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Behavioral Responses to Wealth Taxes: Evidence from Switzerland[†]

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We study how declared wealth responds to changes in wealth tax rates. Exploiting rich intranational variation in Switzerland, we find a 1 percentage point drop in a canton's wealth tax rate raises reported taxable wealth by at least 43 percent after 6 years. Administrative tax records of two cantons with quasi-randomly assigned differential tax reforms suggest that 24 percent of the effect arises from taxpayer mobility and 21 percent from a concurrent rise in housing prices. Savings responses appear unable to explain more than a small fraction of the remainder, suggesting sizable evasion responses in this setting with no third-party reporting of financial wealth. (*JEL* D91, H24, H26, H31)

The rise in inequality seen in many developed nations over the past four decades has spurred new interest in the taxation of wealth. Inequality has increased in terms of both income (Atkinson, Piketty, and Saez 2011) and wealth (Piketty 2014; Saez and Zucman 2016). This has led economists to advocate higher taxation of wealth levels, either annually or at death. Most prominently, Piketty, Saez, and Zucman (2013) have proposed the adoption of an "ideal" combination of taxes on capital, covering annual net worth in addition to capital income and bequests.

Yet, there still exists only limited evidence on the behavioral responses triggered by recurrent wealth taxation. The lack of evidence has been seen by some

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economists as a cause for caution. For example, according to McGrattan (2015, 6), "without a quantitatively valid theory or previous experience with taxing financial wealth, economists cannot make accurate predictions about the impact that such taxes will have on either aggregate wealth or its dispersion. Thus, any proposals to tax wealth are, at this point, premature." Auerbach and Hassett (2015, 41) "find little support for Piketty's particular approach … elsewhere in the literature." Indeed, depending on the relative strength of income and substitution effects as well as of avoidance options, even the sign of the response may be indeterminate (Ring 2021).

There are a host of studies to show that reported income is only modestly elastic with respect to income taxation (see Saez, Slemrod, and Giertz 2012 for a review). Ex ante, it is unclear whether taxable wealth will be more or less elastic than taxable income. On the one hand, for most taxpayers, income is predominantly labor income, which is at least partially in the control of their employers and not themselves, while wealth levels are arguably more fully in the control of the taxpayer. Moreover, labor income for the employed is easier for tax authorities to monitor than are wealth levels. On the other hand, most taxpayers hold much of their wealth in illiquid form (their home), and that is hard to adjust as tax rates change, at least in the short term. The mere fact that wealth is a stock and income is a flow may make adjustments to taxable wealth more difficult than adjustments to taxable income.

Compared to research on the response of income to taxation, there has been less work on the response of wealth to taxation. This to some extent reflects that many countries tax only the very wealthiest individuals, and administrative data on wealth holdings are not available below the taxable threshold, making it difficult to measure behavioral responses. A recent literature on this topic has begun to emerge and has already informed high-profile policy evaluation (Saez and Zucman 2019a,b).

The main current user of wealth taxes, and therefore in some respects the most propitious laboratory for studying their effects, is Switzerland. As shown in Table 1, recurrent taxes on private wealth account for 3.9 percent of tax revenue in Switzerland, followed at some distance by Norway (1.1 percent) and Spain and France (both 0.5 percent). Wealth taxes have in recent years been losing political support: Table 1 shows that of the 13 Organisation for Economic Co-operation and Development (OECD) nations that had raised recurrent taxes on wealth in 1995, only 4 still did so in 2018.

Switzerland is an interesting case also in terms of the reach of its wealth taxes and availability of data: Swiss wealth tax schedules have very low exemption levels in international comparison, and data are available for all households. Importantly, these taxes are all raised at the cantonal and municipal levels, with no centralized federal wealth taxation. This leads to sizable intranational variation across jurisdictions and over time.

We exploit two complementary datasets that allow us to study how wealth responds to taxation. The first dataset contains aggregate taxable wealth by canton and wealth bracket over the period 2003–2015. This allows us to consider aggregate responses of wealth holdings—the ultimate response of policy interest—to rich intercantonal time variation in wealth tax levels. These aggregate data do not, however, allow us to investigate the mechanisms through which wealth changes as tax rates change. We therefore supplement them with individual-level tax records from

Table 1—Wealth Taxes in OECD Countries

	1995	2000	2005	2010	2015	2018
Switzerland	2.86	3.09	3.36	3.40	3.62	3.88
Norway	1.31	1.09	1.02	1.12	1.08	1.15
Iceland	1.16	0.00	0.00	0.00	0.00	0.00
Netherlands	0.55	0.49	0.03	0.01	0.00	0.00
Spain	0.53	0.65	0.52	0.21	0.53	0.53
Sweden	0.41	0.69	0.36	0.00	0.00	0.00
Germany	0.26	0.02	0.01	0.00	0.00	0.00
France	0.25	0.38	0.40	0.53	0.52	0.17
Italy	0.21	0.00	0.00	0.00	0.00	0.00
Denmark	0.19	0.00	0.00	0.00	0.00	0.00
Finland	0.08	0.28	0.18	0.00	0.00	0.00
Austria	0.06	0.00	0.00	0.00	0.00	0.00
Greece	0.05	0.00	0.00	0.00	0.00	0.00

Note: In percent of total tax revenue; only OECD countries that had nonzero wealth taxes in 1995.

Sources: Organisation for Economic Co-operation and Development (1990–2019), code 4210, Individual Recurrent Taxes on Net Wealth

two cantons, Lucerne and Bern, over the period 2005–2015. In these data, we can disaggregate the response of taxable wealth. We track how various components of aggregate reported wealth evolved following a cut by half of Lucerne's wealth tax rate in 2009, relative to the evolution in Bern, where wealth taxes were simultaneously cut only by some 14 percent.

We find that reported wealth holdings in Switzerland are very responsive to wealth taxation. According to our baseline estimate, identified over all canton-level tax changes in our sample, a 1 percentage point drop in the top wealth tax rate raises reported wealth by 43 percent. The largest tax cuts are followed by even larger responses, in excess of 100 percent. However, even the largest observed responses do not seem to have implied Laffer revenue effects. Our finding of strong responses is robust to variations of the empirical model and appears fairly constant throughout the wealth distribution.

In the second part of the paper, we explore possible mechanisms of adjustment. To do so, we analyze individual-level tax records for Lucerne and Bern, exploiting the fact that Lucerne cut its wealth tax by half in 2009, whereas Bern only adopted a modest reform. The difference between the two cantons' policies can be considered quasi-random, as it hinged on a marginal decision against a larger reform in Bern made possible by a direct-democratic instrument that exists in Bern but not in Lucerne.

The Lucerne tax cut triggered a very large response, implying a semielasticity with respect to a 1 percentage point tax cut of 187 percent. We find that this aggregate response can be decomposed as follows: up to 6 percent of the response can be attributed to increased savings, including the mechanical effect of lower wealth taxation; some 24 percent can be attributed to net taxpayer migration; some 21 percent can be attributed to a concurrent rise in housing prices; and some 49 percent can be attributed to changes in taxable financial assets of immobile taxpayers. Considering the fact that financial wealth is self-reported in Switzerland, and in

view of our findings (i) that bunching responses to exemption thresholds are larger in Switzerland than in other countries while (ii) earnings do not seem to respond to wealth taxation, the most plausible explanation for the strong response by financial assets of nonmovers are changes in evasion behavior.

Our paper proceeds as follows. We begin in Section I with a review of the related literature. Section II describes the Swiss institutional context. Section III presents our data. In Section IV, we show our results from the aggregate cross-canton data analysis, while Section V shows a detailed analysis of a particularly large cut to a cantonal wealth tax rate. In Section VI, we consider implied effects on wealth tax revenues. Section VII concludes.

I. Related Literature

Other researchers have recently sought to quantify behavioral responses to wealth taxation, as reviewed by Scheuer and Slemrod (2021). We summarize the main results of the relevant empirical studies in Table 2.

This literature has taken two approaches. One approach is to analyze the bunching of reported wealth at discontinuities in tax schedules (Seim 2017; Londoño-Vélez and Ávila-Mahecha 2019). This approach yields small elasticity estimates. Bunching-based estimates, however, have been shown to be potentially less revealing of long-run (frictionless) responses than reform-based estimates (Kleven and Schultz 2014). Jakobsen et al. (2020) argue that bunching is particularly likely to underestimate real behavioral responses with respect to wealth taxation since changes in wealth depend to a large extent on asset prices that are uncertain and exogenously determined.

Other researchers use difference-in-difference analysis of changes in wealth tax schedules, comparing taxpayers who are affected differently by these changes for reasons that are arguably unrelated to their subsequent responses (Zoutman 2018; Jakobsen et al. 2020; Durán-Cabré, Esteller-Moré, and Mas-Montserrat 2019). These studies find responses that are an order of magnitude larger than the bunching-based analyses, with semielasticities of reported wealth with respect to a 1 percentage point wealth tax cut ranging from 14 percent to 32 percent. All three studies use data from countries where wealth taxation is limited to large fortunes, mostly in the top 1 percent wealth bracket.

In this paper, we apply difference-in-difference estimation methods not based on how differently affected taxpayers react to a single policy reform, but through comparisons of policy reforms with different magnitudes and timings across Swiss cantons.[1] Our study is unique in that it can draw on within-country variation, which allows us to estimate moving responses and consider the impact of wealth taxes and

[1] In an earlier version of this paper (Brülhart et al. 2016), we employed similar panel-data estimation using variations across municipalities within one canton (Bern). This yielded a baseline semielasticity estimate of 23 percent. However, the relatively small municipality-level tax changes did not offer much statistical power. This is why we now focus entirely on between-canton comparisons. In Brülhart et al. (2016), we also reported cross-canton estimates. Those estimates are updated and extended in Section IV of this paper.

Table 2—Estimates of the Aggregate Response of Taxable Wealth

Citation	Country	Wealth bracket	Time horizon	Semielasticity	Identification
Seim (2017)	Sweden	top 4%	n.a.	0.3%	bunching at tax kink
Londoño-Velez and Ávila-Mahecha (2019)	Colombia	top 1%	1 year	0.6–2%	bunching at tax notch after policy change
Zoutman (2018)	Netherlands	n.a.[a]	4 years	14%	diff-in-diff on change in tax schedule
Jakobsen et al. (2020)	Denmark	top 1%	8 years	25%	diff-in-diff on change in tax schedule
	Denmark	98–99%	8 years	17%	diff-in-diff on change in tax schedule
Durán-Cabré, Esteller-Moré, and Mas-Montserrat (2019)	Catalonia, Spain	top 1%	4 years	32%	diff-in-diff on change in tax schedule
Brülhart et al. (2016)	Switzerland	top 34%[b]	5 years[c]	34%	diff-in-diff on change in canton tax rates
	Bern, Switzerland	top 34%[b]	5 years[c]	23%	diff-in-diff on change in municipal tax rates
This paper	Switzerland	top 34%[b]	5 years	43%	diff-in-diff (dynamic effects) on change in canton tax rates
	Switzerland	top 34%[b]	5 years	96%	diff-in-diff (dynamic effects) on change in canton tax rates (largest changes only)

Notes: Estimated elasticities expressed as percentage effect on taxable wealth of a 1 percentage point wealth tax cut.

[a] The Dutch wealth tax affected net wealth above €17,000. The paper does not state the share of taxpayers with net wealth above that threshold.

[b] According to the Lucerne and Bern microdata, 34 percent of all taxpayer–year observations involved net wealth above taxable thresholds.

[c] The estimates are based on a ten-year panel of data, which means that the average postreform time horizon is around five years.

other taxes jointly.[2] Moreover, we are able to quantify the share of the aggregate response accounted for by the migration channel, in a setting where taxation affects not just the very wealthiest taxpayers but the top three deciles of the wealth distribution. This allows us to produce some of the "still lacking systematic evidence on the mobility elasticities of the broader population" (Kleven et al. 2020, 21).

Using intranational spatial variation in taxation to identify our estimated effects has the advantage of allowing more plausible ceteris paribus comparisons than cross-country comparisons, as there are fewer institutional and economic confounds that need to be controlled for. Taxation in Switzerland has therefore been used before to estimate behavioral responses to, e.g., income taxes (Eugster and Parchet 2019; Schmidheiny and Slotwinski 2018) or bequest taxes (Brülhart and Parchet 2014). However, given the small size of Swiss cantons, this setting will tend to imply larger mobility responses than what could be expected in the context of country-level tax

[2] Martinez (2022) estimates elasticities of the stock of wealthy taxpayers following a cut in top income and wealth tax rates in the Swiss canton of Obwalden. That empirical setting does not allow separate identification of the effect of wealth taxes.

policies. We address this to some extent below by studying mobility responses to wealth taxation specifically.

Our work also relates to research on the impact of estate taxation on wealth holdings. This small literature is reviewed in Kopczuk (2009). There are several studies from the United States, using either cross-sectional variation in estate taxes across states (Holtz-Eakin and Marples 2001), national tax reforms interacted with age (Kopczuk and Slemrod 2001), or aggregate time series (Joulfaian 2006). These studies reach similar conclusions of a modest elasticity of the taxable base of estates with respect to the tax rate of between -0.1 and -0.2. In a recent paper, Ring (2021) examines the impact of quasi-random changes in housing wealth assessments across Norwegian municipalities and even finds a small positive response of wealth accumulation to increased capital taxation.

Also related are papers that study the impact of capital income taxation on the composition of wealth holdings (e.g., Poterba and Samwick 2003; see Poterba 2002 for a review). This research tends to find that the form of savings is fairly sensitive to its taxability—for example, with rising taxes on capital income leading to more savings in tax preferred channels and with taxes impacting the riskiness of portfolio holdings. But this literature does not focus on the impact of taxation on total wealth accumulation.

More broadly, a large literature has emerged on the impact of income taxation on total income (see Saez, Slemrod, and Giertz 2012 for an overview). This literature has generally found modest elasticities of taxable income with respect to net-of-tax rates, with a central range of estimates of 0.1 to 0.4. These studies have furthermore shown that the summary elasticity estimate can mask considerable heterogeneity across various dimensions, such as the income distribution (Gruber and Saez 2002; Kleven and Schultz 2014). A number of studies have suggested that this response is largely driven by exclusions and deductions from income, rather than real savings or labor supply behavior. But there has been little attempt to decompose the impact of tax changes into capital and labor income. A notable exception is Kleven and Schultz (2014), who find capital income to be two to three times as elastic to income taxes as labor income.

II. Swiss Institutional Context

A. *The Importance of Canton-Level Taxation*

As shown in Table 1, Switzerland is unique in its reliance on wealth taxation and in the subnational nature of that taxation. Wealth taxes are cantonal and municipal; there is no federal taxation of wealth.

