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The Corporate Elasticity of Taxable Income: Event Study Evidence from Switzerland

Abstract

We estimate the corporate elasticity of taxable income. Our analysis draws on panel variation in the decentralized system of corporate taxation in Switzerland. We find that an increase in a jurisdiction's corporate net-of-tax rate by 1% results in an increase in aggregate corporate income by about 3.5% over a time span of 4 years. The elasticity is larger in remote, non-central locations. Firm entry, exit, and mobility only account for a small share of the overall elasticity.

JEL-Codes: H210, H250, H320.

Keywords: corporate income tax, tax elasticity, fiscal federalism.

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1 Introduction

Corporate tax rates in developed countries have been decreasing substantially over recent decades. Between 2000 and 2020, the OECD average of corporate tax rates has steadily fallen from just above 32% to around 23%. Some countries have also provided low-tax regimes for firms in specific, presumably mobile, sectors. International organizations have taken action to address these, from their point of view, harmful developments. The OECD Base Erosion and Profit Shifting (BEPS) Project provides guidelines for countries to adjust their corporate tax code to mitigate loopholes and profit shifting. Continued reductions in corporate tax rates during the BEPS implementation period, for example through the "Tax Cuts and Jobs Act" of 2017 in the U.S., have, however, raised concerns that tax code harmonization may as well intensify competition.

A key parameter to evaluate the economic effects of corporate tax reforms is the corporate elasticity of taxable income (CETI). A greater responsiveness of the base of corporate taxable income to changes in corporate tax rates will more likely induce different jurisdictions to undercut each other's tax rates to attract corporate income. Yet, after years of extensive research, the magnitude of the CETI is still an open question.

In this paper, we use Swiss canton and municipality-level aggregate data to analyze the effects of corporate tax reforms. Switzerland not only competes over corporate tax revenue with other countries, it also grants far-reaching tax autonomy to sub-federal jurisdictions, which compete against each other. This institutional setting with 26 cantons and some 2,200 municipalities ensures significantly more variation across time and across jurisdictions than the empirical settings used in the previous literature.[1] There already is a sizeable literature that uses the Swiss setting as a laboratory to analyze individuals' responsiveness to tax changes. What is missing so far, is an analysis of the responsiveness of *corporate* income to changes in tax rates. This paper fills that gap.[2]

Switzerland's decentralized setting has always caused tensions between those calling for restrictions on supposedly harmful tax competition and others considering tax competition a necessary means to limit the size of government. In 1990, Swiss parliament approved the Federal Tax Harmonization Act (FTHA), which obliges cantons and municipalities to harmonize their *tax bases*.[3] At the same time, the law grants the cantons almost full discretion

[1] Schmidheiny (2017) provides an overview of a growing literature that has used Switzerland's decentralized structure to answer a variety of questions. Brülhart and Jametti (2019), for example, examine on the effectiveness of tax competition to contain the size of government. Feld *et al.* (2010) and Feld, Kirchgässner and Schaltegger (2011), examine the impact of fiscal decentralization and direct voting rights on the size and type of government revenue and debt. Parchet (2019) examines strategic interactions among municipalities in personal income tax rate setting. Eugster and Parchet (2019) analyze the spatial reach of inter-jurisdictional tax competition. Roller and Schmidheiny (2016) quantify effective progressivity in personal income taxes in a fiscally decentralized country.

[2] Schmidheiny and Slotwinski (2018) find causal evidence for strategic income bunching around tax notches exploiting a special tax regime for high-income foreigners. Brülhart, Gruber, Krapf and Schmidheiny (2019) find substantial responses of individuals to wealth taxes and Brülhart and Parchet (2014) find very little response of individuals to bequest tax reforms. See Staubli (2018) for a panel assessment of the elasticity of corporate taxable income that relies on municipality and firm-level data.

[3] The full name of the law, best possibly translated to English, reads "Federal Act on the Harmonization of Direct Taxes of the Cantons and Municipalities". After it went into effect in 1993, cantons were granted a seven years transition period to adjust there cantonal laws accordingly. The FTHA's regulations in German

in setting *tax schedules*.

We first show graphical evidence on large tax reforms in two cantons, Appenzell Ausserrhoden and Lucerne, which reduced their corporate tax rates by 29% and 37%, respectively. A narrative examination (see Romer and Romer, 2010) of official booklets provided to voters prior to the referenda on these reforms shows evidence that taxes were not reduced because policy makers anticipated increasing corporate income. We use Abadie *et al.*'s (2010) synthetic control method to estimate counterfactual evolutions of corporate taxable income in these two cantons without tax rate reductions. Our results suggest sizable elasticities.

We subsequently apply a distributed-lag approach to provide an estimate of the CETI and to investigate heterogeneity. This approach goes back to Schmidheiny and Siegloch (2020), who generalize the event-study approach to multiple events. The distributed lag model captures all changes in municipalities' corporate tax rates. It therefore fully exploits the large variation across jurisdictions and time in Switzerland's decentralized system of corporate taxation.

Applying the distributed-lag model to municipality-level data, we find an elasticity with respect to the net-of-tax rate of around 3.5. That is, an increase in the corporate net-of-tax rate in a municipality by 1% induces an increase in that municipality's aggregate corporate income by around 3.5%. The effect unfolds over time with about half of the effect occurring in the first year after the reform. The CETI is is even larger in more remote municipalities, where it assumes an magnitude of up to 5. While the CETI in Switzerland is large, Swiss municipalities are still on the increasing part of the Laffer curve, where a decrease in corporate tax rates translates into a decrease in corporate tax revenue.

The tax base in urban centers is less sensitive to changes in corporate tax rates, presumably due to agglomeration economies. Focusing on corporate profits of a group of super stayer firms that remain in the same municipality throughout our sample period, we find that only around one sixth of the CETI is related to the extensive margin. Firm birth, death, and mobility only appear to play a minor role, whereas most of the effect is attributable to firms increasing or decreasing reported corporate income while staying in the same municipality. Since we observe profits at the level of legal entities, which may be part of larger corporate groups, our findings may be related to movements across legal entities within a corporation. This may either reflect pure profit shifting or real reorganization of activities within these corporations.

Most studies of behavioral responses to tax reform report estimates of elasticities with respect to changes in net-of-tax rates. Given that the main objective of most firms is to maximize profit, the elasticity with respect to net-of-tax is of particular interest in our context. To address the problem of taxable corporate income being zero for a substantial number of firm-year observations, Gruber and Rauh (2007) as well as Dwenger and Steiner (2012) work with industry-level aggregates. They then apply an IV strategy suggested by Gruber and Saez (2002) to account for the inherent endogeneity of the tax base with respect to tax rates. Devereux *et al.* (2014), on the other hand, rely on a bunching methodology,

can be found on the Swiss confederation's official website. The regulations discussed in this section can be found in Chapter 2 (corporate income tax) and Chapter 3 (capital tax) of the FTHA.

which does not require them to aggregate their data. Bachas and Soto (2018) and Boonzaaier *et al.* (2019) apply the bunching technique to settings in emerging countries. These early studies find the elasticity of corporate taxable income to be in the range 0.15-0.55.

