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Abstract

We investigate how revenues from taxing hydropower production affect local fiscal policy with data for municipalities in Switzerland in 1987–2015. Our instrumental variable approach uses exogenous variation in these revenues by combining the municipality-specific hydropower potential with the varying federally mandated ceiling on taxation of hydropower production. We find negative effects on tax rates and tax revenues, but insignificant spending effects. These results provide fresh evidence on how local authorities use exogenous revenues and on the flypaper effect for a setting with strong local fiscal autonomy and participatory institutions.

Keywords: Local fiscal policy, flypaper effect, natural resource revenues
JEL Codes: H71, H72, Q25, R51

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1 Introduction

Do local authorities use exogenous revenues as other resources or do they largely spend them? Many local jurisdictions receive substantial exogenous revenues, such as grants and natural resource rents, that are independent of their decisions. As any other resources, authorities can use these revenues to fund public sector activities or return them to citizens to finance private consumption. Indeed, one would expect that the distribution of exogenous revenues across the public and private sectors mirrors that of other resources. However, many scholars (see below) contend that such revenues have much larger effects on public expenditures than comparable increases in local incomes. Large discrepancies between the use of exogenous and other resources would indicate that substantial distortions plague the process of setting and implementing policies and that the policies fall far short of first-best solutions. Thus, the use of exogenous resources provides information on the functioning of the political process.

We investigate how Swiss municipalities use their revenues from taxing hydropower production. They own the water rights and receive a *water fee* from hydropower plant operators. Federal law regulates the amount of the water fee and raised it several times over the years. Water fees come without strings and constitute a key source of public revenues in Switzerland's mountain areas. In 2015, they accounted on average for 6.6% of municipal revenues in the mountain cantons of Grisons and Valais. However, the differences between municipalities are considerable. With a share of over 50% of municipal revenues, water fees play a vital role in some municipalities.

Anecdotal evidence suggests that some municipalities use the hydropower revenues to finance local infrastructure, others to reduce taxes and debt.[1] Yet other municipalities are taking unconventional paths thanks to the flood of water fee money pouring in.[2] In one municipality, for example, every resident is entitled to substantial shopping vouchers and discounts as well as subsidized health insurance premiums.

Using an unbalanced panel of 235 municipalities in the cantons of Grisons and Valais over the period 1987–2015, we investigate how water fee revenues affect lo-

[1] See, e.g., Hosp, Janine (2017). "Das Steuerparadies für Familien," *Tages-Anzeiger*, July 6; Wirth, Dominic (2016). "Sorgenfalten in der Idylle," *St.Galler Tagblatt*, April 8.

[2] Humbel, Georg (2017). "Reich dank Wasserzinsen: Walliser Bergdorf verschenkt pro Jahr eine Viertelmillion Franken," *SRF online*, June 21.

cal fiscal policy. Water fee revenues are not completely exogenous. For instance, some municipalities may actively promote local economic development with infrastructure spending, low taxes, and hydropower exploitation. Others may push hydropower development to cover large expected financing needs. Hence, simply regressing fiscal outcomes on water fee revenues yields biased estimates.

We attack this problem with an instrumental variables (IV) approach. We combine the time-invariant hydropower potential of each municipality, which depends on local topographic and hydrological conditions, and the time-variant federal water fee rate. Our instrument measures the local water fee potential, i.e., the amount of revenues a municipality could expect on average if it fully developed its potential. It is not influenced by the decisions of local authorities and, thus, captures exogenous variation in water fees.

Simple fixed effects estimates show a roughly one-for-one rise in expenditures with water fee revenues. However, the IV estimates paint another picture. They reveal no statistically significant effects on expenditures, but negative effects on the tax multiplier (municipal surcharge on cantonal taxes) and tax revenues. A rise in water fee revenues by CHF 1 (roughly USD 1) lowers tax revenues by CHF 1.28. The effect on current expenditures is statistically insignificant, yet our demanding specification prevents us from ruling out any spending effects. Further, we find a statistically significant negative effect on net investment and statistically insignificant negative effects on current revenues and net debt change.