Switzerland is divided into 26 cantons and some 2,300 municipalities. These subfederal jurisdictions taken together autonomously raise 53 percent of total tax revenue. Cantons have almost complete autonomy over taxation and public spending.[3] Municipalities in most cantons can determine their level of taxation by adding

[3] The revenue percentages reported in this section are calculated over our main sample period, 2003–2015, and taken from Swiss Federal Finance Administration (1990–2019). At the federal level, the main tax instruments are

municipal "multipliers" to the canton-level tax schedules. The Swiss constitution assigns taxation rights to the cantons by default, with the federal government allowed to raise taxes only subject to explicit legal provisions to be approved in nationwide referenda. The main constraint on the fiscal autonomy of cantons is a federal law in force since 1993 that standardizes the definitions of tax bases and sets out assignment principles for taxable income and assets that need to be allocated across cantons.

B. *Wealth Taxes*

Cantons have been taxing wealth since the early eighteenth century.[4] Wealth taxes are paid annually on self-reported net wealth, declared to the tax authorities as an integral part of tax filings. In addition, net returns on financial assets are subject to personal income taxation at the federal, cantonal, and municipal levels, but capital gains are not taxed.

Residents aged 18 and over are legally obliged to submit an annual tax filing. All types of wealth (cash, financial assets, real estate, and luxury durable goods) are subject to the same tax, net of debt (mortgage or other). Standard durable household goods, compulsory pension assets, and a limited amount of voluntary pension savings are exempt from the wealth tax.[5] Wealth is taxed by the canton and municipality of a taxpayer's main legal residence irrespective of the taxpayer's nationality, except for real estate, which is taxed where it is located.[6] Married couples are taxed jointly, subject to a different schedule from that applied to single households.

There is no institutional reporting of financial wealth, and tax authorities have no direct access to bank information except in criminal cases. Tax authorities declare that they carry out randomized audits, but no data on such activities are published. A perhaps more important intervention by tax authorities is the request of documentation for changes in wealth holdings that are not evidently compatible with changes in other items of the tax declaration (income, inheritance, real estate transactions, etc.). This makes it difficult to stop or start declaring large amounts. Especially relevant to our study, this mechanism implies that declaring previously undeclared large holdings needs to be done incrementally over time if it is to escape the attention of the tax authority. Another gray area for wealth declaration is the valuation of closely held firms, an area where monitoring by tax authorities is especially complex and time consuming.[7]

value-added taxes (37 percent of federal tax revenue and the sole prerogative of the federal government), personal income taxes (16 percent of federal tax revenue, 17 percent of consolidated personal income tax revenue), and corporate income taxes (13 percent of federal tax revenue, 46 percent of consolidated corporate income tax revenue).

[4] The federal government raised such taxes intermittently between 1915 and 1957, after which wealth taxation again became the sole prerogative of the cantons and municipalities (Dell, Piketty, and Saez 2007).

[5] In 2015 the maximum tax-exempt annual contribution to voluntary pension schemes was CHF (Swiss francs) 6,768 for employees and CHF 33,840 for the self-employed. This ceiling is changed annually in line with inflation.

[6] This means that Swiss nationals residing abroad are liable for Swiss wealth taxes only to the extent that they own real estate in Switzerland. Conversely, Swiss residents do not owe Swiss wealth taxes on real estate located abroad.

[7] To our knowledge, no rigorous estimates exist of the extent of wealth tax evasion in Switzerland. We return to this issue below, when interpreting our estimates.

Table 3—Descriptive Statistics: Cross-Canton Panel Data

	Levels					First differences			
		SD							
	Mean	Overall	Within	Min	Max	Mean	SD	Min	Max
Top marginal wealth tax rate (in %)	0.534	0.217	0.078	0.127	1.005	−0.010	0.040	−0.398	0.057
Top marginal income tax rate (in %)	33.546	5.537	1.250	29.767	39.152	−0.160	0.828	−7.559	4.367
Bequest tax rate (in %)	0.607	1.421	0.642	0	5.9	−0.046	0.428	−5.8	0.1
Taxable wealth (in million CHF)	53,829	66,763	13,322	2,717	39,115	2,475	5,145	−27,288	39,400
Log taxable wealth (log of million CHF)	10.300	1.144	0.204	7.907	12.877	0.050	0.064	−0.165	0.521
Wealth share of millionaires	0.564	0.138	0.049	0.236	0.866	0.012	0.019	−0.060	0.105

Notes: 338 observations from the 26 Swiss cantons, 2003–2015. See online Appendix Section A.1 for details.

The main statutory instrument to incentivize the declaration of wealth is the 35 percent federal withholding tax applied to income from all financial assets (mainly interest and dividends). Withholding tax payments are returned upon declaration of the assets in tax filings. This implies an incentive for declaring financial assets when statutory income tax rates are below 35 percent, wealth tax rates are low, and asset returns are high. However, for a wealthy individual with a marginal income tax rate of 34 percent and a wealth tax rate of 0.5 percent (top marginal rates averaged across cantons; see Table 3) and assuming zero detection probability, it would only pay to declare a financial asset if it yielded a return in excess of 50 percent. In times of low interest rates and high capital gains, the incentive effect of the withholding tax is evidently particularly weak.

Switzerland offers "non-dom" status to foreign nationals whose earnings flow entirely from non-Swiss sources (wealthy foreign retirees, international sports stars, etc.). These taxpayers are not required to declare their worldwide wealth. We therefore consider them in none of our analyses.[8]

Exemption levels vary by canton but are always low in international comparison. In 2015, they ranged from CHF 25,000 (US$25,000) to CHF 200,000 (US$200,000).[9] The wealth tax thus affects much of the middle class in addition to the wealthiest families.

Figure 1 presents representative wealth tax schedules for married couples in Lucerne and Bern, the two cantons used for our case study in Section V. We focus on these two cantons because we have individual-level tax data for both and because they offer a useful event study, as Lucerne dramatically lowered its wealth tax rate

[8] In 2014, 5,382 taxpayers availed of this scheme. Their total income and wealth tax payments were CHF 740 million—a mere 1.2 percent of total revenue from income and wealth taxes (see https://www.fdk-cdf.ch/-/media/FDK_CDF/Dokumente/Themen/Steuerpolitik/Aufwandbesteuerung/190607_AufwBest_MM_FDK_DEF_F.pdf?la=de-CH[https://www.fdk-cdf.ch/-/media/FDK_CDF/Dokumente/Themen/Steuerpolitik/Aufwandbesteuerung/190607_AufwBest_MM_FDK_DEF_F.pdf?la=de-CH]).

[9] The CHF has been trading roughly at parity with the US dollar since 2015. We therefore do not report separate figures in US dollars in the remainder of this paper.

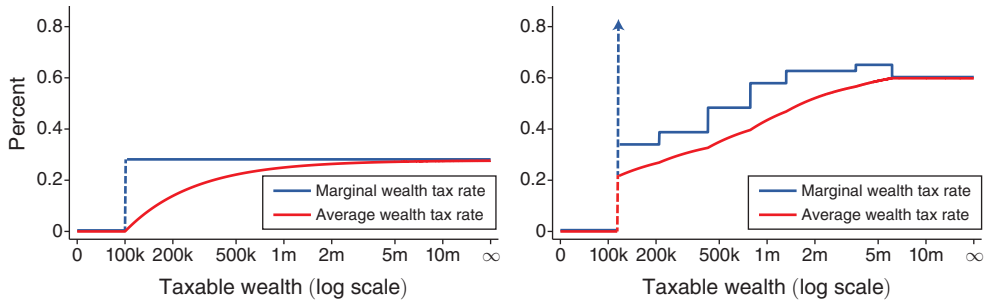


FIGURE 1. MARGINAL AND AVERAGE WEALTH TAX SCHEDULES FOR THE CANTONS OF LUCERNE AND BERN (2015)

Notes: Marginal tax rates are computed over CHF 1,000 intervals, as taxable wealth is rounded by tax authorities to the nearest thousand. All numbers refer to married households, as for those, the exemption thresholds of CHF 115,000 in Bern and CHF 100,000 in Lucerne are comparable. The vertical arrow at the exemption threshold in the graph for Bern indicates the fact that marginal tax rate at that point is 21.0 percent, because above the threshold, all wealth (increasing below-threshold wealth) is subject to the tax. For additional detail see Figure B1 in the online Appendix.

in 2009.[10] In Lucerne (left-hand panel of Figure 1), the couples exemption threshold in 2015 stood at CHF 100,000, and a constant marginal tax rate applied above the threshold. In Bern (right-hand panel of Figure 1), a progressive schedule applied, with marginal tax rates rising from the threshold at CHF 115,000 up to a taxable wealth level of CHF 6.1 million for married couples.[11] Our data show that 42 percent of filers in Lucerne and 34 percent of filers in Bern had wealth above the exemption level (see Figure B1 in the online Appendix). Total wealth below the exemption level accounted for only 2.5 percent of total wealth in Lucerne and 5.4 percent of total wealth in Bern. Hence, most declared private wealth in Switzerland is nonexempt from the wealth tax.

In our cross-canton panel analysis, we focus on top marginal tax rates. In 2015, top wealth tax rates varied by a factor of almost eight, ranging from 0.13 percent to 1.00 percent. Wealth taxes are generally highest in the French-speaking cantons of western Switzerland and lowest in the small, German-speaking cantons of central Switzerland (see Figure A1 in the online Appendix). Figure 2 shows that wealth taxes have been on a general downward trend in recent years, but there is considerable variation in the size and timing of tax changes. The cumulative changes in the top wealth tax rate range from −0.46 percentage points to +0.01 percentage points. Tax changes are most pronounced in cantons located in central Switzerland, among which tax competition has been particularly intense in the early 2000s; but other, more outlying cantons such as Solothurn (SO) or Graubünden (GR) have

[10] In 2015 Lucerne had a population of 0.4 million and Bern of 1 million, representing some 5 and 12 percent, respectively, of the national population (8.3 million). Further details are given in Section V.

[11] In Bern, unlike Lucerne, taxpayers above the exemption level pay tax on their entire wealth holdings. This creates a "notch" in the wealth tax schedule, which we will discuss below. The 2015 exemption thresholds for singles were CHF 50,000 and CHF 97,000 in Lucerne and Bern, respectively.

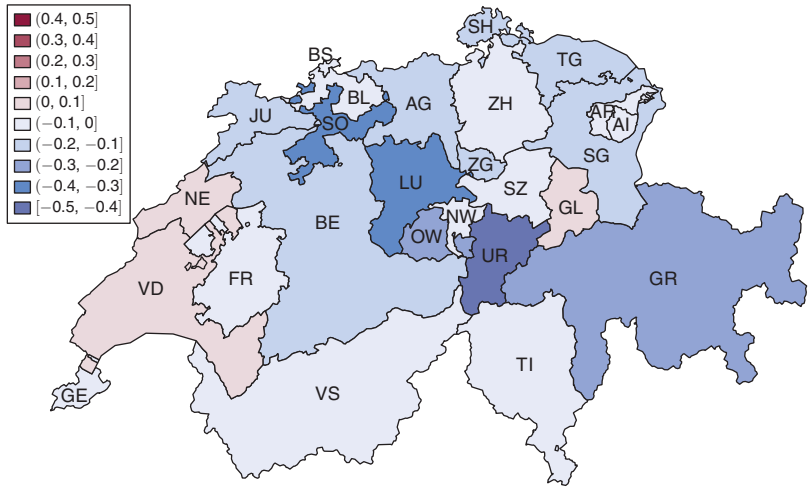


Figure 2. Change in Top Marginal Wealth Tax Rates across Swiss Cantons, 2003–2015

Notes: Change in marginal tax rate on wealth > CHF 5 million, in percentage points. Tax rates are consolidated across municipal and cantonal levels, with municipal rates calculated as averages across each canton's municipalities weighted by the number of taxpayers.

significantly lowered their wealth tax rates as well. The high-tax western cantons left their rates largely unchanged over the sample period.[12]

C. *Other Canton-Level Taxes*

The annual wealth tax is the most prominent form of wealth taxation in Switzerland, accounting for 9 percent of tax revenues of subfederal governments. However, other types of wealth taxation exist.

Bequest taxes account for 2 percent of revenues. Tax rates are low in international comparison: the effective average tax rate on inheritance was 3.0 percent in 2008, with bequests to direct descendants exempt from taxation in most cantons.[13] Over the sample period we study, 17 cantons had no bequest tax on direct descendants, 5 cantons had a bequest tax in all years, and 4 had a tax in some years. We will control for cross-cantonal variation in the bequest tax in our cross-canton analysis. There are also various taxes on real estate.[14] The complicated nature of these taxes and data limitations make it difficult to quantify these taxes precisely. However, a qualitative analysis suggests that there was minimal panel variation in real estate taxes over our sample period (see online Appendix Section A.1).

[12] See also Figure 3 for details on the largest canton-level wealth tax reforms. Figure A2 in the online Appendix shows the universe of tax rate changes in our sample.

[13] This tax rate is weighted by observed shares of heir categories, based on data from Brülhart and Parchet (2014).

[14] Real estate taxes come in three forms that are of comparable importance in revenue terms: land taxes (amounting to a top-up on wealth taxes on real estate), real estate capital gains taxes (a tax on real estate speculation with rates decreasing in the length of time over which a property is held), and real estate transaction taxes (akin to stamp duties).

The most important source of subfederal tax revenues is the tax on personal income, which accounts for 62 percent of those revenues. The personal income tax includes all capital income other than capital gains, and net capital income is treated like labor or transfer incomes in the computation of taxable income. The income tax rate therefore can influence wealth accumulation both directly, by affecting wealth returns, and indirectly, by affecting returns to labor supply. We therefore control for income tax rates in our cross-canton analysis as well.

III. Data

A. *Cross-Canton Panel*

Akin to Einav et al. (2014), who study state sales taxes in the United States, we work with two complementary datasets to explore different margins of responses to taxation. The first dataset covers all 26 cantons over the 2003–2015 period. This dataset has the advantage of offering a maximum of identifying variation on wealth and personal income tax rates, as cantons frequently change their tax schedules.

Our dependent variable is a canton-year measure of total wealth holdings, which has been collected by the Swiss Federal Tax Administration (2018a) in the context of the fiscal equalization scheme since 2003.[15] As our main explanatory variable, we use consolidated (cantonal + municipal) top marginal wealth tax rates provided by the Swiss Federal Tax Administration (2018b). These tax rates depend on the basic cantonal wealth tax schedules as well as on cantonal and municipal multipliers, and they are averaged across municipalities, weighted by the number of taxpayers, for every canton.[16]

We control for personal income taxes, also provided by the Swiss Federal Tax Administration (2018b), which account for the largest share of personal tax revenue and are the most salient jurisdiction-specific tax variable. We again use top marginal rates. Given their potential relevance for wealth accumulation, we also control for representative bequest tax rates by canton and year.

