Income between 1979 and 2007," The Congress of the United States, 4031, 2011.
De Bartolome, C. A. M. and S. L. Ross, "Equilibria with Local Governments and Commuting: Income Sorting vs. Income Mixing," *Journal of Urban Economics*, 54, 1–20, 2003.
Dell, F., T. Piketty and E. Saez, "Income and Wealth Concentration in Switzerland over the Twentieth Century," in A. B. Atkinson and T. Piketty, eds, *Top Incomes over the Twentieth Century: A Contrast between Continental European and English-Speaking Countries*, Oxford University Press, Oxford and New York, 472–500, 2007.
Ellickson, B., "Jurisdictional Fragmentation and Residential Choice," *American Economic Review*, 61, 334–9, 1971.
Feld, L. P., Steuerwettbewerb und seine Auswirkung auf Allokation und Distribution: Eine empirische Analyse für die Schweiz, Dissertation Nr. 2222, St. Gallen: Universität St. Gallen, 1999.
Feld, L. P. and G. Kirchgässner, "Income Tax Competition at the State and Local Level in Switzerland," *Regional Science and Urban Economics*, 31, 181–213, 2001.
Feld, L. P. and E. Reulier, "Strategic Tax Competition in Switzerland: Evidence from a Panel of the Swiss Cantons," *German Economic Review*, 10, 91–114, 2009.
Feenberg, D. R. and J. M. Poterba, "Income Inequality and the Incomes of very High-Income Taxpayers: Evidence from Tax Returns," *Tax Policy and the Economy*, 7, 145–77, 1993.
Föllmi, R. and I. Martínez, "Volatile Top Income Shares in Switzerland? Reassessing the Evolution Between 1981 and 2008," *University of St. Gallen Discussion Paper*, 2012–27, 2013.
Gramlich, E. M., "Intergovernmental Grants: A Review of the Empirical Literature," *International Library of Critical Wirtings in Economics*, 88, 274–94, 1998.
Heyndels, B. and J. Vuchelen, "Tax Mimicking among Belgian Municipalities," *National Tax Journal*, 51, 89–101, 1998.
Kirchgässner, G. and W. W. Pommerehne, "Tax Harmonization and Tax Competition in the European Union: Lessons from Switzerland," *Journal of Public Economics*, 60, 351–71, 1996.
Leigh, A., "How Closely do Top Income Shares Track other Measures of Inequality?" *Economic Journal*, 117, F589–F603, 2007.
Liebig, T., P. A. Puhani and A. Sousa-Poza, "Taxation and Internal Migration: Evidence from the Swiss Census Using Community-Level Variation in Income Tax Rates" *Journal of Regional Science*, 47, 807–36, 2007.
Moriguchi, C. and E. Saez, "The Evolution of Income Concentration in Japan, 1885–2005: Evidence from Income Tax Statistics," *Review of Economics and Statistics*, 90, 713–34, 2008.
Oates, W. E., "An Essay on Fiscal Federalism," *Journal of Economic Literature*, 37, 1120–49, 1999.
Organisation for Economic Co-operation and Development (OECD), *Divided We Stand: Why Inequality Keeps Rising*, OECD Publishing, Paris, 2011.
Piketty, T., *Les Hauts revenus en France au XXe siècle*, Grasset, Paris, 2001.
Piketty, T., "Income Inequality in France, 1901-1998," *Journal of Political Economy*, 111, 1004–42, 2003.
Piketty, T., "*Capital in the 21th century,"* Harvard University Press, 2014.
Piketty, T. and E. Saez, "Income Inequality in the United States, 1913–1998," *Quarterly Journal of Economics*, 118, 1–39, 2003.
Piketty, T., E. Saez and S. Stantcheva, "Optimal Taxation of Top Labor Incomes: A Tale of Three Elasticities," *American Economic Journal: Economic Policy*, 6, 230–71, 2014.
Revelli, F., "Reaction or Interaction? Spatial Process Identification in Multi-Tired Government Structures" *Journal of Urban Economics*, 53, 29–53, 2003.
Roine, J. and D. Waldenström, "The Evolution of Top Incomes in an Egalitarian Society: Sweden, 1903–2004," *Journal of Public Economics*, 92, 366–87, 2008.
Roine, J., J. Vlachos and D. Waldenström, "The Long-Run Determinants of Inequality: What Can We Learn from Top Income Data?" *Journal of Public Economics*, 93, 974–88, 2009.
Ross, S. and J. Yinger, "Sorting and Voting: A Review of the Literature on Urban Public Finance," in Ceshire, Paul and Mills, Edwin S., eds, *Handbook of Regional and Urban Economics*, 3, North-Holland, Amsterdam, 2001–60, 1999.
Saez, E., "Reported Incomes and Marginal Tax Rates, 1960–2000: Evidence and Policy Implications," in James M. Poterba (ed.), *Tax Policy and the Economy*, 18, MIT Press, Cambridge MA, 117–74, 2004.

Saez, E. and M. Veall, "The Evolution of High Incomes in Northern America: Lessons from Canadian Evidence," *American Economic Review*, 95, 831–49, 2005.
Sarkar, S. and M. Tuomala, "Potential Determinants of Top Income Inequality," *Tampere Economic Working Papers, Net Series*, 77, 2010.
Schaltegger, C. A. and R. L. Frey, "Finanzausgleich und Föderalismus: Zur Neugestaltung der föderalen Finanzbeziehungen am Beispiel der Schweiz," *Perspektiven der Wirtschaftspolitik*, 4, 239–58, 2003.
Schaltegger, C. A. and C. Gorgas, "The Evolution of Top Incomes in Switzerland over the 20th Century," *Swiss Journal of Economics and Statistics*, 147, 479–519, 2011.
Schaltegger, C. A., F. Somogyi and J. E. Sturm, "Tax Competition and Income Sorting: Evidence from the Zurich Metropolitan Area," *European Journal of Political Economy*, 27, 455–70, 2011.
Schmidheiny, K., "Income Stratification in Multi-Community Models," *VWI Diskussionsschrift Universität Bern*, 0215, 2002.
Schmidheiny, K., "Income Segregation and Local Progressive Taxation: Empirical Evidence from Switzerland," *Journal of Public Economics*, 90, 429–58, 2006.
Schmidheiny, K. and R. Hodler, "How Fiscal Decentralization Flattens Progressive Taxes," *Finanzarchiv/Public Finance Analysis*, 62, 281–304, 2006.
Stock, J.H. and M. Yogo, "Testing for Weak Instruments in Linear IV Regression," in Andrews, Donald W. K. and Stock, James H., eds, *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, Cambridge University Press, Cambridge, 80–108, 2005.
Tiebout, C., "A Pure Theory of Local Expenditures," *Journal of Political Economy*, 64, 416–24, 1956.
Westhoff, F., "Existence of Equilibria in Economies with a Local Public Good," *Journal of Economic Theory*, 14, 84–112, 1977.

Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web-site:

Figure A1a: Tax rates of neighboring cantons and tax rate for the top 1% and 0.1% income shares, 1917–2009.
Figure A1b: Tax rates of neighboring cantons and tax rate for the top 1% and 0.1% income shares, 1917–2009.
Figure A2: Scatter plot for the top 0.1% income shares and the average tax, 1917–2009.
Table A1: Panel Unit Root Test – Fisher Type Test – Inverse $\chi 2$.
Table A2: Correlation matrix.
Table A3: Descriptives