Our paper relates to the literature on the spending effects of exogenous revenues. According to standard economic theory, the use of fiscal resources should be independent of their source (Bradford and Oates, 1971) and depend only on the marginal propensity to spend. For the US (and similarly Switzerland), this would be around 5–15% (Hines and Thaler, 1995; Inman, 2008). Thus, the authorities should use exogenous revenues mainly to reduce taxes. Yet, many papers (for reviews, see Hines and Thaler, 1995; Gamkhar and Shah, 2007; Inman, 2008) report spending effects of grants and other exogenous revenues exceeding those of income – a phenomenon called the *flypaper effect* as "money seems to stick where it hits" (Arthur Okun cited in Inman, 2008, p. 1). Explanations for this effect refer to distortions in the process of setting and implementing policies such as taxation costs (Hamilton, 1986; Aragon, 2013), agency problems (Filimon et al., 1982; Singhal, 2008), and decision failures (Hines and Thaler, 1995).

The early literature often documents a one-for-one rise of spending with exogenous revenues. More recent and better-identified estimates paint a less coherent picture. Knight (2002) and Gordon (2004) isolate variation in highway and school grants induced by Congress members' influence and the grant formula, respectively. Both find little spending effects. In contrast, other studies find moderately to highly excessive spending effects by using exogenous variation in highway grants due to the grant formula and early highway layout plans (Leduc and Wilson, 2017) or exogenous variation in school grants caused by the introduction or reforms of grant programs (Cascio et al., 2013; Brunner et al., 2020). The same is true for studies exploiting formula- and reform-induced variation in unconditional grants in Sweden (Dahlberg et al. 2008), Brazil (Litschig and Morrison 2013), the US (Feiveson, 2015), Finland (Lundqvist, 2015), and Germany (Baskaran, 2016) or windfall revenues from lawsuit settlement payments (Singhal, 2008).

The differences in results may partly reflect institutional differences. Only with real local fiscal autonomy (Lutz, 2010; Koethenbuerger and Loumeau, 2019) and political processes respecting citizens' preferences would we expect local authorities to use grants in the same way as other resources. Using court-ordered changes in school grants in New Hampshire with strong fiscal autonomy and participatory institutions, Lutz (2010) shows that school grants predominantly reduce taxes. However, in another context with great fiscal autonomy (Swiss canton of Vaud), Koethenbuerger and Loumeau (2019) find inconclusive effects of formula-induced variation in grants on overall spending, large positive effects for some subcategories, and no effect on taxes. Our paper provides novel evidence for a setting with strong participatory institutions and substantial local fiscal autonomy. Our findings support the conjecture of Lutz (2010) on the importance of these institutional aspects.

The differences in results may also reflect differences in the nature of the exogenous revenues. Berset and Schelker (2020) argue that temporary resource shocks should not lead to large permanent changes in spending and revenue patterns. In contrast to this prediction, they find that a one-time windfall for municipalities in the Swiss canton of Zurich entailed a cumulative fiscal response that increased municipal debts by CHF 7.50 for every CHF 1 of exogenous revenues. Similar to nonrecurring resource shocks, formula-based revenues are often volatile and unpredictable because of changes in the underlying fundamentals. In this paper, we isolate highly salient and predictable long-term changes in resource flows that make permanent policy adjustments more likely. However, our setting also allows us to exploit unpredictable weather-induced short-term variation. Thus, we can directly compare the effects of two very different types of exogenous variation.

Our paper also relates to a small literature on the effects of fiscal revenues from hydropower.[3] Our estimation strategy is most closely related to Borge et al. (2015) who assess the effect of hydropower revenues of Norwegian municipalities on efficiency, but not on the fiscal outcomes we are interested in. Similar to our approach, they combine time-invariant determinants of hydropower production with temporal variation in how this production translates into revenues. However, while we mainly focus on salient and predictable legislated long-term changes, they only look at short-term variation caused by changes in weather and wholesale electricity prices.