Table 3 provides summary statistics for the cross-canton panel dataset. Top wealth tax rates range from 0.127 percent to 1.005 percent, with a mean of 0.534 percent. The panel offers considerable identifying variation, as evident in within-canton standard deviation of 0.078 percent, i.e. fully 15 percent of the mean top wealth tax rate.[17] Table 3 also shows that canton-level wealth tax rates were changed considerably more within our sample period than were income tax rates.

[15] There are no individual wealth tax records at the federal level because wealth is not taxed by the federal government. The available aggregate data report taxable wealth as well as the number of taxpayers in each of 11 brackets of taxable asset holdings per canton and year, ranging from a bracket for zero net wealth to one for more than CHF 10 million. See online Appendix Section A.1 for details.

[16] While only a fraction of taxpayers pay the top marginal tax rate, these top rates turn out to be highly correlated with a wealth-weighted average across taxpayers. Results using the weighted marginal wealth tax rate are therefore very similar to the reported estimates. Average and marginal tax rates too are highly correlated such as to yield virtually identical results. See online Appendix Section A.1 for details.

[17] We show the evolution of these top marginal wealth tax rates in all cantons over the years 2001–2017 in Figure A2 in the online Appendix.

B. *Lucerne and Bern Microdata*

Our second dataset contains the universe of individual-level administrative tax records for the cantons of Lucerne and Bern over the period 2005–2015. These confidential data, containing the majority of items recorded in individual tax declarations, were made available to us in anonymized form by the Statistical Services of the canton of Lucerne (Statistik Luzern 2005–2019) and by the tax administration of the canton of Bern (Steuerverwaltung des Kantons Bern 2001–2015). We observe a host of useful individual characteristics in addition to income and wealth, including residence municipality and marital status. These records were matched with data from population registers allowing us to identify moves into and out of the canton (either within Switzerland or abroad), deaths, coming of age (age 18), and changes in marital status.

The combined dataset for the 2 cantons covers 9.45 million taxpayer-years, 6.88 million of which feature positive declared net wealth.[18] Of those, 3.03 million feature net wealth above taxable thresholds.[19] This reflects the broad-based nature of the Swiss wealth tax: it is paid by the top 44 percent of taxpayers with positive net wealth, which includes many households commonly considered middle class.

While we have uncensored data for Bern, stock items in the Lucerne data are top coded above CHF 40 million and flow items above CHF 2 million. However, we were provided with average values in the truncated range, which we attribute to every truncated observation. To make the data comparable across the 2 cantons, we replace actual wealth above CHF 40 million with yearly average wealth conditional on wealth being greater than CHF 40 million also in Bern. Moreover, negative net wealth is reported as such in the Bern data but not in the Lucerne data, where it is recorded as zero. In line with the definition of net wealth underlying the federal government's data used in our cross-canton analysis, we only consider nonnegative net wealth to construct canton-year wealth aggregates from the Lucerne and Bern microdata.

Table 4 shows summary statistics. While Bern is considerably larger than Lucerne, Lucerne is slightly wealthier, with prereform per capita net wealth of CHF 0.25 in Lucerne and CHF 0.22 in Bern. In both cantons, international in-movers have more wealth on average than international out-movers, and in both cantons, the very wealthy—defined as having wealth above CHF 40 million—accounted for about 13 percent of total taxable wealth in 2008.

IV. Cross-Canton Analysis

In this section we draw on the considerable panel variation in wealth tax rates across Swiss cantons to obtain estimates of the aggregate response of taxable wealth.

[18] Married couples are treated as one taxpayer. For Bern we also have data for the years 2001–2004. While we cannot use those data in the comparative analyses with Lucerne, we will use them for the bunching analysis.

[19] In 2005–2015 the taxable threshold in Lucerne remained unchanged at CHF 50,000 for singles and CHF 100,000 for married couples, plus CHF 10,000 for every dependent child. In Bern, the taxable threshold for singles was increased from CHF 92,000 to CHF 94,000 in 2008 and then to CHF 97,000 in 2011. These thresholds were CHF 17,000 (CHF 18,000 as of 2011) higher for married couples, and additionally for every dependent child.

Table 4—Descriptive Statistics: Lucerne and Bern

	Lucerne			Bern		
	Taxpayers	Taxable wealth (CHF m)	Wealth/ taxpayer (CHF m)	Taxpayers	Taxable wealth (CHF m)	Wealth/ taxpayer (CHF m)
Panel A. 2005–2015						
All households	215,077	62,146	0.29	600,210	142,820	0.24
Stayer households	206,620	60,511	0.29	584,117	141,029	0.24
Financial		39,615	0.19		104,073	0.18
Nonfinancial		53,942	0.26		105,755	0.18
Debt		33,046	0.16		68,800	0.12
Stable households	181,294	54,671	0.30	510,959	126,705	0.25
In-movers Switzerland	3,986	826	0.21	6,604	698	0.11
In-movers abroad	747	334	0.45	1,762	336	0.19
Out-movers Switzerland	3,440	408	0.12	6,521	652	0.10
Out-movers abroad	766	127	0.17	2,033	163	0.08
Wealth > CHF 40 m	82	9,611	116.82	96	16,202	169.25
Panel B. 2008						
All households	208,547	51,572	0.25	590,485	133,684	0.23
Stayer households	199,430	50,409	0.25	573,222	132,012	0.23
Financial		31,729	0.16		92,424	0.16
Nonfinancial		49,230	0.25		104,090	0.18
Debt		30,550	0.15		64,502	0.11
Stable households	191,363	49,044	0.26	549,739	129,158	0.23
In-movers Switzerland	4,408	684	0.16	7,113	549	0.08
In-movers abroad	852	138	0.16	2,022	241	0.11
Out-movers Switzerland	3,623	309	0.09	7,145	788	0.11
Out-movers abroad	799	60	0.07	2,053	142	0.07
Wealth > CHF 40 m	61	6,941	113.79	72	16,515	229.37

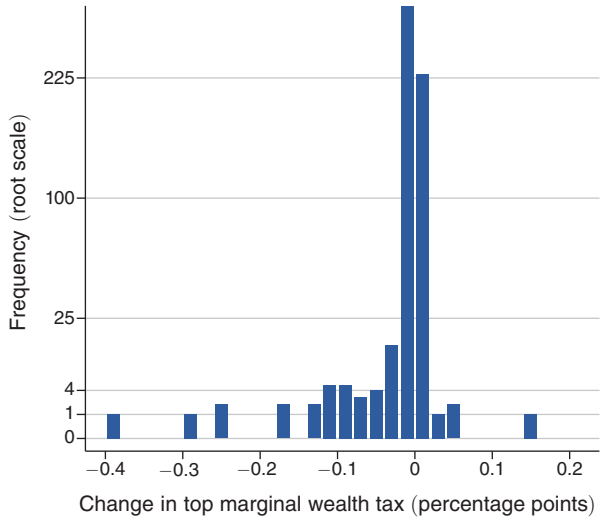
Notes: Data for taxpayers with positive net wealth. "Stayer households" refers to taxpayers who are observed in the same canton in both $t-1$ and t; "stable households" refers to taxpayers who in addition have no change in marital status over that period. See online Appendix Section B.1 for details.

In this analysis, we allay endogeneity concerns by testing for common pretrends. In Section V, we shall draw on individual-level data and a specific quasi-random differential tax reform in order to analyze the mechanisms underlying the aggregate response.

The identifying variation for this analysis is provided by canton-level changes in top marginal wealth tax rates, as illustrated in Figure 2. As a complementary description of those tax changes, Figure 3 shows a histogram of year-on-year tax rate changes in our 2000–2016 data sample. The figure also lists the 20 largest canton-level wealth tax reforms. It turns out that all these reforms involved wealth tax cuts.

We estimate the effect of tax reforms on aggregate wealth by exploiting the magnitudes of all changes in cantonal wealth tax rates. We estimate the following distributed lag model in first differences:

$$\Delta \ln W_{it} = \sum_{j=-2}^{6} \gamma_j \Delta \log\left(1 - \tau_{i,t-j}\right) + \theta_t + \Delta \varepsilon_{it}, \tag{1}$$



1	Uri	2009	−0.4
2	Lucerne	2009	−0.28
3	Obwalden	2006	−0.25
4	Solothurn	2008	−0.25
5	Jura	2005	−0.18
6	Thurgau	2008	−0.17
7	Glarus	2001	−0.12
8	Solothurn	2012	−0.12
9	Schwyz	2007	−0.12
10	Graubünden	2008	−0.12
11	Graubünden	2010	−0.11
12	Thurgau	2002	−0.1
13	Bern	2009	−0.1
14	Basel-Stadt	2003	−0.1
15	Schwyz	2001	−0.1
16	Appenzell I.	2001	−0.09
17	Vaud	2001	−0.09
18	Zug	2009	−0.08
19	St. Gallen	2009	−0.08
20	Aargau	2009	−0.07

FIGURE 3. CANTON-LEVEL WEALTH TAX CHANGES, 1996–2017

Notes: The left panel is the frequency distribution; the right panel lists rank, canton, year, and magnitude of the 20 largest tax reductions.

where W_{it} is aggregate taxable wealth in canton i and year t, $\tau_{i,t}$ is the top marginal wealth tax rate in canton i and year t. First differencing $\Delta \ln W_{it} = \ln W_{it} - \ln W_{i,t-1}$ eliminates canton fixed effects μ_i, which are therefore controlled for. The cumulative effect after j years can be recovered from the distributed lag coefficients γ as

$$\beta_j = \begin{cases} -\sum_{k=j+1}^{-1} \gamma_k, & \text{if} \quad -3 \leq j \leq -2; \\ 0, & \text{if} \quad j = -1; \\ \sum_{k=0}^{j} \gamma_k, & \text{if} \quad 0 \leq j \leq 6; \end{cases} \tag{2}$$

which expresses the effect β_j relative to the year prior to the reform. Hence, we use the customary standardization $\beta_{-1} = 0$. Limiting the distributed lag model to two leads and six lags is equivalent to binning the endpoints in an event study model at three years before and six years after the event.[20]

We use the log of the net-of-tax tax rate as the main explanatory variable, in line with the convention in the elasticity of taxable income literature. However, as wealth tax rates are smaller than 1 percent, $\ln(1 - \tau_{i,t-j})$ is almost exactly equal to $-\tau_{i,t-j}$. β_j can therefore either be interpreted as net-of-tax rate elasticity or as the semielasticity with respect to a 100 percentage point decrease in the wealth tax rate.

[20] Schmidheiny and Siegloch (2020) show that the estimation of the coefficients γ in a distributed lag model and subsequent calculation of the cumulative effects β is the natural generalization of the event study model to multiple events of varying size. Note that an event study model with periods $j = -3$ to $j = 6$ and the standardization $\beta_{-1} = 0$ corresponds exactly to a distributed lag model with 6 lags and -2 leads.

Table 5—Cross-Canton Distributed Lag Model in First Differences for Aggregate Wealth

	(1)	(2)	(3)	(4)
Wealth tax effect				
3 and more years before event	0.078	0.042	0.016	0.092
	(0.077)	(0.081)	(0.120)	(0.113)
2 years before event	−0.041	−0.042	−0.081	−0.052
	(0.054)	(0.061)	(0.088)	(0.085)
1 year before event	0	0	0	0
At event	0.167	0.214	0.222	0.182
	(0.099)	(0.090)	(0.109)	(0.108)
1 year after event	0.124	0.205	0.190	0.126
	(0.096)	(0.105)	(0.114)	(0.112)
2 years after event	0.399	0.486	0.436	0.368
	(0.158)	(0.176)	(0.198)	(0.203)
3 years after event	0.408	0.495	0.488	0.425
	(0.156)	(0.181)	(0.204)	(0.214)
4 years after event	0.391	0.463	0.459	0.411
	(0.157)	(0.175)	(0.183)	(0.200)
5 years after event	0.435	0.511	0.471	0.432
	(0.179)	(0.199)	(0.206)	(0.220)
6 and more years after event	0.485	0.517	0.483	0.461
	(0.245)	(0.254)	(0.265)	(0.276)
Income tax effect				
5 years after event			0.002	0.005
			(0.008)	(0.009)
Bequest tax effect				
5 years after event				−0.011
				(0.015)
Year fixed effects	Yes	Yes	Yes	Yes
Initial share of millionaires × year f.e.		Yes	Yes	Yes
Observations	307	307	307	307
Cantons	26	26	26	26

Notes: Regression of aggregate taxable cantonal wealth (in first differences of logs) on six lags and two leads of net-of-wealth-tax rate (in first differences of logs) and control variables. If included as control variables, the net-of-income-tax and net-of-bequest-tax rate are also included in first differences of logs with six lags and two leads. Data observed from 2003 to 2015 for dependent variable and from 1996 to 2017 for tax rates. Canton fixed effects are implied by first differencing. The table reports cumulative log differences in wealth with respect to a 1 percent increase in the net-of-tax rate. In the case of wealth and bequest taxes, the reported effects with respect to a 1 percent increase in the net-of-tax rate can also be interpreted as the effect with respect to a 1 p.p. decrease in the tax rate. Standard errors clustered for cantons in parentheses.

We report $\beta_j/100$ as the effect on aggregate wealth j years after the reform of a 1 percentage point cut in the wealth tax rate $\tau_{i,t-j}$.

Table 5 shows our estimation results. Column 1 reports estimates of equation 1. We furthermore show specifications that include interaction terms of initial-year millionaire shares and year fixed effects (columns 2–4) that control for canton-level personal income taxes (columns 3–4) and for bequest taxes (column 4).