More recent work has identified potential biases in these prior studies and suggested solutions that pose additional demands on the data. The bunching technique in Coles *et al.* (2019) requires exogenous variation in tax rates across firms conditional on corporate taxable income. Similarly, Kumar and Liang (2020) develop an IV strategy that exploits exogenous variation in tax rates conditional on taxable income, but apply it to the personal income tax. Coles *et al.* (2019) conclude that the elasticity of corporate taxable income is somewhat higher than previously thought at around 0.75.

Riedl and Rocha-Akis (2012) is closely related to our study in that they also exploit variation across jurisdictions. Using a panel of OECD countries, they find an elasticity with respect to the tax rate of about -0.8. This result is of similar magnitude to what we would find if we used the same specification as they do regressing the tax base on tax rates rather than net-of-tax rates. They also present evidence for positive spillovers on the corporate tax base from increases in the corporate tax rates in neighboring countries.

The above mentioned Swiss Federal Tax Harmonization Act (FTHA) of 1990, which ensures that corporate incomes are comparable across jurisdictions during our sample period, allows us to address an important concern raised against cross-country studies. Kawano and Slemrod (2016) document that decreases in corporate tax rates tend to be accompanied by simultaneous tax base broadening provisions. In Switzerland, thanks to the FTHA, the only parameter that policy makers can dispose of to change the corporate tax burden is basically the tax schedule.[4]

The large elasticity we observe may in part be related to profit shifting. There is a literature that analyzes tax-induced shifting of taxable corporate income across jurisdictions within multinational firms. This literature has identified internal debt financing, strategic pricing of intermediate inputs, or royalty payments as channels through which corporate income is shifted to low-tax jurisdictions (see Hines Jr. and Rice, 1994; Bartelsman and Beetsma, 2003; Huizinga and Laeven, 2008; Egger, Eggert and Winner, 2010; Dharmapala and Riedel, 2013 and, on the relative importance of the aforementioned channels, Heckemeyer and Overesch, 2017; Dharmapala and Riedel, 2013).

The remainder of this paper is organized as follows. Section 2 outlines the Swiss institutional context, Section 3 describes the data set. In Section 4, we show graphical evidence on the corporate elasticity of taxable income using a synthetic control model, and in Section 5, we present our baseline causal estimates from a distributed lags model. Section 6 discusses our results and concludes.

[4]The cantons have a certain amount of leeway in determining the depreciation rules. As of 2020, the Swiss corporate tax reform (Tax proposal and AHV financing (TRAF)) enables cantons to allow for super deductions for R&D expenditures and privileged tax treatment for revenue from patents. Those tax relief measures were meant to partly offset the loss of previously existing tax privileges which were no longer compatible with international standards (BEPS).

2 Swiss Institutional Context

Switzerland is divided into 26 cantons and about 2,200 municipalities. More than half (53%) of total tax revenue is raised by these sub-federal government entities. Sub-federal jurisdictions are free to set tax rates at their discretion. To a large extent, the fiscal autonomy of sub-federal jurisdictions extends to public expenditure as well. The federal and sub-federal jurisdictions both levy a corporate income tax and a personal income tax with a larger share of tax revenue going to sub-federal jurisdictions for both types of taxes. 53% of total corporate income tax revenue and 81% of total personal income tax revenue is raised at sub-federal levels.[5]

Personal wealth and corporate capital (equity capital) are subject to taxation only at sub-federal levels. Overall, the average firm pays more than half of its corporate income and capital taxes at sub-federal levels and less than half at the federal level. Corporations face a tax on corporate income and a tax on equity capital. By far the largest part of the corporate tax burden falls on the corporate income tax. Total revenue from the corporate income tax is about eleven times higher than total revenue from the capital tax. Other kinds of sub-federal corporate taxes such as real estate taxes play a minor role.

The Federal Tax Harmonization Act (FTHA) grants sub-federal jurisdictions almost full autonomy with respect to their corporate tax rates. The only requirement is that they have to levy positive taxes on corporate income and on corporate capital. Despite almost full autonomy in tax rate setting, sub-federal jurisdictions face extensive formal restrictions aimed at simplifying the tax code by increasing transparency and by facilitating cross-jurisdictional comparisons. Most importantly for this study, the FTHA stipulates how sub-federal jurisdictions determine corporate income and capital for taxation purposes. According to the FTHA, all corporate income is subject to the corporate income tax. The FTHA also provides a detailed account of what type of expenses are deductible. Similarly, the FTHA stipulates that all equity capital is subject to the capital tax and it specifies how to determine taxable equity capital.

3 Data

Our data set comprises all 2,240 Swiss municipalities (as of 2017) in 26 cantons and spans 15 years, from 2003 to 2017. In the following we will discuss our two main variables of interest, corporate income and corporate tax rates.

3.1 Corporate Income

Data on corporate income are provided by the Swiss Federal Tax Administration (FTA).[6] We have access to information on corporate income, corporate capital, and the municipality code

[5]The main sources of tax revenue at the federal level are the value added tax (36% of federal tax revenue and the sole prerogative of the federal government), personal income taxes (16% of federal tax revenue) and corporate income taxes (14%). The source of all numbers on Swiss tax revenue in this paper is the financial statistic of the Swiss confederation. All numbers are averaged over the sample period (2003-2017).

[6]ESTV Statistik der direkten Bundessteuer - juristische Personen, 2020, Bern.

of the domicile of every firm subject to corporate income and capital taxation in Switzerland, including stock companies, limited liability companies, and cooperatives that are subject to ordinary taxation.

To perform aggregate-level estimations, we aggregate corporate income of all firms domiciled in municipality j in year t, and denote the result as y_{jt}.[7] In Section 4, we will aggregate at the cantonal level. Mean aggregate profit per municipality and year in our data is CHF 26.7 million with a maximum of CHF 15.7 billion. Mean profit of super stayer firms per municipality and year is CHF 16.3 million with a maximum of CHF 13.7 billion.

Note that the data set assigns all corporate income to the municipality, in which a firm is registered as a legal entity and does not take into account tax apportionment among permanent establishments, which may induce measurement error. In reality, if a legal entity is domiciled in municipality A and has a production site with no separate legal entity in municipality B, a share of that firm's corporate income would be allocated to municipality B. In the data, however, firm's corporate income is fully reported in municipality A.