2 Institutional Background

2.1 Fiscal autonomy and direct democracy

Switzerland's decentralized political system consists of the federal, cantonal, and municipal level. It constitutionally guarantees widespread fiscal autonomy for its cantons and municipalities – regarding both expenditures and revenues. Municipalities account for 20% of the total tax revenues and for 23% of total expenditures.[4] Cantonal statutes set the progressivity of the tax schedule and the exemptions and deductions for the definition of the taxable income. Municipalities collect a surcharge on the cantonal taxes, hereafter called *tax multiplier*, which is expressed in percent of cantonal taxes.[5] In Grisons and Valais, the multipliers are applied for personal income and wealth taxes, while corporate income is taxed at a canton-wide uniform tax rate. Because of their far-reaching fiscal autonomy, taxes and expenditure levels differ considerably between municipalities.

All levels of government have direct democratic participation possibilities. In

[3] Several contributions discuss fiscal revenues from hydropower and resource rent sharing schemes from a normative perspective (e.g., Rothman, 2000; Banfi et al., 2004; Banfi and Filippini, 2010).

[4] Data from the OECD (2019) for 2017 as of November 27, 2019 (excluding social security funds). The municipalities rely mostly on personal income taxes, but also on taxes on wealth, corporates, and property, fiscal transfers, and user fees, to finance public services such as primary education, health, social security, roads, and energy supply. They exercise considerable autonomy in their expenditure decisions.

[5] In the canton of Grisons, the municipalities are free to choose any level of tax multiplier. The municipalities in the canton of Valais are bound to fix their multiplier between 100–150%. However, they also set an index parameter to adjust for inflation (compensation for bracket creep between 100–170%), which we will not consider in our analysis.

most municipalities of the cantons Grisons and Valais, citizens directly decide on legislative and budgetary matters in assemblies. In the few municipalities with a parliament, they can challenge expenditure and tax decisions or the budget in referendums.

2.2 The water fee system and its importance for local public finances

Hydropower accounts for 55% of the national electricity generation (SFOE, 2019b) and is an important revenue source for jurisdictions in the mountain area (Banfi et al., 2004, pp. 23-38; Hediger et al., 2019).

The federal constitution (article 76) endows cantons with property rights over water resources. The cantons Grisons and Valais transfer these rights to their municipalities, which in turn can grant concessions to electric utilities to exploit hydropower (Grisons's *Wasserrechtsgesetz*, article 7; Valais' *Gesetz über die Nutzbarmachung der Wasserkräfte*, articles 4-7). As a compensation for the use of the water, the hydropower plant operators pay a *water fee* to the municipalities (Banfi et al., 2004, p. 9; Wyer, 2006, p. 16). It is calculated based on the annual production potential of a plant (see Section 2.3). The federal Water Rights Act (*Wasserrechtsgesetz*, articles 49 and 51) sets out its calculation method and maximum rate. Federal politics gradually raised the maximum rate. Over our sample period, it almost doubled in real terms from 40 CHF/kW (57 CHF at 2015 prices) in 1987 to 110 CHF/kW in 2015 (see Figure 1). In most cases, cantons and municipalities directly apply the legal maximum rate (Banfi et al., 2004, p. 16; Hediger et al., 2019).

In the cantons of Grisons and Valais, the canton and the municipalities split the water fee revenues with cantonal and municipal shares of 60% and 40% (Valais, except the river Rhone) and 50% each (Grisons) (Banfi et al., 2004, p. 18).

Concession contracts between the municipalities and the hydropower plant operators regulate the details about water fee payments. Occasionally, both parties agree on fixed water fee payments that are independent of actual water flows. The concession contracts also specify other obligations of the plant operator such as the one-time concession fees, free electricity deliveries or infrastructure funding (Hediger et al., 2019). The federal water fee maximum has no bearing on these other obligations.