The results of Table 5 show that tax changes triggered significant tax base responses. While we see no statistically significant trends in wealth accumulation prior to the tax cuts, all four specifications shown in Table 5 imply statistically significant increases in taxable wealth subsequent to tax cuts. The same qualitative

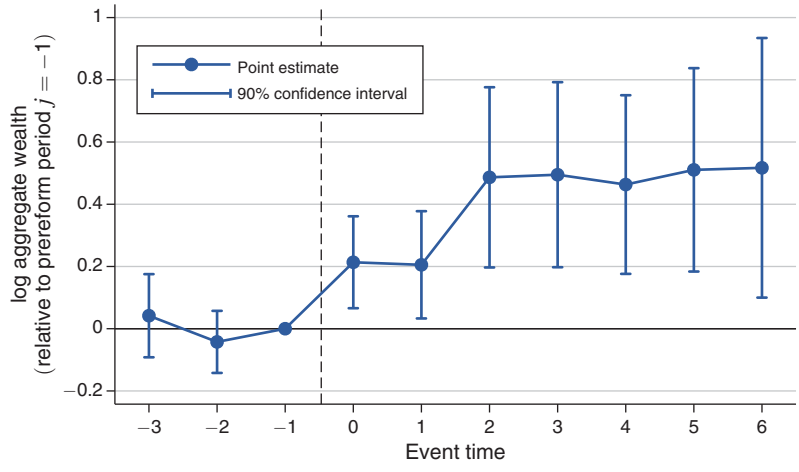


FIGURE 4. CROSS-CANTON DISTRIBUTED LAG MODEL ESTIMATED IN FIRST DIFFERENCES

Notes: Distributed lag cumulative effects according to equation (2), estimated through the first-differences empirical model (1) with nonparametric controls (initial share of millionaires × year dummy). Effects are the cumulated coefficients after and before the reference year (defined as one year prior to the event). Estimated effects × 100 percent can be interpreted as the percentage effect of a 1 p.p. reduction in the wealth tax rate on aggregate wealth. Note that the largest tax reduction in our sample is 0.4 p.p. (see Figure 3).

findings emerge in the event study analysis reported in Section A.2 in the online Appendix, where we focus only on the 10 or 20 largest tax reforms.

We illustrate the implied tax base response in a graph of the sequencing of average effects, in Figure 4 (based on the estimates in column 2 of Table 5). The graph shows a strong response that plateaus out after some three years. Figure 4 also clearly illustrates the absence of pretrends in our first-differences panel model.

In the first-difference panel design employed here, estimated coefficients can be interpreted directly as implied semielasticities with respect to a 1 percentage point decrease in the wealth tax rate. If we consider responses over a 5-year horizon, our estimates in Table 5 imply semielasticities between 0.43 and 0.51. These responses are larger than all estimates reported elsewhere (see Table 2).

Changes in income tax rates or bequest tax rates, however, have no discernible impact on taxable wealth.

When looking at separate wealth categories, we find that wealth declared by the very wealthy may respond somewhat more strongly to tax cuts than wealth declared by the moderately wealthy (Figure 5). We find a semielasticity that is some 20 percent larger for millionaires than for all taxpayers combined. However, these estimates are not statistically significantly different from each other, and we therefore cannot reject the hypothesis that the moderately wealthy react as strongly as the very wealthy.

To summarize the results of our cross-canton analysis, we find large aggregate responses to canton-level wealth tax changes. Our lowest estimated semielasticity, identified over all tax rate changes within our sample, is 0.43. This is higher than panel-based estimates reported for other countries, which range from 0.14 to 0.32

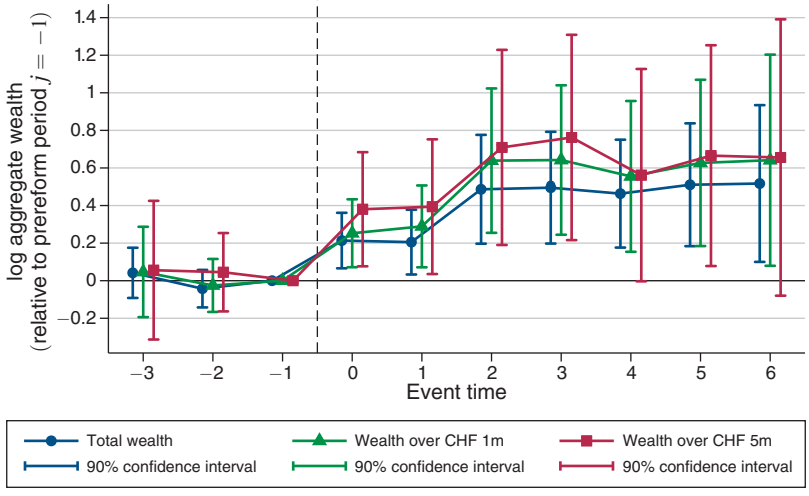


FIGURE 5. CROSS-CANTON DISTRIBUTED LAG MODEL: TOTAL WEALTH AND MILLIONAIRE WEALTH

Notes: Distributed lag cumulative effects according to equation (2), estimated through the first-differences empirical model (1) with nonparametric controls (initial share of millionaires × year dummy). Full estimates are shown in columns 1, 3, and 4 of Table A3 in the online Appendix. Effects are the cumulated coefficients after and before the reference year (defined as one year prior to the event). Estimated effects × 100% can be interpreted as the percentage effect of a 1 p.p. reduction in the wealth tax rate on aggregate wealth. Note that the largest tax reduction in our sample is 0.4 p.p. (see Figure 3).

(see Table 2). We estimate even higher elasticities when we focus on the largest tax reforms only through an event study design, where we obtain effects even in excess of 1—consistent with larger reforms being more salient or with the presence of fixed adjustment costs (see Section A.2 in the online Appendix). However, evidence of stronger responses by wealthier taxpayers is weak at best. We also observe that while declared wealth in Swiss cantons reacts very sensitively to wealth taxation, it does not discernibly respond to personal income or bequest taxes.

V. The Lucerne Wealth Tax Cut

A. *A Two-Canton Case Study*

The cross-cantonal panel analysis of Section IV has allowed us to estimate the aggregate behavioral response that is of main interest from a fiscal policy perspective. For more detailed insights into response heterogeneity and mechanisms, however, we need disaggregated information. We have obtained access to the universe of individual-level tax records for two cantons that offer a well-suited case study: Lucerne and Bern.

In 2009 the canton of Lucerne cut its wealth tax rate in half. This meant that top rates fell from 0.56 percent in 2008 to 0.28 percent in 2009. In the same year, the neighboring canton of Bern cut its top wealth tax rate more modestly, from 0.74 percent to 0.64 percent. The Lucerne wealth tax cut was thus nearly three times

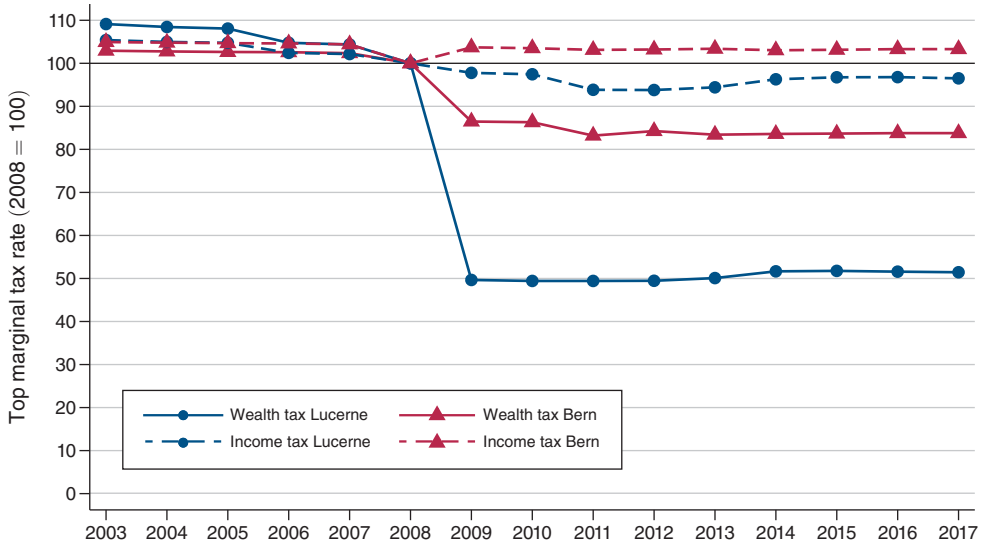


FIGURE 6. WEALTH AND INCOME TAX RATES IN LUCERNE AND BERN

Notes: The graph shows consolidated cantonal and municipal top marginal tax rates, scaled to their 2008 level. Municipal tax rates are weighted annually by the number of taxpayers. The unscaled statutory tax rates are shown in Figure B2 in the online Appendix.

larger than the Bern tax cut, with a difference of 0.18 percentage points. Usefully for our comparative analysis, these simultaneous wealth tax cuts represented isolated events: in both cantons, wealth tax rates remained essentially unchanged in the years prior to and after those reforms, and personal income tax rates remained stable throughout the 2003–2017 period (see Figure 6). Both cantons also left their laws and regulations for valuing real estate and nontraded financial assets unchanged throughout our sample period.

Comparing the evolution of taxable wealth between Lucerne and Bern around the year 2009 can thus offer difference-in-difference evidence of taxpayer responses to a large change in the wealth tax rate.

Lucerne and Bern offer an attractive empirical setting for two additional reasons. First, Lucerne and Bern resemble each other in a number of important respects: they are contiguous neighbors, are predominantly German speaking, are among the larger cantons, have comparable urban–rural demographic compositions, and both straddle Alpine and lowland regions. The 2008 aggregate net wealth was CHF 51.6 billion in Lucerne and CHF 132.8 billion in Bern, and per capita net wealth was somewhat over CHF 0.2 million in both cantons (see Table 4).[21]

[21] Lucerne, with 0.4 million inhabitants, is the seventh largest of Switzerland's 26 cantons. Bern, with one million inhabitants, is the second largest canton. Both cantons have per capita tax bases that are below the Swiss average, and they are thus net recipients of fiscal equalization transfers. The 2018 tax capacity index of Lucerne stood at 89.4 and that of Bern at 75.1, for a Swiss average of 100. For the impact of linguistic and cultural similarity on fiscal preferences, see Eugster and Parchet (2019).

Second, and even more importantly for our analysis, the difference between their 2009 tax reforms came about quasi-randomly. In September 2006 (Lucerne) and in March 2007 (Bern), the two cantonal parliaments adopted tax reform packages to cut top wealth tax rates by around half.[22] The two reforms were submitted to compulsory popular referenda in the subsequent year. Uniquely, the cantonal constitution of Bern allows citizens to submit amendments. This meant that Lucerne voters could only vote for or against the large tax cut proposed by their parliament, whereas the Bern voters had a choice between the parliament's large tax cut and a smaller tax cut proposed by a citizen committee as a compromise solution. The principle of a wealth tax cut passed with solid majorities in both cantons (77 percent in Lucerne, 60 percent in Bern), but in a tie-breaking vote in Bern, a very narrow majority of 50.9 percent against 49.1 percent preferred the smaller version of the tax cut proposed by the citizen committee. The fact that Bern adopted a much smaller reduction of its wealth tax rate than Lucerne in an otherwise comparable environment thus hinged on a tiny electoral margin.

B. *The Aggregate Response*

We begin by estimating the aggregate response of the Lucerne tax cut. We compute the response as the cumulative change in reported wealth between 2008 and t in percent of net wealth in 2008:

$$w_{it} = \begin{cases} -\sum_{s=t+1}^{2008} \Delta W_{is}/W_{i,2008}, & \text{if } t \leq 2007; \\ 0, & \text{if } t = 2008; \\ \sum_{s=2009}^{t} \Delta W_{is}/W_{i,2008}, & \text{if } t \geq 2009; \end{cases} \tag{3}$$

where $\Delta W_{it} = W_{it} - W_{i,t-1}$ is the change in net wealth between $t-1$ and t. We use discrete changes rather than log changes, because this allows us to decompose the aggregate response into different components, and we then interpret the difference between Lucerne and Bern, $(w_{LU,t} - w_{BE,t})/(1 + w_{BE,t})$, as the cumulative effect of the large 2009 wealth tax cut in Lucerne relative to the small 2009 wealth tax cut in Bern.[23]

We show the aggregate response as computed from the Lucerne–Bern comparison in Figure 7. Total wealth in these two cantons grew slowly and at almost identical rates prior to the 2009 reform, with a symmetric drop in 2008 explained by the global financial crisis, but it grew significantly more strongly thereafter. Importantly, the post-2009 increase in aggregate wealth was more pronounced in Lucerne than in

[22] The reform proposals were motivated by their proponents with earlier wealth tax cuts in small neighbor cantons attracting away wealthy taxpayers, combined with the introduction of a new federal fiscal equalization scheme scheduled for 2008 that promised greater fiscal leeway for net recipient cantons.

[23] We will use log changes to quantify behavioral responses in Section VD. In order to minimize direct dependence between the two cantons, we removed all bilateral movers in the year of their move. Including those observations never changes our observed effects by more than 0.1 percentage points. Figure B20 in the online Appendix illustrates these moves. It shows that there has been a bilateral migration surplus in terms of taxable wealth in favor of Lucerne throughout our sample period. The size of those flows was small, however, with Lucerne's average annual bilateral migration surplus with Bern representing some 1.9 percent of net wealth inflow due to in-migration and some 0.02 percent of the stock of taxable wealth in Lucerne (see Table 4).

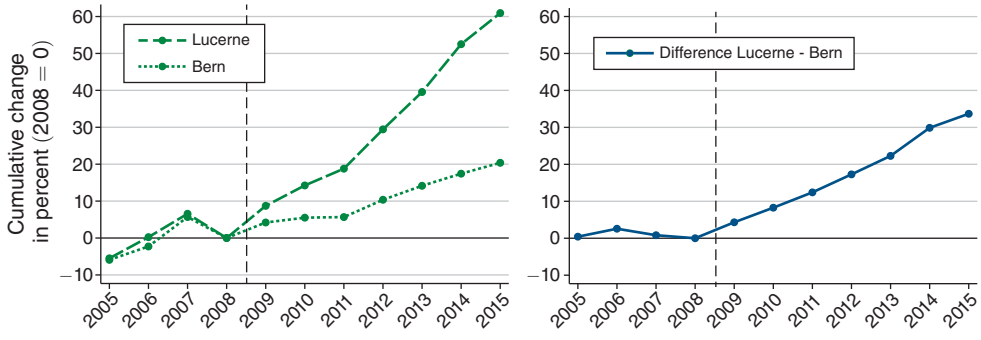


FIGURE 7. DIFFERENTIAL GROWTH OF AGGREGATE WEALTH: LUCERNE VERSUS BERN

Notes: The left-hand-side graph shows cumulative changes, relative to 2008, in Lucerne and Bern separately. The right-hand-side graph shows cumulative differential changes in wealth of Lucerne relative to Bern, scaled to differential wealth in 2008. The 2015 values of the depicted series are, respectively, 60.9 p.p. for Lucerne, 20.4 p.p. for Bern, and 33.7 p.p. for the difference (divided by wealth in Bern in 2015 relative to wealth in Bern in 2009).

Bern. By 2015 the cumulative postreform growth of total wealth was 33.7 percentage points larger in Lucerne than in Bern. This is the aggregate response we shall seek to decompose.