There are thus two types of firm responses that we may not accurately observe in our data. First, firms may respond to changes in corporate tax rates by moving corporate income between production sites without moving the domicile of the legal entity. Second, firms may respond to changes in corporate tax rates by changing the legal entity's location without moving corporate income. Federal data on balances of intercantonal tax allocations indicate interjurisdictional tax allocations are of minor quantitative importance.[8]

3.2 Corporate Tax Rates

Our main explanatory variable of interest will be the consolidated effective tax rate (ETR) on corporate income consisting of a federal, a cantonal, and a municipal component.[9] To compute the ETR, we rely on publicly available federal, cantonal, and municipal tax law records. In most cantons, the tax schedule is set at the cantonal level and municipalities can set the so-called multiplier. By doing so, they can adjust the tax burden but not the progression or the relative weights of corporate income and capital taxes. The ETR_{ijt} measures the total burden from corporate income and capital taxes of a firm i in municipality j and year t relative to its corporate income

$$ETR_{ijt}(y_{it}, k_{it}) = \frac{\tau^y_{ijt}(y_{it}, k_{it}) + \tau^k_{ijt}(y_{it}, k_{it})}{y_{it}},$$

[7] In Switzerland, the corporate tax is deductible from taxable corporate income. We work with corporate income before taxes which we compute for each individual firm by adding corporate taxes to taxable income.

[8] The canton of Lucerne provided data that allow to narrow down the extra corporate income from production sites of firms headquartered in another canton to around 13% of the corporate tax base. Data from the Confederation indicate that, in most cantons, the balance of inter-cantonal tax allocations amount to between plus/minus 3% of the cantonal aggregate corporate income.

[9] The federal government levies a unique tax rate of 8.5% on corporate income throughout our sample period.

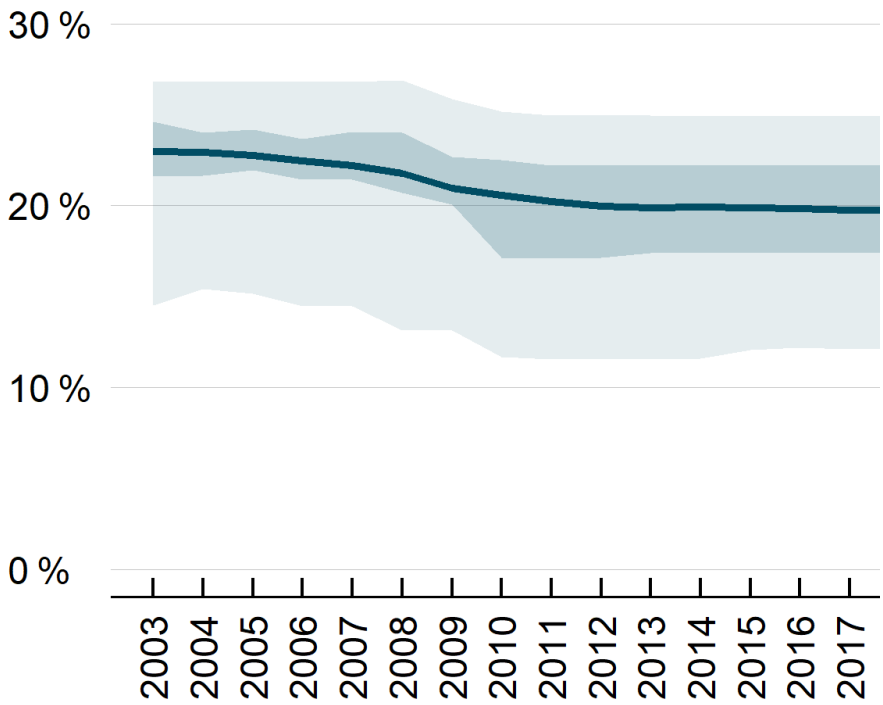

Figure 1: Range in light blue; range percentiles 25-75 weighted by corporate income in dark blue; thick line indicates average across all municipalities weighted by corporate income. Source: Portmann and Staubli (2020).

where y_{it} is firm i's corporate income in year t, τ_{it}^{y} is firm i's corporate income tax in year t, and τ_{it}^{k} is firm i's capital tax in year t.[10] The ETR is an average tax rate. It is, however, highly correlated with marginal tax rates. In cantons with proportional corporate income and capital tax schedules, average and marginal tax rates are even identical.

Following Devereux and Griffith (2003) and Riedl and Rocha-Akis (2012), we will focus on a hypothetical firm. We use a firm with CHF 2 million in equity capital and a return on equity of 13%, which implies CHF 260,000 in corporate income.[11] The corporate tax rate of the hypothetical firm ETR^{*} in municipality j and year t is defined as

$$ETR_{jt}^{*} = (\tau_{jt}^{y}(y^{*}, k^{*}) + \tau_{jt}^{k}(y^{*}, k^{*}))/y^{*},$$

where y^{*} and k^{*} indicate corporate income and capital of the hypothetical firm. Similar to studies like Kawano and Slemrod (2016) that use the top marginal tax rate, our hypothetical firm of choice is located toward the top of the distribution. The hypothetical firm's corporate income of CHF 260,000 corresponds to the 90^{th} percentile of corporate income distribution, its corporate capital of CHF 2 million to the 93^{rd} percentile of the corporate capital distribution. Given that cantonal tax schedules are either proportional or only slightly progressive, ETRs do not vary much across alternative choices of a hypothetical firm.

[10] The corporate income tax accounts for the lion's share of the combined tax burden. The relative share of the capital tax is decreasing during the sample period.

[11] Our hypothetical firm of choice corresponds to the average firm with at least one non-zero observation of corporate income. During the sample period one Swiss franc (CHF) fluctuated in the range USD 0.7-1.2.

Figure 1 shows a general downward trend in ETRs during our sample period. The corporate income-weighted mean ETR across all municipalities decreased from 22.8% in 2003 to 19.5% in 2017. The municipality-specific changes in the ETR between 2003-17 range from a reduction by 10.2%-points to an increase by 1.7%-points. Figure 1 also visualizes significant variation in the ETR across municipalities. In 2017 (2003) the range was from 12.1% to 24.9% (14.5% to 26.8%). There also was substantial variation beyond the displayed percentiles. Most of the variation in corporate tax changes originates at the cantonal level (see Portmann and Staubli, 2020).

We only include firms that are subject to ordinary taxation in our analysis. The Swiss tax system used to offer tax privileges to so-called status companies (SCs) that engage in only limited business activities in Switzerland. SCs were largely exempt from sub-federal (but not federal) corporate income taxes on their foreign corporate income and they pay a reduced sub-federal capital tax. We drop all SCs from our sample.