Hydropower and, consequently, water fee revenues are highly concentrated on a few mountain cantons: The cantons of Valais (27%) and Grisons (22%) account

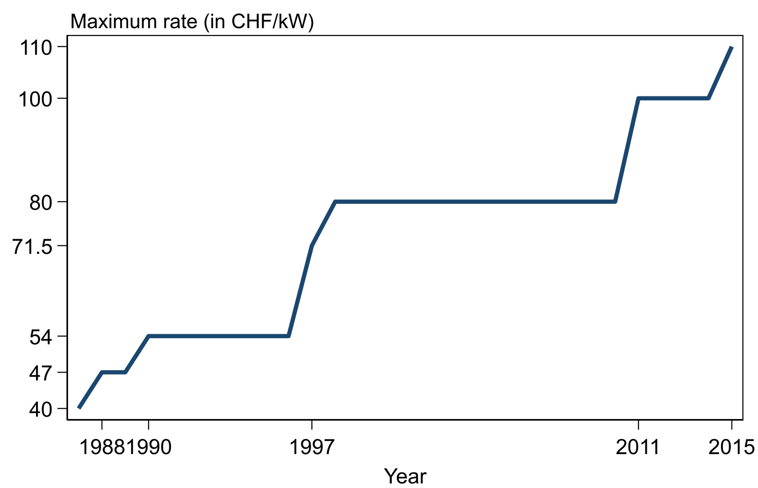


Figure 1: Federal water fee maximum, 1987–2015

Notes: The years labeled on the x-axis correspond to increases in the water fee rate. The increase in 1997 came into force on May 1. The rate in 1997 is a weighted average of old and new maximum rates with weights of 120/365 and 245/365, respectively.

Source: Federal Water Rights Acts, article 49, versions entered into force on January 1, 1986, May 1, 1997, and January 1, 2011.

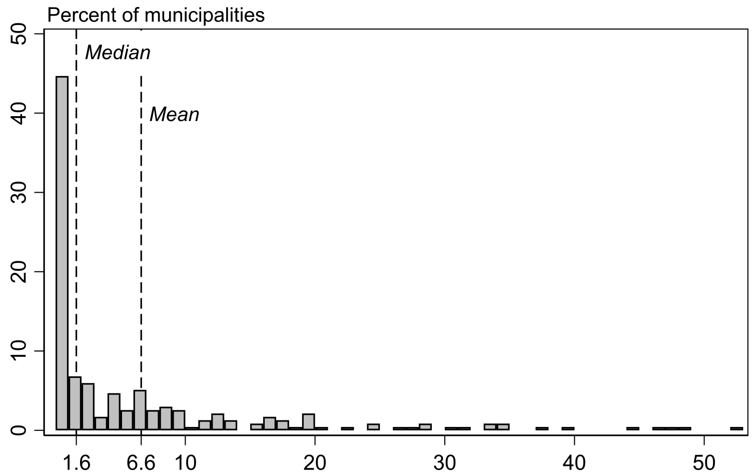


Figure 2: Water fee revenues as a share of total revenues for municipalities in the cantons of Grisons and Valais, 2015

for almost half of the Swiss electricity production from hydropower, followed by Ticino with 10% (SFOE, 2019a). Likewise within cantons, the importance of water fee revenues differs greatly across municipalities. Figure 2 shows the water fee revenues as a share of total revenues for municipalities in the cantons of Grisons and Valais in 2015. While water fees account for 6.6% of total revenues on average, the share is around 50% for some municipalities. As data from other years show, the maximum share can rise up to almost 90%. Thus, for many municipalities, water fees are of vital importance.[6] At the other end, around 45% of the municipalities have no or only negligible water fee revenues.

2.3 Water fee calculation and endogeneity issues

Because we aim to establish the causal impact of hydropower revenues on municipal finance, let us have a look at the calculation of water fees, to illustrate the problem of simply regressing fiscal outcomes on water fee revenues and to show how we deal with this problem.

The water fee is levied on a hydropower plant's annual production potential (hereafter also called capacity). Specifically, the water fees (in CHF) for a plant on

[6]For the hydropower plant operators, water fees are a substantial cost factor of around 25% of average electricity generation costs (Filippini and Geissmann, 2018).

the stream segment j in municipality i, canton c, and year t are the product of its capacity (in kW) and the federal water fee maximum τ_t^{max} (in CHF/kW) (adapted from SWV, 2017, p. 2):

$$\text{Water fees}_{jict} \;=\; \tau_t^{max} \cdot \underbrace{g \cdot \rho \cdot \Delta h_{jic} \cdot Q_{jict}}_{\text{Capacity}_{jict}}, \tag{1}$$

where g denotes the gravitational acceleration ($9.81\,\mathrm{m/s^2}$), ρ the water density ($1000\,\mathrm{kg/m^3}$), Δh_{jic} the fall height (in m) and Q_{jict} the average volumetric water flow rate (in $\mathrm{m^3/s}$). Thus, the water fees change over time with changes in the maximum rate and hydrological conditions.[7]