Given that the Lucerne tax cut was 0.18 percentage points larger than the Bern tax cut, this cumulative response implies a semielasticity with respect to a 1 percentage point decrease in the wealth tax rate of 187 percent—more than 4 times larger than the baseline effect estimated in the cross-canton analysis of Section IV. Moreover, Figure 7 suggests that the effect of the 2009 tax cut continued to accumulate beyond 2015. Hence, the 33.7 percentage point effect observed in 2015 is most likely a lower-bound estimate of the long-run aggregate wealth response to the Lucerne tax cut. This strong response is consistent with our finding that larger reforms trigger disproportionately larger responses, Lucerne's tax cut being the second-largest wealth tax change observed in our sample (see Figures 2 and 3).

The aggregate responses we estimate from the Lucerne–Bern comparison could in principle be driven by other changes in the two cantons' policies that coincide with the timing of the wealth tax reforms. Although no such contemporaneous policy difference is evident to us, we investigate this further in two ways.[24]

First, we validate our Lucerne–Bern estimates by looking at responses within Lucerne only. Similarly to Jakobsen et al.(2020), we exploit the fact that some wealthy taxpayers were unaffected by the change in wealth tax rates because of a tax shield that caps maximum tax payments as a share of taxable income. We compare

[24] We can rule out some potential confounds with considerable confidence. One is the evolution of income tax rates—by far the most important personal tax. As shown in Figure 6, those tax rates changed only minimally. Another potential confound are valuations of illiquid assets such as real estate and artworks. The Lucerne authorities could have adopted more frequent and more stringent valuations after the reform to offset some of the drop in wealth tax rates. There is no evidence for this: neither were statutory regulations for valuation procedures changed, nor was there any increase in the staffing of the relevant tax administration. Officials confirm that informal valuation practices did not change after the tax cut.

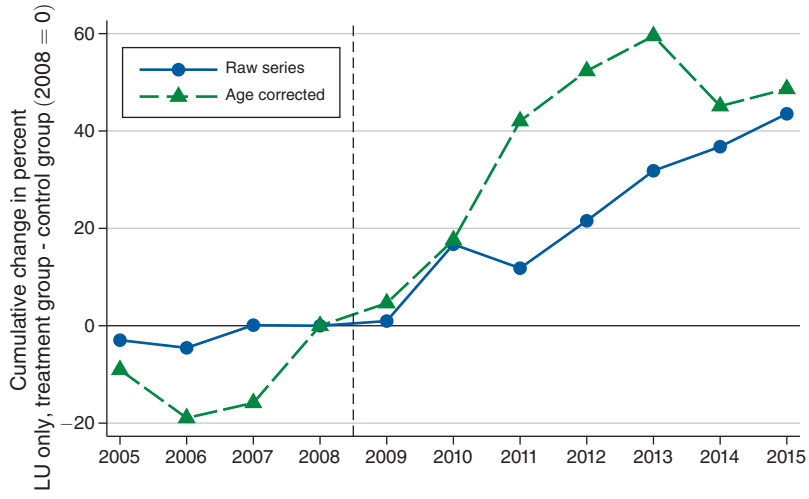


FIGURE 8. DIFFERENTIAL GROWTH OF WEALTH BY AFFECTED VERSUS UNAFFECTED TAXPAYERS, LUCERNE ONLY

Notes: The graph shows cumulative differential changes in wealth of two groups of Lucerne taxpayers with 2008 wealth in the CHF 1–5 million range, scaled to wealth in 2008. The treated group are taxpayers who were not affected by the tax shield (average 2009 change in wealth tax rate $= -0.27$ p.p.). The control group are taxpayers who were affected by the tax shield (2009 change in wealth tax rate $= 0$). The series depicted with triangles is based on residuals from a first-stage regression of taxable wealth on the interaction of age in 2008 with year dummies. The 2015 values of the depicted series are 43.5 (raw series) and 48.6 (age corrected). Further details are provided in Section B.5 in the online Appendix.

the evolution of taxable wealth by taxpayers unaffected by the shield (the "treatment group") to that of comparable taxpayers affected by the shield (the "control group"; see Section B.4 in the online Appendix for details).

The results of this estimation are shown in Figure 8. We find confirmation for the strong aggregate response observed in the Lucerne–Bern comparison. The treated group in this analysis experienced a tax cut of 0.27 percentage points, and by 2015 its cumulative response relative to the untreated group was 43.5 percentage points. This implies a semielasticity with respect to a 1 percentage point decrease in the wealth tax rate of 161 percent, which is consistent with the large impact of the Lucerne wealth tax cut on declared wealth. Since the control group consists of 251 taxpayers only, we consider this intra-Lucerne comparison as a robustness check rather than as the baseline estimate.

Second, we can take cantons other than Bern as controls, provided they had stable wealth tax rates over our period of investigation. While we have no microdata for other cantons, we can draw on the aggregate series used in the cross-canton panel analysis of Section IV. This comparison shows wealth in Bern to track with wealth in Lucerne particularly well prior to the reform of 2009, confirming Bern to be a suitable comparator canton in terms of pretrends (see Figure B9 in the online Appendix). We find that Lucerne wealth increased more strongly than in all alternative control cantons. The difference relative to Bern was more pronounced than in three of the comparison cantons but less pronounced than in the four other comparison cantons, adjusted for different pretrends. This analysis confirms Bern as a suitable control canton.

Overall, the three approaches (Lucerne versus Bern, Lucerne versus other cantons, and within Lucerne) show sizable responses of wealth to wealth taxation changes—but the magnitudes are somewhat variable. For this reason, we use the aggregate cross-cantonal estimates as our central estimates in the paper. But the findings of very large responses in Lucerne from all three methods suggest that we can still use the Lucerne versus Bern comparison for decomposing the aggregate response into contributory mechanisms.

C. *Decomposing the Aggregate Response*

The main appeal of the Lucerne–Bern case study is that it allows us to decompose the aggregate response into different components. We therefore take the 33.7 percentage point cumulative difference in wealth growth between Lucerne and Bern 7 years after the tax cut as the response to be disaggregated into the contributions from different components of the wealth tax base. The share of each of these components in explaining the aggregate response depends on both the respective component's share of base-year aggregate wealth and the magnitude of their respective response.

Taxpayer Mobility.—First, we use our individual-level data to estimate the proportion of the postreform increase in taxable wealth that was due to net in-migration. And we further break down the migration effect into intranational and international taxpayer mobility.

To this end, the year-on-year change of aggregate wealth can be decomposed as follows:

$$\Delta W_{it} = \Delta W_{it}^{stayer} + W_{it}^{in} - W_{i,t-1}^{out} = \Delta W_{it}^{stayer} + W_{it}^{mover}, \tag{4}$$

where ΔW_{it}^{stayer} is the change of wealth of all taxpayers whose tax residence was canton i in both $t-1$ and t, W_{it}^{in} is the wealth of taxpayers who moved into canton i in year t, and $W_{i,t-1}^{out}$ is the wealth of taxpayers who moved out of canton i in year $t-1$. Net mover wealth between $t-1$ and t is defined as $W_{it}^{mover} = W_{it}^{in} - W_{i,t-1}^{out}$. We calculate the change in aggregate wealth of stayers as the residual $\Delta W_{it}^{stayer} = \Delta W_{it} - W_{it}^{mover}$.[25]

We calculate the cumulative change of wealth attributed to movers relative to aggregate wealth in 2008, $W_{i,2008}$, as in (3), where $W_{is}^{mover} = W_{it}^{in} - W_{i,t-1}^{out}$ is the change in the stock of wealth ΔW_{is} attributed to movers.

We observe that Lucerne's large wealth tax cut triggered a net inflow of wealthy taxpayers. The result of this computation is shown in Figure 9. Of the aggregate 33.7 percentage point cumulative difference in wealth growth between Lucerne and Bern by 2015, 8.1 percentage points were due to the additional wealth of net in-movers in their year of arrival, of which 2.2 percentage points were due to international movers. Expressed differently, of the total tax base response, about 24 percent is

[25] Changes in taxable wealth of stayers include changes due to coming of age, death, marriage, and divorce.

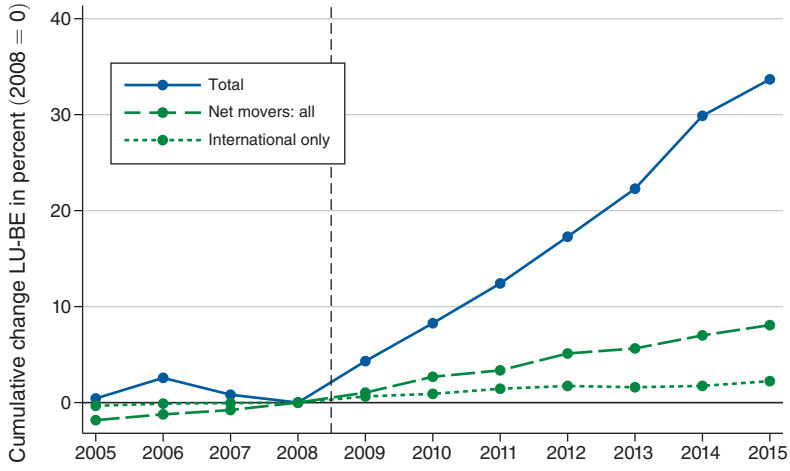


FIGURE 9. CONTRIBUTION OF INTRANATIONAL AND INTERNATIONAL TAXPAYER MOBILITY

Notes: The graph shows cumulative differential changes in wealth of Lucerne relative to Bern, scaled to differential wealth in 2008. It also shows the contributions to the total effect by net intranational and international taxpayer moves, in the year of moving. The 2015 values of the depicted series are, respectively, 33.7 p.p. for differential wealth, 8.1 p.p. for the wealth of all net movers, and 2.2 p.p. for the wealth of international net movers only. Separate graphs for Lucerne and Bern are shown in Figure B12 in the online Appendix.

explained by the migration margin thus defined, and about 7 percent is due to migration from abroad.

This measure considers wealth of in-movers at the time of arrival only. One could argue that considering only wealth on arrival will not capture the full contribution of the migration margin, as movers' subsequent accumulation behavior should also be considered. The contribution of taxpayer mobility computed in that (generous) way amounted to 9.9 percentage points by 2015, or some 29 percent of the aggregate response.[26]

Considering the size of Lucerne—smaller in both area and population than any US state—it is striking that less than 30 percent of the tax base response is attributable to mobility, with most of the increase in the tax base accounted for by responses of already resident taxpayers.[27]

Financial and Nonfinancial Wealth.—We have found most of the aggregate response to come from nonmover households. Changes in net wealth declared by stayers could come from two main wealth categories: real estate and financial assets.

[26] For this computation, we attribute to in-movers not only their wealth in the year of arrival but also changes in their reported wealth in subsequent years, for as long as they remain in the canton. The results are shown in Figure B11 in the online Appendix.

[27] Interestingly, the cantonal government's first and most prominent argument in the referendum campaign in favor of the wealth tax cut was fiscal attractiveness for mobile taxpayers (see https://www.lu.ch/-/media/Kanton/Dokumente/JSD/Wahlen_und_Abstimmungen/volksbotschaft_2007_03_11.pdf). Our results suggest this emphasis to have been based on an overestimate of taxpayer mobility.

Our data allow us to distinguish between financial and nonfinancial wealth, where nonfinancial wealth primarily captures real estate wealth.[28]

In gross terms, the change in aggregate wealth of stayers from year $t-1$ to t can be decomposed into

$$\Delta W_{it}^{stayer} = \Delta W_{it}^{financial} + \Delta W_{it}^{nonfinancial} - \Delta W_{it}^{debt}, \tag{5}$$

where stayers are again defined as taxpayers who were resident in canton i in both year $t-1$ and year t. $W_{it}^{financial}$ are the aggregate financial assets of stayers such as bank accounts, stocks, etc.; $W_{it}^{nonfinancial}$ are nonfinancial assets, including housing; and W_{it}^{debt} denotes aggregate debt including mortgages. Aggregate gross wealth, defined as $W_{it}^{financial} + W_{it}^{nonfinancial}$, exceeds aggregate wealth because of debt. We calculate the cumulative change of, e.g., financial wealth relative to the stock of wealth in 2008, $W_{i,2008}$, analogously to the computation of aggregate response according to equation (3).

Figure 10 shows the difference of the cumulative change between Lucerne and Bern. Both financial and nonfinancial taxable wealth clearly increased subsequent to the Lucerne tax cut. The cumulative effect by 2015 was 18.9 percentage points for gross financial wealth, 11.5 percentage points for gross nonfinancial wealth, and 4.8 percentage points for debt.[29]

Housing.—Gross nonfinancial wealth is mostly housing wealth. As we do not observe mortgage debt separately in the data, we apportion debt to the two wealth types. According to Swiss National Bank statistics, mortgage loans account for 94 percent of household debt.[30] For an approximative decomposition, we shall therefore apportion 94 percent of debt to nonfinancial assets and the remaining 6 percent to financial assets. With this attribution of debt to assets, the total increase in stayer wealth of 25.6 percentage points can be decomposed into 7.0 percentage points (or $7.0/25.6 = 27$ percent) from nonfinancial wealth and 18.6 percentage points (73 percent) from financial wealth. This, in turn, implies that the effect from nonfinancial assets—mainly housing—represents 21 percent ($= 7.0/33.7$) of the aggregate response.

When expressed relative to the initial share of nonfinancial wealth of 40.7 percent (Table 4), the increase of 7.0 percentage points implies an increase of 17.2 percent ($=$ 7.0 percent/40.7 percent) in the taxable value of nonfinancial assets. This estimated effect corresponds well to the observable differential growth of real estate prices in Lucerne relative to Bern. The cumulative price growth differential between 2008 and 2013 was 4.6 percentage points for rental properties, 7.0 percentage points for condominiums, and 13.3 percentage points for single-family houses (see

[28] According to the Lucerne data, some 78 percent of nonfinancial wealth is real estate. Some 3 percent is wealth from closely held firms. The remainder consists mainly of durable luxury items and life insurance assets. The Bern data allow no such decomposition.

[29] The 25.6 ($= 18.9 + 11.5 - 4.8$) percentage point response by stayers and the 8.1 percentage point response by movers (Section VC, "Taxpayer Mobility") add up to the aggregate response of 33.7 percentage points (Section VB).

[30] See https://data.snb.ch/en/topics/uvo.