4 Cantonal-level analysis using the Synthetic Control Method

In this section, we will rely on the synthetic control method (SCM) to provide graphical evidence for the effect of corporate tax rates on corporate income using cantonal-level data. As outlined above, the tax rate stipulated in the cantonal law affects corporate tax rates in all municipalities within that canton. We will focus on two such experiments in the cantons of Lucerne and Appenzell-Ausserrhoden. Both reforms induced substantial drops in corporate tax rates.

Rather than comparing the outcome of interest in the treated unit to another unit, the SCM creates a convex combination of potential counterfactual units that closely tracks the treated unit during the pre-treatment period. We will use this method to create a synthetic Lucerne and a synthetic Appenzell Ausserrhoden to estimate the evolution of the tax bases in the two cantons in the counterfactual case without a tax reduction. The synthetic counterfactuals will be weighted averages of untreated cantons with no substantial changes in tax rates. The SCM was developed by Abadie and Gardeazabal (2003) and Abadie *et al.* (2010) (see Abadie, 2020, for a review). Previous applications in the tax literature mostly rely on cross-country comparisons and include Kleven *et al.* (2013) and Rubolino and Waldenström (2020).

Figure 2 shows corporate tax rates in Lucerne and Appenzell Ausserrhoden, as well as in the comparison group between 2003 and 2017. Lucerne implemented its reform in two steps in 2010 and 2012, whereas Appenzell Ausserrhoden implemented its reform in 2008. During the pre- and post-reform periods there is little movement in corporate tax rates. Similarly, corporate tax rates did not remain entirely constant in most comparison cantons, in which they display slight and smooth downward trends.

The construction of the comparison group, also referred to as the synthetic control, follows a formalized procedure. First, one needs to specify a pool of donors that did not experience any substantial movement in the corporate tax rate during the period of interest.

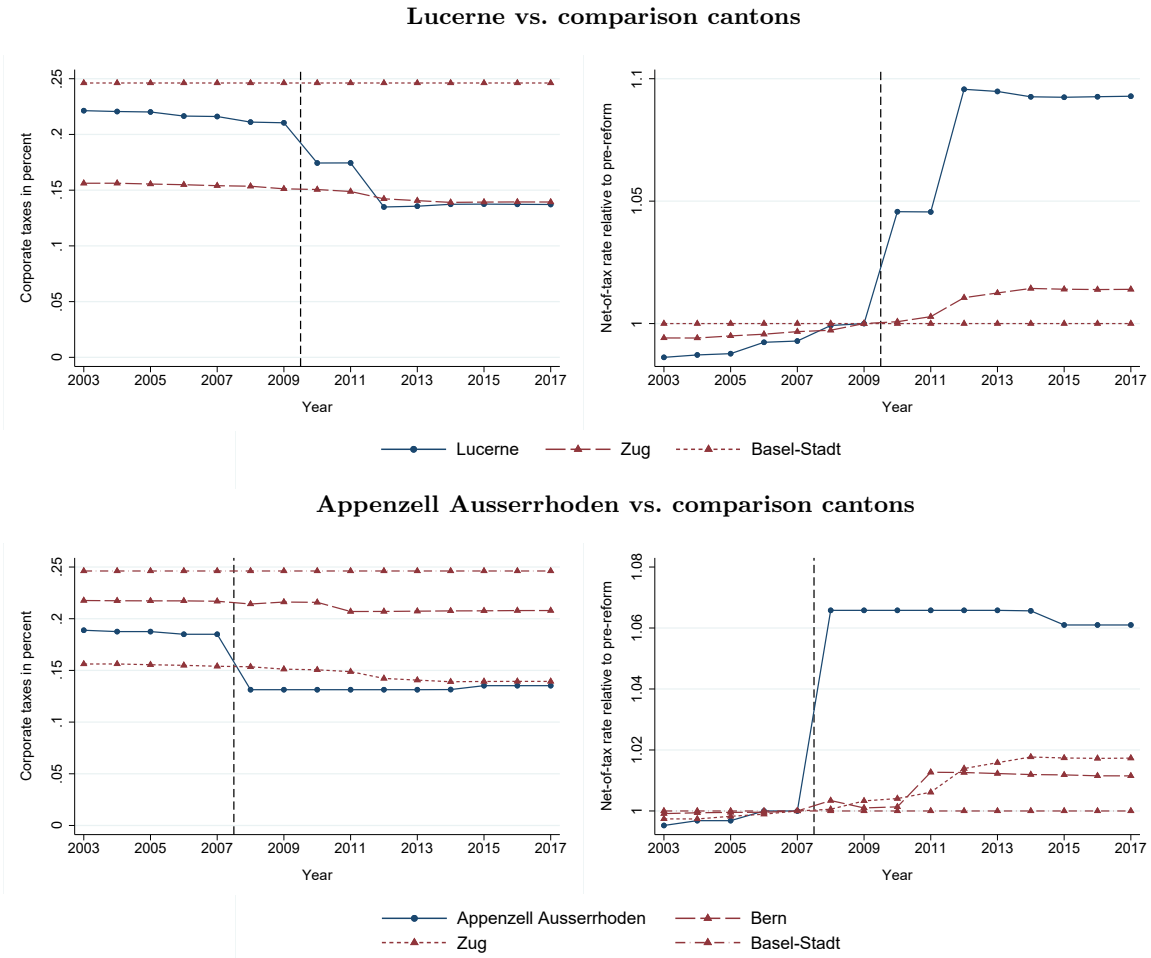

Figure 2: This graph displays the evolution of corporate tax rates and net-of-tax rates in the treated and comparison cantons used to construct synthetic controls for our two experiments. The upper panels show tax and net-of-tax rates for the Lucerne experiment, the lower panels for the Appenzell Ausserhoden experiment. Synthetic Lucerne consists of the cantons of Zug (75.4%) and Basel-Stadt (24.6%). Synthetic Appenzell Ausserrhoden consists of the cantons of Bern (36.0%), Zug (42.7%) and Basel-Stadt (21.4%). The left-hand panels show tax rates in absolute value. The right-hand panels show the implied net-of-tax rates scaled to their value in the pre-tax reform period.

In our case, we include the cantons of Zurich, Bern, Zug, Basel-Stadt, Ticino, and Jura in this group. Besides corporate profits, the construction of the synthetic control group takes corporate and personal tax rates as well as population and the canton's score attained in the national fiscal transfer scheme into account.[12] In the end, the combination of comparison cantons that best resembles Lucerne in years prior to 2010 consists of the canton of Zug with a share of 75.4% and Basel-Stadt with a share of 24.6%, whereas the combination that best resembles Appenzell Ausserrhoden in years prior to 2008 consists of Bern (36.0%), Zug (42.7%), and Basel-Stadt (21.4%).