A municipality's water fee revenues depend on the summed capacities of all hydropower plants using its waters. We can think of this total capacity as the summed potential capacities at all stream segments multiplied by the degree $\delta_{ict} \in [0,1]$ to which the municipality develops this potential. Thus, we express the water fee revenues of the municipality as:

$$\text{Water fees}_{ict} \;\approx\; \tau_t^{max} \cdot \sigma_c \cdot \chi_{ict} \cdot \delta_{ict} \cdot \sum_j g \cdot \rho \cdot \Delta h_{jic} \cdot Q_{jict}, \tag{2}$$

where $\sigma_c \in [0,1]$ and $\chi_{ict} \in [0,1]$ are the municipal share of the water fees (see Section 2.2) and contractual arrangements with the plant operators, respectively. Equation (2) simplifies reality as we assume all factors to be linear.

We further approximate the volumetric water flow rate Q_{jict} by the product of local precipitation P_{ict} and hydromorphological conditions π_{jic}. We then decompose water fee revenues into their long-term average (determined by average local precipitation levels $\overline{P_{ic}}$) and the short-term deviations from this average:

[7] They do not vary with actual production (even in case of a temporary shutdown), nor with electricity prices or cost changes. For an economic analysis of the water fee scheme, see Banfi et al. (2004), Banfi and Filippini (2010), Barry et al. (2019), and Kosch et al. (2021).

$$\text{Water fees}_{ict} \approx \chi_{ict} \cdot \delta_{ict} \cdot \underbrace{\tau_t^{max} \cdot \sigma_c \cdot \overbrace{\left[\sum_j g \cdot \rho \cdot \Delta h_{jic} \cdot \pi_{jic} \cdot \overline{P_{ic}} \right]}^{\text{Hydropower potential}}}_{\text{Instrument}} \cdot \left(1 + \frac{P_{ict} - \overline{P_{ic}}}{\overline{P_{ic}}} \right) \tag{3}$$

The factors collected in the square brackets constitute the *hydropower potential* of the municipality. It depends on local topographic, hydromorphological, and climatic conditions and measures the average amount of electricity, which the municipality could produce if it fully developed its potential.

Most of the elements in equation (3) are clearly exogenous, i.e., neither influenced by the decisions of the municipality i nor targeted towards it. There are two exceptions: Contractual agreements and the degree of capacity development are clearly endogenous. Hence, simply regressing fiscal outcomes on water fee revenues may yield biased estimates. Omitted variables and reverse causality would possibly lead us to overestimate the effects. For instance, some municipalities may actively promote local economic development with infrastructure spending, low taxes, and hydropower exploitation. Other municipalities may push hydropower development to cover large expected financing needs. However, there are also reasons to think that we underestimate the effect. For example, excessive spending and the failure to exploit hydropower might both signal poor governance. Further, measurement errors in the water fee variable (see Section 3.2) attenuate any effects. In the next Section, we discuss how we address these endogeneity concerns.

3 Empirical Strategy and Data

3.1 Identification strategy

We estimate the effects of the water fee revenues of municipality i in year t, Water fees$_{it}$, on the following fiscal outcomes y_{it}: current expenditures, current revenues (excluding water fee revenues), net investment, tax multiplier, tax revenues, and net debt change. As controls $\boldsymbol{X}_{it}$, we use total taxable income, population, foreigners, and the population below 15 and above 65 years of age. Further, we include linear municipality-specific time trends γ_i, municipality effects μ_i, and canton-specific year effects ν_{ct}. Adding the error term ϵ_{it}, our empirical model is:

$$y_{it} = \alpha \text{Water fees}_{it} + \beta \boldsymbol{X}_{it} + \gamma_i t + \mu_i + \nu_{ct} + \epsilon_{it} \tag{4}$$

We address the endogeneity concerns discussed in Section 2.3 with an IV approach. Our instrument is the *water fee potential* (in CHF) (see equation (3)). It is the product of the federal water fee maximum τ_t^{max}, the municipal share σ_c, and municipalities' hydropower potential.[8] It measures the amount of revenues the municipality could expect on average if it fully developed its potential.