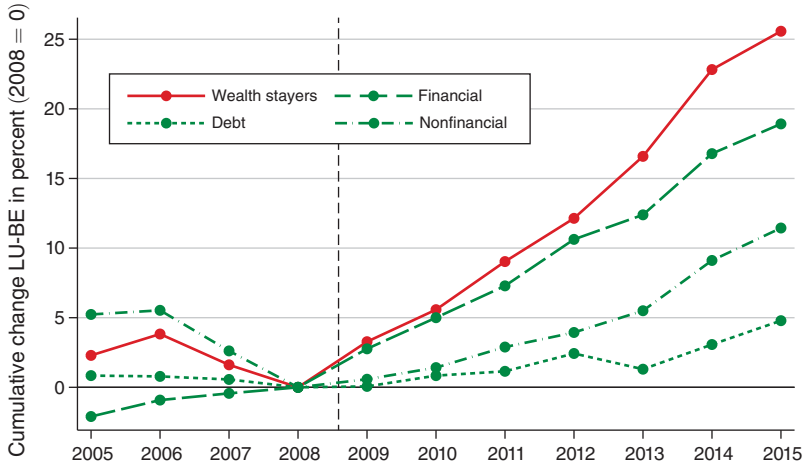


FIGURE 10. CONTRIBUTION OF CHANGES IN FINANCIAL WEALTH AND DEBT, STAYERS ONLY

Notes: The graph shows cumulative differential changes in wealth of Lucerne relative to Bern for taxpayers who do not move between $t-1$ and t ("stayers"), scaled to differential wealth in 2008. It also shows the contributions to the total effect from stayers by changes in financial wealth and in debt. The 2015 values of the depicted series are, respectively, 25.6 p.p. for differential wealth, 18.9 p.p. for financial wealth, 4.8 p.p. for debt, and 11.4 p.p. for nonfinancial wealth. Separate graphs for Lucerne and Bern are shown in Figure B13 in the online Appendix.

Figure 11).[31] Considering that increased taxable housing wealth includes also new builds, the observed price changes by 2013 seem roughly consistent with a 17.2 percent rise in average housing wealth by 2015.

We note that the evolution of housing prices shown in Figure 11 confirms the pertinence of our empirical setting: while Lucerne and Bern housing prices evolved in parallel prior to 2009, a very clear divergence appears concurrently with Lucerne's wealth tax cut of 2009. The parallel trends in housing prices confirm that there were no diverging tendencies in locational attractiveness between the two cantons prior to the 2009 wealth tax reform.

Summarizing the results obtained so far, we find that the aggregate response can be decomposed as follows. Some 21 percent are due to capitalization into housing prices, some 24 percent are due to taxpayer mobility, and some 50 percent are due to changes in the taxable financial assets of immobile taxpayers.

[31] Price indices for single-family houses and condominiums are based on transaction-price data collected by commercial banks and provided by the real estate consultancy firm Fahrländer Partner (1985–2013). These transactions cover some 60 percent of real estate sales in Switzerland. Fahrländer and Lehner (2016) estimate municipality-year-level price indices with a hedonic model controlling for object size, age, and renovation status, as well as for canton fixed effects, but, importantly, not including fiscal variables. We compute population-weighted means for both cantons using population data for 2010 from the Swiss Federal Statistical Office (1991–2020). Rental prices are based on offer prices for individual units provided by Fahrländer Partner (1985–2013). We run a hedonic regression of rental price (in logs) on type of housing, number of rooms, surface area, gross versus net price, floor number, existence of balcony, an indicator for good views, and canton-year fixed effects. Exponentials of these fixed effect estimates then serve as rental price index values.

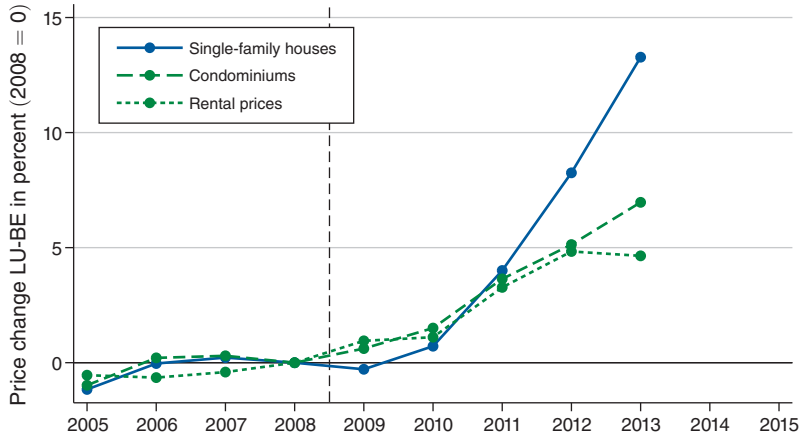


FIGURE 11. EVOLUTION OF HOUSING PRICES, LUCERNE VERSUS BERN

Notes: The graph shows the difference in price indices for single-family houses and condominiums in Lucerne and Bern up to 2013. The difference in 2013 relative to 2008 was 13.3 p.p. for single-family houses, 7.0 p.p. for condominiums, and 4.6 p.p. for rental prices. Separate graphs for Lucerne and Bern are shown in Figure B14 in the online Appendix.

Earnings.—One mechanism through which the wealth of immobile taxpayers could respond is adjustments to labor supply: individuals could adapt their wealth accumulation in response to lower wealth taxes by generating higher or lower earnings, depending the dominance of substitution or income effects (Ring 2021).

For this mechanism to have explanatory power over the seven-year time horizon we consider, it would require sizable earnings adjustments. For example, for the roughly 18.9 percentage point nonmechanical response of stayer financial wealth to be explained solely by changed earnings, given an average wealth/earnings ratio of around 5 and a savings rate of around 0.2, the Lucerne wealth tax would need to have triggered a differential increase in Lucerne annual earnings of some 10 percent annually.

We explore the response of the earnings of stable households aged 30–50 in 2008, thus focusing on prime working years and eliminating effects due to retirement. We find no effect of the wealth tax cut on earnings. If anything, earnings growth in Lucerne post-2008 was somewhat lower than in Bern. However, that appears to have been the continuation of a trend that applied already before 2009, and the tax cut did not have any discernible effect. In the top 0.1 percent wealth category, the wealth tax cut seems to have been associated with lower earnings growth, but this series is based on fewer than 80 taxpayers and thus rather volatile.[32]

Savings and the Mechanical Effect.—Another potential "real" response to wealth taxation is changed consumption and savings behavior. Some increases in taxable

[32] For a graphical representation, see Figure B18 in the online Appendix.

wealth may be mechanical—i.e., the mere result of higher posttax wealth due to the lower tax rate, assuming all tax savings are left unspent. To this end, we simulate how aggregate wealth in Lucerne would have evolved after the tax cut in the absence of any behavioral responses.

We calculate the counterfactual postreform growth rate of wealth as the growth rate of aggregate wealth in the canton of Bern before tax payments, i.e., $g_t = \left(W_{BE,t} + T_{BE,t-1} - W_{BE,t-1}\right)/W_{BE,t-1}$, where $W_{BE,t}$ is observed aggregate wealth in Bern at time t and $T_{BE,t-1}$ are tax payments on wealth at time $t-1$.[33] We find postreform annual growth rates of pretax aggregate wealth in Bern between 0.9 and 5.9 percent, with an average of 3.8 percent. We then iteratively calculate the postreform evolution of counterfactual wealth in Lucerne without behavioral responses as $\tilde{W}_{LU,t-1}\left(1 + g_t - \tau_{LU,t}\right)$, where $\tau_{LU,t-1}$ is the Lucerne wealth tax rate. We calculate $\tilde{W}_{LU,t}$ with and without wealth tax reform, i.e., $\tau_{LU,t} = \tau_{LU,2008}$ for all $t > 2008$. The difference, expressed as a percentage of prereform wealth $W_{LU,2008}$, is then the mechanical effect, assuming that tax savings are invested and yield the same return as the stock of wealth.[34]

We find a cumulative mechanical effect of 1.9 percentage points in 2015.[35] Accordingly, 5.7 percent of the estimated 33.7 percentage point aggregate response can be attributed to mechanical tax savings and the return thereon. If some of the mechanical tax savings were consumed—which we implicitly assume not to be the case—this effect would be smaller. Using top tax rates also biases this estimate upward. We can alternatively use average tax rates, computed as the mean ratio of individual wealth tax bills to taxable wealth. In that case, the estimated mechanical effect shrinks to 1.1 percentage points, or 3.3 percent of the aggregate response.

In order to investigate the savings mechanism directly, we can resort to survey data on household finances.

We use data from the Swiss Household Budget Survey (Swiss Federal Statistical Office 2006–2008, 2012–2014) for a difference-in-difference estimation of the changes in incomes and savings associated with the Lucerne tax reform. These calculations are shown in the final column of Table 6. We find that between 2007 and 2013, per-household disposable incomes have increased by 8.2 percentage points more in Lucerne than in Bern, and per-household savings have increased by 3.5 percentage points more. This implies that savings rates have increased by 0.2 percentage points more in Lucerne than in Bern—consistent with an increase in household savings rates in Lucerne associated with the 2009 wealth tax reform.

How large is this effect relative to the aggregate response implied by the tax data? If we linearly interpolate total income as observed in Table 6, an immediate and constant 0.2 percentage point increase in the savings rate from 2009 onward translates into a stock of wealth that is some CHF 0.18 billion higher by 2015. We can compare this

[33] For simplicity, we assume a linear wealth tax, i.e., $T_{BE,t} = \tau_{BE,t} \times W_{BE,t}$, where $\tau_{BE,t}$ is the observed top marginal tax rate in the Bern, and hence $g_t = \Delta W_{BE,t}/W_{BE,t-1} + \tau_{BE,t-1}$. The true average wealth tax rates are lower than the top marginal rate because of the exemption threshold and, in the case of Bern, the progressivity of the tariff above the threshold (see Figure B1 in the online Appendix). Hence, our reported mechanical effect is an upper-bound estimate.

[34] This calculation takes account of deferred tax payment in Switzerland by assuming that taxes on wealth at time $t-1$ are paid in the subsequent year t and hence still yield a return g_t between $t-1$ and t.

[35] For a graphical representation, see Figure B10 in the online Appendix.

TABLE 6—SAVINGS AND WEALTH: EVIDENCE FROM HOUSEHOLD SURVEY DATA

	Lucerne (LU)			Bern (BE)			LU – BE
	2007 (1)	2013 (2)	Growth =((2)/(1))–1 (3)	2007 (4)	2013 (5)	Growth =((5)/(4))–1 (6)	Diff-in-diff =(3)–(6) (7)
Income/househ. (CHF)	75,595	86,862	14.9%	76,142	81,279	6.7%	8.2%
Total income (bn CHF)	11.35	14.30	26.0%	33.09	36.53	10.4%	15.7%
Savings/househ. (CHF)	11,725	17,935	53.0%	9,381	14,019	49.5%	3.5%
Total savings (bn CHF)	1.76	2.95	67.8%	4.08	6.30	54.5%	13.3%
Savings/income	15.5%	20.6%	5.1%[a]	12.3%	17.2%	4.9%[b]	0.2%
Wealth inc./househ. (CHF)	3,249	4,646	43.0%	4,001	4,514	12.8%	30.2%
Total wealth inc. (bn CHF)	0.49	0.76	56.9%	1.74	2.03	16.7%	40.2%
Households	150,100	164,652		434,633	449,384		

Notes: All CHF amounts reported per annum. Income defined as recurrent disposable income after taxes and compulsory insurance contributions, plus sporadic income. Savings defined as disposable income minus consumption expenditure and voluntary insurance contributions. Wealth income defined as interest and dividends from financial assets and rental income from real estate. Data based on stratified random household samples; annual sample size $\approx$ 10,000 nationwide. Data for 2007 in the table are averages for sampling years 2006–2008. Data for 2013 in the table are averages for sampling years 2012–2014. Households are defined here as people co-habiting. They can comprise more than one taxpayer (e.g., in the case of unmarried couples or of adult children living with their parents).

[a] =((2)–(1)).

[b] =((5)–(4)).

to our estimated aggregate response of 33.7 percentage points. Applied to Lucerne's 2008 aggregate wealth of CHF 51.6 billion, this implies a tax-cut-induced increase in reported wealth of CHF 17.4 billion by 2015. Taken literally, therefore, our estimated savings response can account for $\left(0.18 \text{ billion}/17.4 \text{ billion } =\right)$ 1.0 percent of the aggregate response.[36]

The savings response estimated from survey data is thus smaller than the mechanical effect, for which we estimate an upper bound of 5.7 percent of the aggregate response. Our estimated savings effect therefore implies that households on average do not save more than their mechanical tax savings. If we instead assume that the post-2009 Lucerne savings rate of around 21 percent (Table 6) also applied to tax savings, then the mechanical effect shrinks from 5.7 percent of the aggregate response to some 1.2 percent—very close to the estimated savings effect based on household survey data. In view of the likely imprecision of our survey-based estimate, we shall continue to consider 5.7 percent of the aggregate response as our upper-bound estimate for the savings response inclusive of the mechanical effect.

Our estimate of the, at most, 5.7 percent weight of savings in explaining the aggregate response at first sight contrasts with Jakobsen et al.(2020), who interpret the sizeable behavioral wealth responses observed in Denmark entirely in terms of responses in savings rates. However, recall from Section VB that the

[36] The modest size of the behavioral savings response could be attributed to the fact that Table 6 relies on survey data and that surveys sometimes struggle to accurately capture high-wealth households. Some 58 percent of the aggregate response to the Lucerne tax cut, after all, is driven by top 1 percent taxpayers (see Figure B3). However, it is striking how well the survey aggregates reported in Table 6 match aggregates from our administrative tax data. One variable that is comparable across the two datasets is income from wealth (interest, dividends, and rental income). When we compare these values for Lucerne as reported in Table 6 to aggregate wealth income from the tax records, we find the latter to be only 10 percent larger than the former on average. (We cannot make this comparison for Bern, as the Bern tax data do not separately identify income from wealth.) While there does seem to be some underestimation of wealth through household surveys, the difference appears to be minor.

implied semielasticity with respect to a 1 percentage point tax cut estimated from the Lucerne event study is 187 percent. 5.7 percent of a 187 percent response is a response of roughly 11 percent. Thus, the savings response we estimate is in the ballpark of the 17 percent semielasticity estimated for the second-highest wealth percentile in Denmark (see Table 2). Indeed, to replicate their observed behavioral responses, Jakobsen et al. (2020) need to calibrate their savings-only model with elasticity values that are "much larger than existing estimates" and recognize that their estimates "represent upper bounds on real wealth accumulation responses." While the magnitudes of estimated savings responses therefore seem comparable, we are able to quantify additional response margins, including mobility, house price capitalization and (by a process of elimination) evasion, all of which are likely to be larger in Swiss cantons than in Denmark, given cantons' smaller scale and lack of third-party reporting.