Lucerne lowered its corporate tax rate first in 2010 from 21.0% to 17.4%, and in 2012 to 13.5%.[13] Both steps were part of a broader tax strategy crafted in 2006, which, among other things, aimed to put Lucerne among the five most attractive cantons in terms of corporate

[12] A canton's score reflects the amount of taxable resources per capita.

[13] Cantonal effective tax rates are corporate-income weighted averages across municipalities.

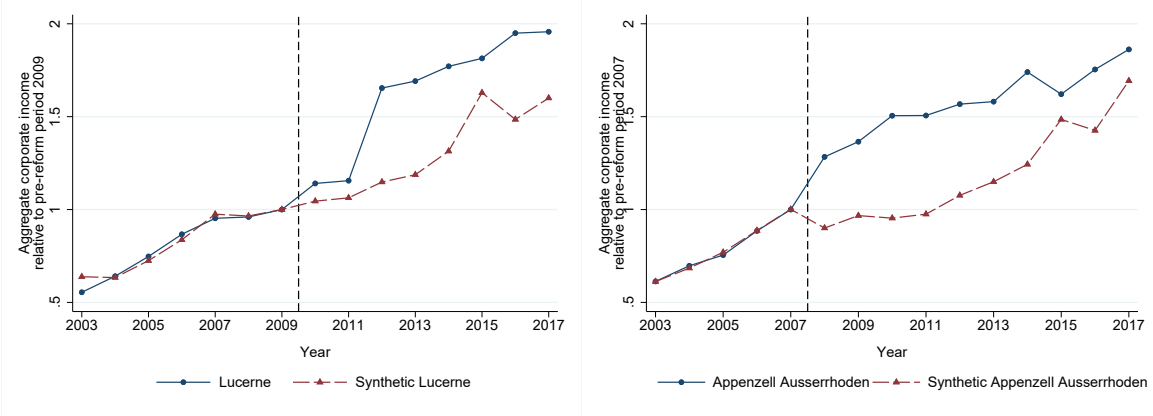

Figure 3: Aggregate corporate income in treated cantons vs. synthetic counterfactuals relative to pre-reform year 2009. The synthetic unit is a weighted average of corporate incomes from a donor pool of cantons with no large tax reform, with weights chosen to match the evolution of aggregate corporate income in pre-reform years.

taxes. Both reforms were subject to a popular referendum. 77% of voters approved the first step of the tax decrease in March 2007 and 68% approved the second step in September 2009. As indicated in the upper panel of Figure 2, corporate taxes in Lucerne decreased by nearly 7.6 percentage points over three years, which corresponds to an increase in the net-of-tax rate by 9.6%.

The lower panel of Figure 2 visualizes the reduction in Appenzell Ausserrhoden's corporate tax rate in 2008 from 18.5% to 13.1%, which implied an increase in the net-of-tax rate by 6.6%. The canton's voters approved the tax reform in a popular referendum in October 2007 with 76% against 24%.

Whether Lucerne's corporate tax reform was a success or not has dominated the canton's political debates for years. On the one hand, aggressively lowering taxes may have deprived the canton of financial means to provide public services.[14] On the other hand, Lucerne's improved attractiveness as a business location may enhance its public finances and other economic outcomes in the long run. In 2016, there was a referendum on whether to undo the second tax cut by half, which was voted down.

The left panel of Figure 3 shows that the reform had an enormous effect on reported corporate income. Whereas the first tax reduction in 2010 induced only a small differential between corporate income in Lucerne and in synthetic Lucerne by around 10 percentage points, this differential jumped to 50 percentage points after the second reduction in 2012. Given an increase in the net-of-tax rate by 9.6%, this implies an elasticity of taxable corporate income of up to 5.3.

The response in Appenzell Ausserrhoden even exceeds the already sizeable response in Lucerne. The right panel of Figure 3 shows that the differential between the treated and the synthetic unit fluctuated between around 40 and 55 percentage points during seven years following the tax reform and decreased afterwards. Relative to an increase in the net-of-tax rate of 6.6%, this implies an elasticity of up to 8.4. In both, Lucerne and Appenzell

[14] In fall 2016, the canton shut down its schools for a week, which appeared to confirm such concerns, see https://www.srf.ch/news/schweiz/luzerner-schueler-muessen-ferien-machen.

Ausserrhoden, we observe fluctuations and a decline in the gap between the treated and the control unit starting at around five years after the reform.

An analysis of official information booklets provided to citizens prior to the vote shows no evidence that the governments anticipated an increase in corporate income which enabled them to lower corporate taxes. The tax cuts were touted to the voters with the argument of positioning the respective canton as an attractive business location. Based on this narrative examination (see Romer and Romer, 2010), we find no evidence to substantiate endogeneity concerns regarding our SCM.

These cantonal-level estimates show clear evidence of a "smoking gun". The synthetic control methodology comes with the caveats that there might be direct spillovers from corporate tax reforms to other cantons in our control groups. In the following section, we will corroborate our finding of a large elasticity using the comprehensive set of municipality-level data. We will rely on the distributed-lag model, which, similarly to the synthetic control method, allows to inspect pre-trends to examine causality.

5 Distributed-lag model

In this section, we make use of the sizeable panel variation in corporate tax rates across Swiss municipalities.[15] Rather than focusing on large experiments at the cantonal level as above in Section 4, we now exploit all events independent of their size. Our methodology relies on work by Schmidheiny and Siegloch (2020), who demonstrate that a distributed-lag model with binned treatment dummies is a natural generalization of the standard event-study model with multiple events of different magnitudes. We estimate the equation

$$\ln y_{jt} = \sum_{k=-2}^{4} \gamma_k \ln(1 - ETR_{j,t-k}) + \lambda_t + \mu_j + \psi_t \cdot x_j + \varepsilon_{jt}, \tag{1}$$

where y_{jt} is aggregate corporate income and $ETR_{j,t-k}$ is the corporate tax rate in municipality j and year t. We include controls for time fixed effects λ_t and municipality fixed effects μ_j. We further include municipality-specific personal tax rates and corporate tax rates in surrounding municipalities in the initial year in a vector x_j, which we interact with a vector of year fixed effects to allow for heterogeneous responses to aggregate shocks.[16] We allow for the standard errors to be correlated across municipalities within cantons because most variation in tax rates emerges at the cantonal level.

[15] Using the data from Staubli (2018), Burgherr (2020) also used a distributed-lag model to estimate the corporate elasticity of taxable income in Switzerland.

[16] We construct the personal and corporate tax rates in surrounding municipalities by taking the population-weighted average of all municipalities within 20 minutes road distance. This is, according to Eugster and Parchet (2019), the spatial reach of tax competition.

The distributed-lag coefficients give rise to the cumulative effect after k years

$$\beta_k = \begin{cases} -\sum_{m=k+1}^{-1} \gamma_m, & \text{if } -3 \leq k \leq -2 \\ 0 & \text{if } k = -1 \\ \sum_{m=0}^{k} \gamma_m, & \text{if } 0 \leq k \leq 3, \end{cases} \tag{2}$$

where the coefficients β_k capture the cumulative response of taxable corporate income to changes in tax rates relative to the year prior to the change $k = -1$, for which we normalize $\beta_{-1} = 0$. Note that we bin the event-time dummies at $k = -3$ for more than three years prior to and at $k = 3$ for events more than three years after the event of interest, which allows us to also include events outside the event-time window. $\beta_k = -3$ hence picks up the effect for all $j \leq -3$, while $\beta_k = 3$ picks up the effect for all $j \geq 3$. Since we take logs both on the left-hand side and the right-hand side of equation (1), we can interpret our coefficients of interest β as elasticities.

The top left-hand panel of Figure 4 displays how the implied tax-base response unfolds over time between three years before and three years after tax reform. The flat pre-trends in this figure support our identifying assumption that municipalities do not adjust their tax rates in response to prior shocks to the tax base. We observe a substantial response with an implied elasticity of 3.5 in total. About half of the effect happens in the year of the tax change itself. The full effect takes about two years to accumulate. Whether we include controls for personal tax rates and for corporate tax rates in neighboring municipalities does not affect our results.

In the top right-hand panel of Figure 4, we distinguish between municipalities by proximity to Switzerland's five largest airports. For each municipality in our data, we compute the road travel distance to the closest municipality which hosts an airport with more 100,000 passengers per year. We construct two groups, one with municipalities below the median in terms of the distance to the nearest airport and the other with municipalities above the median.[17] This variable not only picks up transport connection of a municipality, which is itself economically important. It also proxies for proximity to urban centers with their associated agglomeration effects.

We observe that the effect is concentrated among municipality farther away from airports and urban centers. In remote municipalities, the CETI attains a value of nearly 4.7, whereas in more central locations, the CETI is not statistically significantly different from zero. This finding is in line with previous research which shows that agglomeration economies mitigate tax competition (Brülhart *et al.*, 2012, 2015). Intuitively, Zurich, Geneva, or Basel, each with large industries specialized in the financial or pharmaceutical sectors, have more room to play around with their tax rates without inducing firms to reduce their activity than more remote municipalities.

In the middle and bottom panels of Figure 4, we repeat the above analysis, but in the middle, we only use corporate income in municipalities with a group of super stayer firms

[17]These airports are located in Kloten near Zurich, Le Grand-Saconnex/Meyrin near Geneva, Hésingue/Saint-Louis in France near Basel, Belp near Bern and in Lugano.

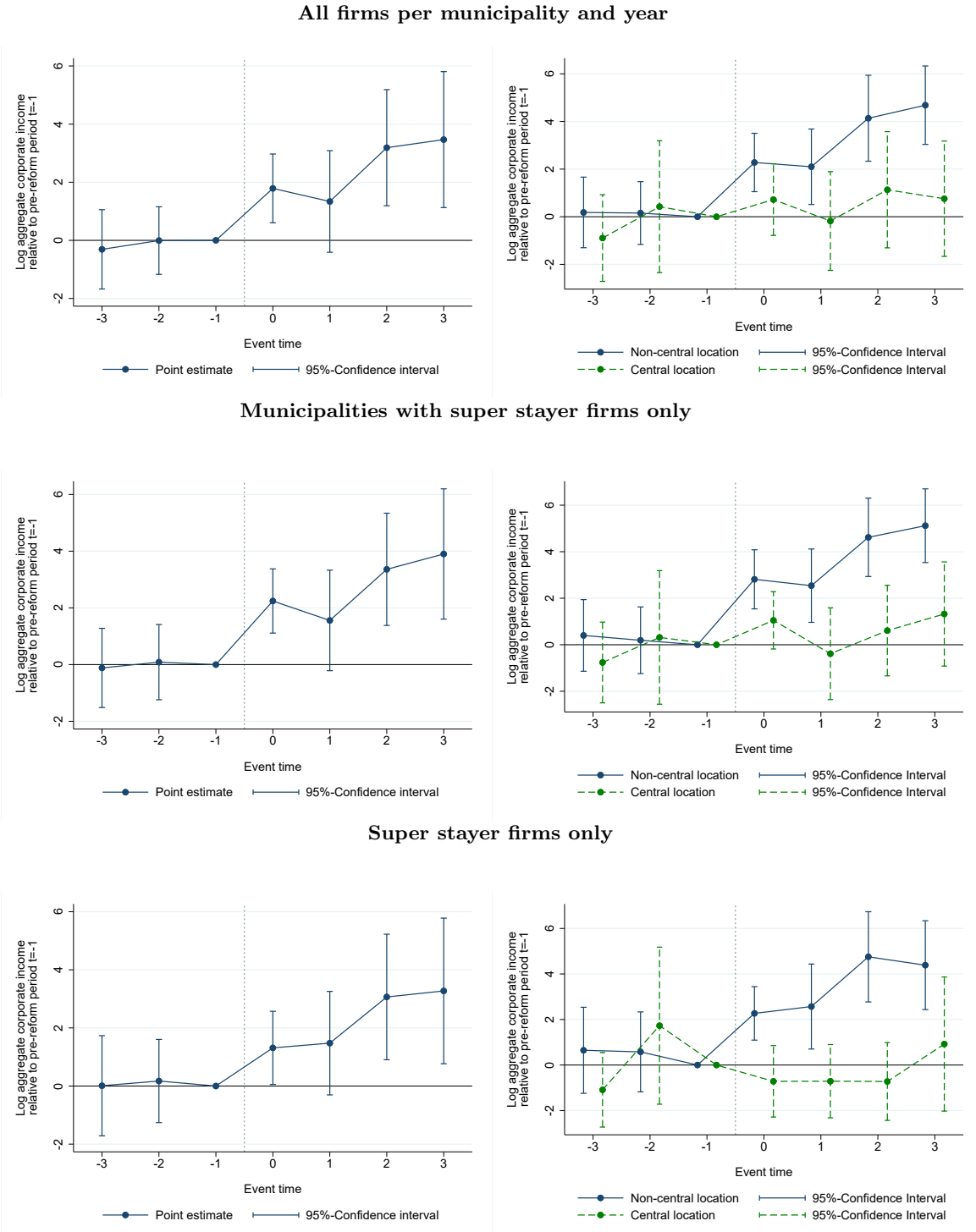

Figure 4: Distributed-lag cumulative effects according to equation (2), estimated through the first-differences empirical model (1) with nonparametric controls for initial personal taxes and corporate taxes in neighboring municipalities for all changes in corporate tax rates. The upper panel uses municipality-year aggregates of corporate income of all firms subject to regular taxation. The lower panels only takes corporate income generated by a group of super stayer firms that we observe in all years of our sample period into account. Effects are the cumulated coefficients after and before the reference year, i.e. one year prior to the event. Standard errors clustered at canton level. The estimated effects correspond to elasticities and can be found in Appendix Table A1.

and in the bottom panel we only use corporate income of these super stayers. We define super stayers as firms that we observe in all years in the same municipality throughout our sample period. This allows us to eliminate relocation of legal entities, firm birth and firm death as potential margins. In this specification, the entire effect is arguably due to changes in reported corporate income. Comparing the results in the middle and bottom panels, we conclude that around one sixth of the elasticity is related to firm birth, death, and mobility.