Evasion.—Yet another conceivable mechanism for the stayer response is evasion: after the wealth tax cut, taxpayers may have found tax savings from hiding wealth no longer to outweigh the associated monetary and psychic costs and thus decided to declare formerly undeclared assets or to more comprehensively declare newly acquired assets.

Given the absence of third-party reporting in Switzerland, both domestically and (in the period covered by our data) internationally, nondeclaration of domestic financial assets and all foreign assets was relatively easy.[37] However, nondeclaration carries costs even in a system with purely self-reported financial wealth. The 35 percent withholding tax on domestic financial assets cannot be claimed back unless the assets are declared. Moreover, nondeclared assets cannot be used for large domestic real estate purchases (as this would be visible to tax authorities), place a burden on heirs when they are bequeathed, and risk back taxes, fines, and even prison sentences if detected.[38]

While evasion by definition is not observed, there are ways of finding suggestive patterns in the data. We consider three complementary approaches: tracking income from wealth in household survey data, analyzing bunching behavior at tax thresholds, and exploring voluntary self-disclosure before and after tax reform.

Reported Income from Wealth.—Our first approach is to return to the household survey data summarized in Table 6. Difference-in-difference analysis suggests that Lucerne savings rates increased only modestly after the wealth tax cut relative to those observed in Bern. Nonetheless, due to higher income growth in Lucerne, Lucerne savings per household grew 3.5 percentage points faster than Bern savings per household. Over the same period, however, reported per-household income

[37] Domestic real estate, being recorded in land registries, was much riskier not to declare. Assets held abroad were entirely self-reported until 2017, when Switzerland adopted the OECD's global standard on the automatic exchange of financial account information.

[38] Swiss tax law is relatively lenient on tax evaders in that it distinguishes between "tax evasion," defined as the nondeclaration of assets and income components, and "tax fraud," defined as the evasion of tax liabilities through falsified documents. Tax evasion, when detected, is sanctioned through back taxes and fines but generates no criminal record. Detection mainly occurs through audits by the tax authorities triggered by inconsistent income and wealth filings or through denunciation. Penal sanctions apply only to tax fraud.

from wealth increased 30.2 percentage points faster in Lucerne than in Bern. Other than measurement error, there are only two possible explanations for this phenomenon: either Lucerne residents managed to generate considerably higher asset returns postreform than Bern residents, or Lucerne residents revealed more of their previously hidden wealth postreform than Bern residents.[39] Given that the two cantons are part of a frictionless capital market, the evasion margin appears as the more plausible of the two mechanisms.

Bunching below Tax Thresholds.—As argued by Jakobsen et al. (2020) and empirically supported by Seim (2017), bunching of taxable wealth likely reflects evasion and avoidance behavior rather than real earnings and savings responses. Precise targeting of taxable wealth is difficult, as prices of financial assets and, to a lesser extent, real estate are uncertain and often volatile. Hence, bunching can be considered a lower-bound indicator of evasion responses.

We observe evident bunching of reported wealth just below exemption thresholds in both Lucerne and Bern (for details, see online Appendix Section B.3). Assuming equal movement from the wealth distribution above the threshold to below the threshold, our analysis suggests that bunching in the exempt range accounts for a 0.2–0.3 percent reduction in the taxable wealth of the two cantons. At face value, this would suggest a small role for avoidance/evasion behavior. However, bunching should realistically be considered as providing a measure that is (i) local, i.e. relevant mainly for filers with true wealth close to the threshold, and (ii) downward biased due to the difficulty of targeting taxable wealth at a particular value. To the extent that these two features apply across countries, it is informative to compare our bunching results to those found elsewhere.

We find that observed bunching below exemption thresholds implies net-of-tax elasticities of about 0.7 in Lucerne and 0.8 in Bern (see online Appendix Section B.3). These magnitudes can be compared to bunching-based estimates found for other countries. Seim (2017) reports an elasticity of up to 0.27 for Sweden, and Londoño-Vélez and Ávila-Mahecha (2019) find a value of 0.6 for Colombia.[40] The results reported by Jakobsen et al. (2020) imply a corresponding bunching-based estimate of 0.14 for Denmark. Hence, bunching behavior below exemption thresholds, while quantitatively negligible relative to aggregate taxable wealth, seems to be more elastic in Switzerland than in other countries—especially Scandinavia. This is particularly striking given that bunching thresholds apply for much lower wealth levels in Switzerland than in Sweden and Colombia and that evasion technologies are commonly viewed as more easily accessible for very wealthy individuals (Alstadsæter, Johannesen, and Zucman 2019).

Our finding that bunching-based elasticities in Switzerland are large even at low wealth levels implies that fixed costs of evasion are low. This is likely due to the

[39] Wealth revelation in the survey data means declaration to an interviewer, not to the tax authority. While not verifiable in the data, it is plausible to assume wealth declarations to tax authorities and to the statistical office to be highly correlated.

[40] Londoño-Vélez and Ávila-Mahecha (2019) report a lower-bound and an upper-bound bunching estimate. The value we cite here is their lower-bound, "bunching-hole," estimate, which corresponds to the estimation method used by Seim (2017) as well as in this paper.

self-reporting principle of the Swiss tax system, combined with banking secrecy. Hence, evasion may well be "affordable" also for the moderately wealthy. This is consistent with our finding in Section IV that the magnitude of behavioral responses to wealth taxes is only weakly increasing in wealth.[41]

Voluntary Self-Disclosures.—Characterizing the evasion response is notoriously difficult. We attempt this through the lens of voluntary self-disclosures.[42] Undeclared assets discovered by Swiss tax authorities through denunciation or audits are usually charged ten years' worth of back taxes plus a fine equivalent to 100 percent of those back taxes. Until 2010, taxpayers had the option of voluntarily declaring formerly hidden assets, which reduced the fine to 20 percent of the back taxes. A federal law passed in 2008 and in force since 2010 reduces the fine imposed on first-time voluntary self-disclosures to zero. This law is sometimes referred to as the "mini tax amnesty."

We can establish that voluntary disclosures in Lucerne were larger than those in Bern, and they clearly increased after 2009 tax cut and the 2010 mini tax amnesty.[43]

We estimate that the Lucerne tax cut triggered voluntary self-disclosures of previously hidden assets worth some CHF 256 million—about 1.5 percent of the aggregate response.[44] The fact that we do not detect much of an interaction effect between the tax cut and the voluntary disclosure program is consistent with theory. When penalties are proportional to back taxes owed, as is the case in Switzerland, the Allingham–Sandmo–Yitzhaki model of tax evasion implies that cheating is independent of tax rates.[45]

The self-disclosures documented here concern only cases in which taxpayers formally announce previously undeclared assets and the tax authority opens a special procedure resulting in a separate invoice for back taxes and penalties owed. They do not include situations in which taxpayers reveal formerly undeclared assets without notifying the authority about that fact.[46] According to our

[41] A similar invariance of effects to wealth levels also emerges in our analysis of heterogeneous responses in Section VD below.

[42] Another conceivable approach is to match administrative tax records to leaked offshore account data such as those made public in the Panama Papers (see Londoño-Vélez and Ávila-Mahecha 2019). This is not possible in our case, as our tax records are anonymized.

[43] Voluntary self-disclosures are not integrated into administrative tax records and are thus poorly documented. However, we have obtained data on aggregate voluntary disclosures in Lucerne for our full 2005–2015 sample period (Dienststelle Steuern des Kantons Luzern 2019) and in Bern for the postamnesty period 2010–2015 (Steuerverwaltung des Kantons Bern 2019). The data for Lucerne were generously made available to us by the Lucerne cantonal tax administration. Their pre-2010 data are estimates based on aggregate revenues from back taxes and fines. The evolution of the two data series in per-taxpayer terms is illustrated in Figure B19 in the online Appendix.

[44] We net out the post-2009 increase in voluntary self-disclosures in Lucerne relative to Bern as follows. The cumulative volume of voluntarily self-disclosed assets in Lucerne over the period 2010–2015 was CHF 828 million. The corresponding total for 2004–2009 was CHF 117 million. Hence, the net increase post-2010 was CHF 711 million. Self-disclosures in Bern corresponded to 64 percent of those in Lucerne in per capita terms post-2009 (see Figure B19 in the online Appendix). Assuming that the higher self-disclosure volume in Lucerne was due to the interaction of the mini tax amnesty and the tax cut, we can interpret the difference in post-2009 per capita disclosures as the effect of the Lucerne tax cut. The upper bound of our estimated cumulative response by financial assets is 18.6 p.p. (see Section VC, "Housing"). Given that Lucerne total taxable wealth was CHF 50.4 billion in 2008, this implies that the Lucerne tax cut triggered an increase in declared assets of CHF 9.4 billion. Hence, about 2.7 percent of the response of financial assets can be explained by voluntary self-disclosures.

[45] See, e.g., Slemrod and Yitzhaki (2002); Kleven et al. (2011).

[46] They also do not cover cases where taxpayers make a formal announcement but the tax authority does not open a special procedure, instead incorporating additional taxes owed in the standard annual tax invoice. This

decomposition of the aggregate response in Section VC, some 49 percent of the aggregate response remains unexplained after considering savings and mechanical effects, house-price capitalization, and taxpayer mobility. With only between 1 and 2 percent of the aggregate response attributable to self-disclosures, the natural conclusion is that close to half of the aggregate response is due to declarations of previously hidden assets that are not disclosed as such to the tax authority. This is consistent with our finding that the response builds up gradually and over a long time horizon, since large undeclared wealth can be declared only in small installments if it is not to arouse the tax authority's suspicion.

D. *Response Heterogeneity*

The decompositions of Section VC are informative from a fiscal policy viewpoint, but they do not show whether behavioral responses differ across the wealth distribution. To complement those decompositions, we now report behavioral responses, which we compute as cumulative changes relative to wealth at the beginning of each yearly change.

Analogously to Section VC, "Financial and Nonfinancial Wealth," we decompose year-t aggregate wealth of stayer households into financial wealth, nonfinancial wealth, and debt, but unlike in that subsection, we calculate the cumulative change by adding up the yearly log differences with respect to the reference year 2008:

$$\omega_{it}^{financial} = \begin{cases} -\sum_{s=t+1}^{2008} \ln\left(W_{is}^{financial}/W_{i,s-1}^{financial}\right), & \text{if} \quad t \leq 2007; \\ 0, & \text{if} \quad t = 2008; \\ \sum_{s=2009}^{t} \ln\left(W_{is}^{financial}/W_{i,s-1}^{financial}\right), & \text{if} \quad t \geq 2009. \end{cases} \tag{6}$$

The cumulative log change computed in this way approximately corresponds to the percentage change of the wealth component. As before, we report the difference between the change in Lucerne and Bern.

Figure 12 shows those calculations for financial wealth, nonfinancial wealth, and debt. Behavioral responses are most pronounced for financial wealth. By 2015, Lucerne reported that financial wealth had increased some 0.36 log points (44 percent). This shows that the large contribution of financial wealth to the aggregate effect found in Figure 10 is due to both the stronger response of financial wealth and its larger share in the base-year total.[47]

In the left-hand-side panel of Figure 13, we show responses across wealth quantiles, focusing on the top 10 percent and top 1 percent brackets.[48] Strikingly, the behavioral response of top 1 percent taxpayers is almost identical in magnitude to

"simplified procedure" is applied in about 10 percent of self-disclosures, where the disclosed amounts are too small to justify the opening of a special procedure. These cases are therefore of negligible importance.

[47] According to Table 4, and if we attribute 94 percent of debt to nonfinancial assets, we find that in the base year 2008, the share of financial wealth was 59.3 percent in Lucerne and 58.7 percent in Bern.

[48] The top 1 percent category exhibits a negative pretrend in Figure 13, and a similar pattern appears for nonfinancial wealth in Figure 12. Examination of the individual-level data shows this to be linked to the residential choices of a single exceptionally wealthy family in the canton of Bern. Ignoring the observations linked to that family would remove those pretrends, but we prefer not to selectively omit data points.

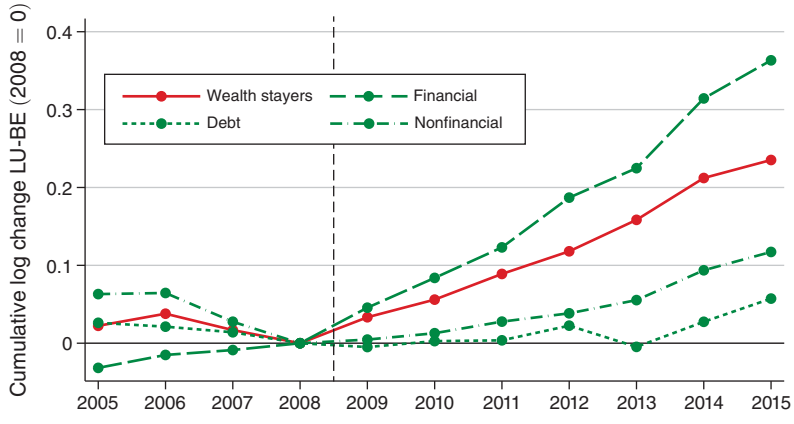


FIGURE 12. BEHAVIORAL RESPONSE OF FINANCIAL WEALTH AND DEBT, STAYERS ONLY

Notes: The graph shows cumulative differential log changes in the wealth, financial wealth, nonfinancial wealth, and debt of Lucerne relative to Bern for stayers. The graph shows cumulative differential log changes in total wealth and its components of Lucerne relative to Bern for taxpayers who do not move between $t-1$ and t ("stayers"). The 2015 values of the depicted series are, respectively, 0.235 for total wealth, 0.363 for financial wealth, 0.057 for debt, and 0.117 for nonfinancial wealth. Separate graphs for Lucerne and Bern are shown in Figure B15 in the online Appendix.