6 Discussion and conclusion

The results of this study suggest that the impact of corporate tax rate changes on corporate income is significant. Our baseline estimate of the corporate elasticity of taxable income with respect to the net-of-tax rate is 3.5. Agglomeration economies in urban centers mitigate the elasticity. Firm birth, death, and mobility only account for around one sixth of this effect. This suggests that real investment responses play a role. Part of the observed magnitudes may, however, be related to internal profit shifting across legal entities within a corporation. Changes in corporate income across legal entities within corporations may, however, also reflect real responses such as reorganization of departmental activities.

An alternative specification would be to perform the same analysis as above but with respect to changes in the tax rate instead of changes in the net-of-tax rate. Because net-of-tax rates are around 4 times as large as tax rates, this would yield an elasticity with respect to the tax rate of around -0.75. This implies that a 1% increase in the municipal corporate tax rate would lead to a decrease in aggregate corporate income by around 0.75%. As mentioned above, this magnitude is similar to the findings of Riedl and Rocha-Akis (2012), who use this specification. Note, however, that the mean corporate tax rates in Riedl and Rocha-Akis's sample is around twice as large as in our sample. Their results, hence, imply elasticities with respect to the net-of-tax rate that are less than half as large as ours. Despite the large magnitude of this estimate, Swiss municipalities are still on the increasing part of the Laffer curve where tax cuts don't finance themselves. An increase in the corporate tax rate by 1% would still translate into an increase in corporate tax revenue by about 0.25%.[18]

Our estimates exceed previous findings in the literature (Gruber and Rauh, 2007; Dwenger and Steiner, 2012; and Coles *et al.*, 2019). As already mentioned, it is, however, in a similar range as the estimate in Riedl and Rocha-Akis (2012), the methodologically most closely related paper. Their baseline estimate of the elasticity with respect to the tax rate of -0.8 is based on OECD country-level data, which is a much larger scale than Swiss municipalities. While one might expect to find more intense tax competition at the smaller geographical scale of Swiss municipalities compared to cross-country settings, our study does not suffer from a potential upward bias due to non-harmonized tax bases.

The estimated response to the two major corporate tax reforms is a bit stronger than what is implied by the elasticity estimate from the distributed-lag model. This difference may partly reflect a bias in the synthetic control analysis resulting from treated cantons attracting

[18]Note that the cantonal tax burden is only a share of the total tax burden. Thus, for tax cuts to be self-financing from the a canton's point of view, a tax-rate elasticity way beyond -1 is required.

corporate income from control group cantons. The difference is, however, also in line with previous research on tax sensitivities. First, it is consistent with estimates on behavioral responses to wealth taxes where larger tax cuts are found to have a disproportionately strong impact (Brülhart *et al.*, 2019). Second, behavioral responses increase with the salience of taxes (documented by Chetty *et al.*, 2009, for sales taxes). The tax cuts we analyze within the SCM framework were particularly salient. Not only because they were large in magnitude, but also because both Lucerne and Appenzell Ausserrhoden offered the lowest corporate tax rates in Switzerland right after the implementation of their tax reforms.

References

Abadie, Alberto, "Using synthetic controls: Feasibility, data requirements, and methodological aspects," *Journal of Economic Literature*, 2020, *forthcoming.*

_ , Alexis Diamond, and Jens Hainmueller, "Synthetic control methods for comparative case studies: Estimating the effect of California's tobacco control program," *Journal of the American statistical Association*, 2010, *105* (490), 493–505.

_ and Javier Gardeazabal, "The economic costs of conflict: A case study of the Basque Country," *American economic review*, 2003, *93* (1), 113–132.

Bachas, Pierre and Mauricio Soto, "Not(ch) your average tax system : corporate taxation under weak enforcement," Policy Research Working Paper 8524, World Bank 2018.

Bartelsman, Eric J. and Roel M.W.J. Beetsma, "Why pay more? Corporate tax avoidance through transfer pricing in OECD countries," *Journal of Public Economics*, 2003, *87* (9), 2225–2252.

Boonzaaier, Wian, Jarkko Harju, Tuomas Matikka, and Jukka Pirttilä, "How do small firms respond to tax schedule discontinuities? Evidence from South African tax registers," *International Tax and Public Finance*, 2019, *26* (5), 1104–1136.

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

_ and Raphaël Parchet, "Alleged tax competition: The mysterious death of bequest taxes in Switzerland," *Journal of Public Economics*, 2014, *111*, 63–78.

_ , Jonathan Gruber, Matthias Krapf, and Kurt Schmidheiny, "Behavioral Responses to Wealth Taxes:Evidence from Switzerland," Discussion Paper 14054, CEPR 2019.

_ , Mario Jametti, and Kurt Schmidheiny, "Do agglomeration economies reduce the sensitivity of firm location to tax differentials?," *The Economic Journal*, 2012, *122* (563), 1069–1093.

_ , **Sam Bucovetsky, and Kurt Schmidheiny**, "Taxes in cities," in "Handbook of regional and urban economics," Vol. 5, Elsevier, 2015, pp. 1123–1196.

Burgherr, David, "Dynamic Effects of Corporate Tax Changes on Corporate Income: Evidence from Switzerland," *Workshop at University of Bern*, 2020.

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

Coles, Jeffrey L., Elena Patel, Nathan Seegert, and Matt Smith, "How Do Firms Respond to Corporate Taxes?," mimeo, University of Utah 2019.

Devereux, Michael P. and Rachel Griffith, "Evaluating tax policy for location decisions," *International Tax and Public Finance*, 2003, *10* (2), 107–126.

_ , **Li Liu, and Simon Loretz**, "The elasticity of corporate taxable income: New evidence from UK tax records," *American Economic Journal: Economic Policy*, 2014, *6* (2), 19–53.

Dharmapala, Dhammika and Nadine Riedel, "Earnings shocks and tax-motivated income-shifting: Evidence from European multinationals," *Journal of Public Economics*, 2013, *97*, 95–107.

Dwenger, Nadja and Viktor Steiner, "Effective profit taxation and the elasticity of the corporate income tax base: evidence from German corporate tax return data," *National Tax Journal*, 2012, *65* (1), 117–150.

Egger, Peter, Wolfgang Eggert, and Hannes Winner, "Saving taxes through foreign plant ownership," *Journal of International Economics*, 2010, *81* (1), 99–108.

Eugster, Beatrix and Raphaël Parchet, "Culture and taxes," *Journal of Political Economy*, 2019, *127* (1), 296–337.

Feld, Lars P., Gebhard Kirchgässner, and Christoph A. Schaltegger, "Decentralized taxation and the size of government: evidence from Swiss state and local governments," *Southern Economic Journal*, 2010, *77* (1), 27–48.

_ , _ , **and** _ , "Municipal debt in Switzerland: new empirical results," *Public Choice*, 2011, *149* (1), 49–64.

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

_ **and Joshua Rauh**, "How elastic is the corporate income tax base?," in Alan J. Auerbach, James R. Hines Jr., and Joel Slemrod, eds., *Taxing corporate income in the 21st century*, Cambridge University Press, 2007, chapter 4, pp. 140–163.

Heckemeyer, Jost H. and Michael Overesch, "Multinationals' profit response to tax differentials: Effect size and shifting channels," *Canadian Journal of Economics*, 2017, *50* (4), 965–994.

Hines Jr., James R. and Eric M. Rice, "Fiscal paradise: Foreign tax havens and American business," *The Quarterly Journal of Economics*, 1994, *109* (1), 149–182.

Huizinga, Harry and Luc Laeven, "International profit shifting within multinationals: A multi-country perspective," *Journal of Public Economics*, 2008, *92* (5), 1164–1182.

Kawano, Laura and Joel Slemrod, "How do corporate tax bases change when corporate tax rates change? With implications for the tax rate elasticity of corporate tax revenues," *International Tax and Public Finance*, 2016, *23* (3), 401–433.

Kleven, Henrik Jacobsen, Camille Landais, and Emmanuel Saez, "Taxation and international migration of superstars: Evidence from the European football market," *American economic review*, 2013, *103* (5), 1892–1924.

Kumar, Anil and Che-Yuan Liang, "Estimating taxable income responses with elasticity heterogeneity," *Journal of Public Economics*, 2020, *188*.

Parchet, Raphaël, "Are Local Tax Rates Strategic Complements or Strategic Substitutes?," *American Economic Journal: Economic Policy*, 2019, *11* (2), 189–224.

Portmann, Marco and David Staubli, "Entwicklung der Steuerbelastung der juristischen Personen in den Gemeinden von 2003 bis 2020," *Bericht Eidgenössische Steuerverwaltung*, 2020.

Riedl, Aleksandra and Silvia Rocha-Akis, "How elastic are national corporate income tax bases in OECD countries? The role of domestic and foreign tax rates," *Canadian Journal of Economics*, 2012, *45* (2), 632–671.

Roller, Marcus and Kurt Schmidheiny, "Effective tax rates and effective progressivity in a fiscally decentralized country," *CESifo Working Paper Series*, 2016, (5834).

Romer, Christina D. and David H. Romer, "The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks," *American Economic Review*, 2010, *100* (3), 763–801.

Rubolino, Enrico and Daniel Waldenström, "Tax progressivity and top incomes evidence from tax reforms," *The Journal of Economic Inequality*, 2020, *18*, 261—289.

Schmidheiny, Kurt, "Emerging Lessons from Half a Century of Fiscal Federalism in Switzerland," *Swiss Journal of Economics and Statistics*, 2017, *153* (2), 73–101.

_ **and Michaela Slotwinski**, "Tax-induced mobility: Evidence from a foreigners' tax scheme in Switzerland," *Journal of Public Economics*, 2018, *167* (C), 293–324.

_ **and Sebastian Siegloch**, "On event studies and distributed-lags in two-way fixed effects models: Identification, equivalence, and generalization," Discussion Papers 20-017, ZEW 2020.

Staubli, David, "The Elasticity of Corporate Income: Panel Data Evidence from Switzerland," Working Paper 18.01, Université de Lausanne, Faculté des HEC, Département d'économie 2018.

Table A1: Elasticity estimates distributed-lag model.

	All firms		Super stayer muni's		Super stayers	
	(1)	(2)	(3)	(4)	(5)	(6)
Event −3	-0.309	0.181	-0.118	0.400	0.010	0.648
	(0.697)	(0.756)	(0.713)	(0.786)	(0.879)	(0.964)
Event −2	-0.007	0.155	0.086	0.193	0.173	0.577
	(0.593)	(0.673)	(0.677)	(0.731)	(0.730)	(0.896)
Event 0	1.788***	2.278***	2.242***	2.813***	1.314**	2.269***
	(0.603)	(0.625)	(0.577)	(0.648)	(0.642)	(0.600)
Event +1	1.338	2.099***	1.557*	2.540***	1.476	2.569***
	(0.892)	(0.808)	(0.904)	(0.805)	(0.909)	(0.953)
Event +2	3.189***	4.135***	3.359***	4.618***	3.065***	4.754***
	(1.020)	(0.920)	(1.010)	(0.860)	(1.102)	(1.011)
Event +3	3.467***	4.682***	3.900***	5.118***	3.273**	4.387***
	(1.194)	(0.840)	(1.172)	(0.808)	(1.278)	(0.996)
Event −3 · central		-0.895		-0.762		-1.090
		(0.928)		(0.885)		(0.835)
Event −2 · central		0.423		0.316		1.728
		(1.413)		(1.466)		(1.760)
Event 0 · central		0.721		1.050		-0.717
		(0.767)		(0.629)		(0.801)
Event +1 · central		-0.179		-0.385		-0.711
		(1.057)		(1.006)		(0.821)
Event +2 · central		1.133		0.608		-0.724
		(1.244)		(0.993)		(0.872)
Event +3 · central		0.757		1.322		0.921
		(1.236)		(1.142)		(1.503)
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Initial corp. tax neighb. × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Initial personal taxes × year FE	Yes	Yes	Yes	Yes	Yes	Yes
N municipalities	2,230	2,230	2,129	2,129	2,129	2,129
N	32,520	32,520	30,041	30,041	30,041	30,041

Notes: Event study estimates of the elasticity of the corporate income tax base relative to the year prior to tax reform. The interaction terms with childcare (*central*) indicate differences in elasticities between remote and centrally located municipalities. Controls if indicated include corporate tax rates in neighboring municipalities (<20 km) in 2003 interacted with year fixed effects and personal tax rates (on personal income and wealth) in 2003 interacted with year fixed effects. Standard errors are clustered at canton level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.