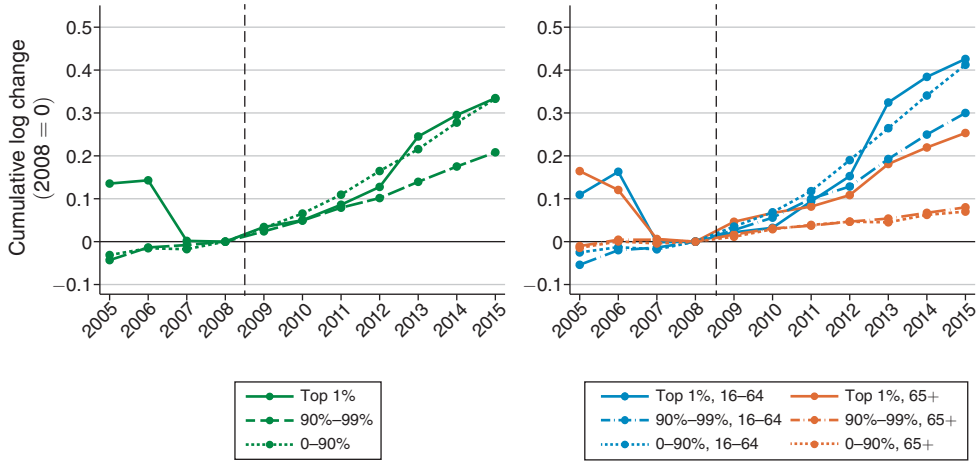


FIGURE 13. BEHAVIORAL RESPONSE ACROSS WEALTH BRACKETS AND AGE, STABLE HOUSEHOLDS ONLY

Notes: The left-hand-side graph shows cumulative differential log changes in wealth by quantiles of the wealth distribution in Lucerne relative to Bern for "stable" taxpayers. The 2015 values of the depicted series are, respectively, 0.335 for the top 1 percent, 0.208 for percentiles 90–99, and 0.333 for the remaining percentiles 0–90. Separate graphs for Lucerne and Bern are shown in Figure B16 in the online Appendix. The right-hand-side graph shows cumulative differential log changes in wealth of different wealth quantiles by age groups older/younger than 65 in 2008, in Lucerne relative to Bern for "stable" taxpayers. The 2015 values of the depicted series are, respectively, 0.426 for the top 1 percent, age 16–64; 0.253 for the top 1 percent, age 65 and older; 0.300 for percentiles 90–99, age 16–64; 0.080 for percentiles 90–99, age 65 and older; 0.412 for percentiles 0-90, age 16–64; and 0.070 for percentiles 0–90, age 65 and older. Separate graphs for Lucerne and Bern are shown in Figure B17 in the online Appendix.

that of bottom 90 percent taxpayers, while that of the top 90–99 percent taxpayers appears to be considerably lower.

The patterns shown in the left-hand-side panel of Figure 13 do not point toward systematically stronger behavioral responses as one moves up the wealth distribution. This result might, however, be influenced by unobserved confounding factors. A natural candidate is age: wealthier taxpayers tend to be older, and older households might be less flexible in reoptimizing their financial affairs subsequent to a wealth tax cut. We have therefore additionally divided taxpayers into those below the official retirement age of 65 in 2008 and those above the official retirement age. These results are shown in the right-hand-side panel of Figure 13. It can be seen that younger taxpayers react more strongly than older taxpayers, irrespective of their level of wealth. There is evidence of top 1 percent taxpayers reacting more strongly than the rest, irrespective of age. Among the younger taxpayer group, however, we again observe that top 90–99 percent taxpayers respond somewhat less strongly than the bottom 90 percent taxpayers. The general conclusion is that the young, defined as being below retirement age, respond significantly to wealth taxation, whereas among the old only the very wealthy show significant responses.

An approximately constant behavioral elasticity across wealth levels of course does not mean that all wealth brackets contributed equally to the aggregate response documented in Section VB. Given their disproportionately higher shares of total prereform wealth, the top wealth brackets still accounted for the major part of the aggregate response. We for instance find that top 1 percent taxpayers accounted for 58 percent of the aggregate response by stable households.[49]

VI. Revenue Effects

In view of the large observed behavioral responses, it is interesting to consider the revenue implications of wealth tax changes. Did wealth tax cuts in Swiss cantons pay for themselves?

We first estimate the effect of wealth tax changes on wealth tax revenue through our cross-canton panel dataset used in Section IV. Data on wealth tax revenue are taken from the Swiss Federal Finance Administration (1990–2019).[50] These data record consolidated cantonal and municipal tax payments in a given year on a cash flow basis. As it can take several years for tax assessments to be finalized and billed, the tax payments in these data do not match exactly with tax liabilities accrued in a particular year.

Unlike for the estimation of the tax base response in equation (1), we now use $\ln(\tau_{i,t-j})$ rather than $\ln(1-\tau_{i,t-j})$ as the explanatory tax variable. This is the relevant effect from the point of view of the policymaker, and it allows us to interpret the estimated coefficients directly as elasticities. We estimate the following distributed lag model in first differences:

$$\Delta \ln W_{it} = \sum_{j=-2}^{6} \gamma_j \Delta \ln(\tau_{i,t-j}) + \theta_t + \Delta \varepsilon_{it}, \tag{7}$$

[49] For further details and graphical representations, see online Appendix Section B.5.
[50] See also online Appendix Section A.1.

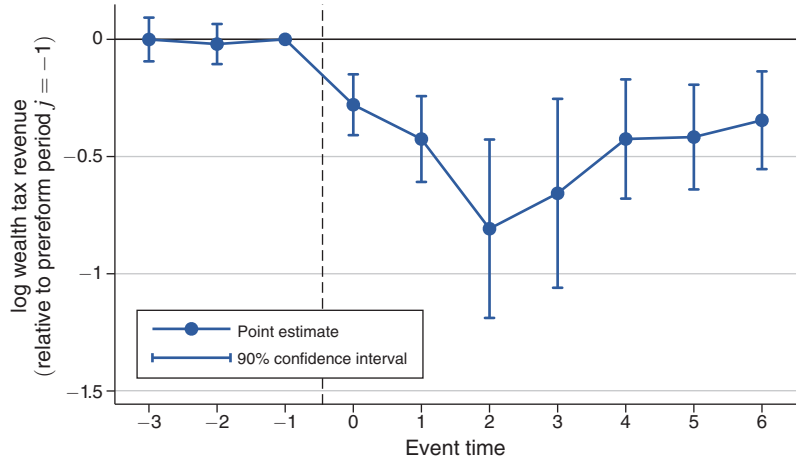


FIGURE 14. WEALTH TAX REVENUE: CROSS-CANTON DISTRIBUTED LAG MODEL

Notes: Regression of consolidated wealth tax revenue (canton + municipalities, in logs) on the wealth tax rate (in logs) as reported in column 2 of Table A4 in the online Appendix. Distributed lag model with six lags and two leads estimated in first differences with nonparametric controls (initial share of millionaires × year dummy). Visualized effects are the cumulative coefficients after and before the reference year, defined as the year prior to the event. As in Table A4, we inverse the sign of the effect to visualize the effect of a tax cut. Estimated effects are elasticities and can be interpreted as the percentage effect of a 1 percent reduction in the wealth tax rate.

where $\tau_{i,t}$ is the top marginal wealth tax rate in canton i and year t. First differencing $\Delta \ln W_{it} = \ln(W_{it}) - \ln(W_{i,t-1})$ eliminates canton fixed effects μ_i. In the specifications that include income and bequest taxes, we consider the net-of-income-tax rate and the net-of-bequest-tax rate in logs with the same number of leads and lags as considered for the wealth tax. The cumulative effect relative to the year prior to the reform is recovered from the distributed lag coefficients γ according to equation (2).

Our estimations show that the medium-term elasticity of tax revenue with respect to the tax rate is somewhere in the range between -0.27 and -0.36.[51] This confirms that behavioral responses significantly reduce the revenue effects of tax-rate changes, but are not strong enough to let tax cuts pay for themselves. The timing of these effect is illustrated in Figure 14: an initial drop in revenue following a tax cut—somewhat delayed in our data because of the cash flow accounting of revenues—is followed by a gradual increase attributable to the behavioral response. That gradual increase, however, does not compensate for the initial drop in revenue within our six--year data window.

We also consider the revenue implications of the Lucerne tax cut—for which we found a particularly large behavioral response. Compared to the prereform top wealth tax rate of 0.58 percent, the differential 0.18 percentage point tax cut in Lucerne relative to Bern represented a change of -31 percent. After 6 years, this drop in the tax rate had triggered a 33.7 percent increase in declared wealth (our estimated aggregate response; see Figure 7), implying a tax base elasticity of

[51] For detailed results, see Table A4 in the online Appendix.

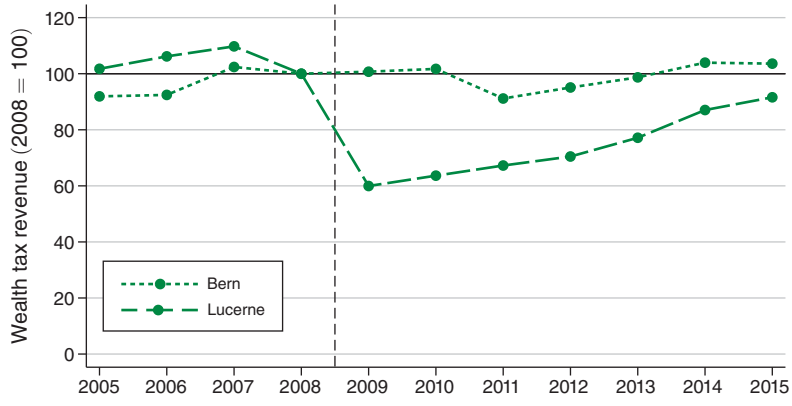


FIGURE 15. WEALTH TAX REVENUE: LUCERNE VERSUS BERN

Notes: The graph shows annual wealth tax revenues in Lucerne and Bern, scaled relative to 2008 values set to 100. Revenue aggregated from individual tax records. The 2015 values of the depicted series are, respectively, 103.6 for Bern and 91.6 for Lucerne.

$-0.78\big(=\ln[1+0.337]\big)/\ln[1-0.31]\big)$—still below unity in absolute value. Figure 15 shows the resulting evolution of wealth tax receipts in Lucerne and Bern. These revenue series are calculated from our individual-level data and cantonal tax multipliers (Steuerverwaltung des Kantons Bern 2021; Dienststelle Steuern des Kantons Luzern 2003–2022) and are therefore attributed to the exact tax year for which the taxes were due. We observe that by 2015 Lucerne's wealth tax revenues remained below their prereform level. The strong aggregate tax base response was not strong enough, up to 2015, for the tax cut to yield Laffer effects.[52]

VII. Concluding Discussion

The growth in wealth inequality observed in many countries has led to a renewed focus on redistributive taxation. This focus has included the notion of expanding the package of redistributive tax tools to include an annual wealth tax. In fact, OECD nations have been moving in the opposite direction over the past decade, with most nations abandoning annual wealth taxation. The major exception is Switzerland, which has by far the largest wealth tax in the OECD relative to the size of government. Despite the policy interest in this area and renewed scientific attention, ours is the first analysis of responses to wealth taxation that is based on variation across multiple jurisdictions.

In this paper we explore the role of annual wealth taxes using policy heterogeneity within Switzerland. We can draw both on aggregate data reporting wealth

[52] The main reason why wealth tax revenues in Bern did not fall in 2009 despite the tax cut is the recovery of asset prices subsequent to the financial crisis. For a full assessment of the fiscal effects of the Lucerne wealth tax cut, one would need to take account also of other taxes paid by in-movers attracted by low wealth taxes.

holdings across cantons, matched to cantonal variation in wealth taxes, and on microdata reporting individual-level wealth holdings in two cantons, Lucerne and Bern, exploiting a quasi-random difference in the size of their wealth tax cuts in 2009. Both datasets deliver the same bottom line: reported wealth holdings are highly sensitive to wealth taxation. According to our baseline cross-canton panel estimate, a 1 percentage point increase in wealth taxes leads to 43 percent lower wealth holdings after 5 years. When we focus on the ten largest reforms, this semielasticity doubles in size. Our case study based on the canton of Lucerne cutting its wealth tax in half even implies a semielasticity of 187 percent. Nevertheless, even our largest estimated elasticities imply that wealth tax cuts caused revenue losses.

We can compare our findings to existing estimates in the elasticity of taxable income literature. As the wealth tax is an annual tax on a stock of wealth, while the income tax is an annual tax on a flow of wealth, we ask how large our estimated wealth response is relative to the implied net-of-tax rate on the annual flow of capital income. For the purpose of this illustrative calculation, we assume a rate of return of 4.5 percent.[53] With this assumed rate of return, a 1 percentage point increase in the wealth tax corresponds to a 41.1 percent reduction in the keep rate.[54] Such a drop in the keep rate, according to our baseline estimate, lowers wealth by 43 percent, which corresponds to an elasticity of 43 percent/41.1 percent $=$ 1.05.

This elasticity of approximately one is large relative to previously estimated taxable income elasticities. Such keep-rate elasticities, however, are sensitive to what we assume the rate of return to be. If we take 3 percent as our representative return instead of 4.5 percent, the elasticity drops to 0.70; and if we instead assume 10 percent, the elasticity rises to 2.32. Even the conservatively estimated elasticity implied by a 3 percent return clearly exceeds the range of estimates for the net-of-tax elasticity of taxable income of 0.12–0.40 reported by Saez, Slemrod, and Giertz (2012).

Crucially, available individual-level tax records for two cantons allow us to decompose the tax base response to the large and quasi-random Lucerne tax cut relative to the response to the much smaller tax cut in neighboring Bern. We find that some 24 percent of the aggregate response can be attributed to net taxpayer migration, 21 percent can be attributed to a concurrent rise in reported real estate values, and up to 6 percent can be attributed to increased savings, including the mechanical effect of lower wealth taxation. We observe no effect on earnings. Hence, by a process of elimination, it would appear that the remaining unexplained changes in declared financial assets—49 percent of the aggregate response—could be driven

[53] We do not have exact measures of returns to private wealth in Switzerland, but evidence from neighboring countries suggests returns in 2010 of 4–4.5 percent in France and 7–7.5 percent in Germany (Piketty and Zucman 2014). Probably the most precise estimates have been produced for Norway, where the average return on wealth, including capital gains, is estimated at 3.8 percent for the 2005–2015 period (Fagereng et al. 2020), and for Sweden, where the real return on median household wealth is estimated at 4.6 percent for the 2000–2007 period (Bach, Calvet, and Sodini 2020).

[54] The calculation is as follows. The mean (municipal + cantonal + federal) income tax rate on high-income households in Switzerland is around 35 percent. To this we add the mean average wealth tax rate of 0.5 percent, which corresponds to 11.1 percent of a 4.5 percent capital return. Hence, the "keep rate" after consolidated income + wealth taxes is $1 - (0.35 + 0.11) = 54$ percent. A 1 percentage point increase in the wealth tax would represent an increase in the tax rate on capital income by 22.2 percentage points, from 11.1 percent to (0.5 percent + 1 percent)/4.5 percent $=$ 33.3 percent. This, in turn, implies a fall in the keep rate by 22.2 percentage points, i.e., 22.2 percent/54 percent $=$ 41.1 percent.

by evasion and avoidance behavior. Of that, only some 1 percent to 2 percent can be attributed to increased voluntary self-disclosures. Close to half of the apparent wealth accumulation following the tax cut would thus appear to be explained by gradual and stealthy self-reporting of previously hidden assets.

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