Our instrument captures the salient and predictable long-term variation in water fee revenues. In an extension, we also interact our main instrument with the annual percentage deviation of local precipitation from its long-term average, $(P_{ict} - \overline{P_{ic}})/\overline{P_{ic}}$, to isolate the unpredictable weather-induced short-term variation (similar to Borge et al., 2015). Thus, our setting uniquely allows us to separately analyze two very different types of variation in water fee revenues.

The exclusion restriction of the water fee potential is only plausible with municipality and time effects. Topographical characteristics suitable to hydropower production may raise the costs of providing public goods and services and impede productive economic activity. Similarly, the increases in the federal water fee maximum may coincide with many other developments.

As Figure 1 shows, the federal water fee maximum changes stepwise, but so far only in one direction: There is a clear upward trend. Therefore, one might be concerned that the water fee potential captures differential trends between municipalities that are suitable for hydropower generation and those that are not. Therefore, we additionally include linear municipality-specific time trends and use only the deviations from long-term trends to identify the fiscal effects. This decision is not innocuous and greatly affects our results. In Section 5.3, we show results without these trends and further justify their inclusion.

Finally, it is important to reiterate that the maximum water fee rate is fixed at the federal level. Obviously, the Alpine cantons champion a high rate, which sometimes earns them the nickname "Alpine OPEC".[9] With cantonal shares of the water

[8]The instrument is loosely related to the instruments for (irrigation and hydroelectric) dam construction in Duflo and Pande (2007) and Lipscomb et al. (2013), who combine time-invariant river topography with time-varying regional or national dam building activity.

[9]See, e.g., Council of States minutes, December 15, 1992.

fee revenues of 50% (Grisons) and 60% (Valais), they have a strong interest in a high rate independently of any benefits to individual municipalities. Representatives from the cantons of Grisons and Valais sponsored nine of the 13 parliamentary interventions demanding an increase in the water fee maximum, that are mentioned in the reports accompanying the draft bills on the increases in our sample period. However, representatives living in highly water fee-dependent municipalities had no disproportionate direct influence. The average share of the water fees in total revenues in 2015 in the municipalities of the sponsors of the nine parliamentary interventions is 2.3% – well below the overall average of 6.6% reported in Figure 2. Election districts for both parliamentary chambers are the cantons and the members represent cantons, not individual municipalities. Many municipalities are small and headed by someone with a part-time or honorary appointment. They lack the resources for significant lobbying. Neither was strong lobbying necessary: Both parliamentary chambers approved the relevant increases in the final votes with majorities of 67–100%. Therefore, it is very unlikely that federal politics set the maximum rate with an eye to individual municipalities or municipal characteristics. As we only use variation from within two Alpine cantons, there is no reason to expect the politics of water fees to bias our results.

3.2 Data

We employ an unbalanced panel of 235 municipalities in the canton of Valais in the years 1987–2015 and the canton of Grisons in the years 2004–2015. For the placebo analysis in Section 5.1, we use data from 135 municipalities in the canton of Ticino in the years 2000–2015. In the following, we briefly describe our main variables, i.e., the fiscal outcomes, the water fee revenues, and the water fee potential. We refer to the Data Appendix for details.

The data on our fiscal outcomes – current expenditures, current revenues (excluding water fee revenues), net investment, tax multiplier, tax revenues, and net debt change – come from cantonal offices.[10] Swiss municipalities have a current account and an investment account. Current expenditures and revenues are broad categories capturing all financial flows that are not related to investments. Net in-

[10] We have fewer observations for net debt change than for other fiscal variables as we lose some observations at the beginning of the data periods in generating the variable. We also lose observations due to the staggered introduction of a harmonized accounting model (Grisons) and missing data for some municipalities in pre-merger years in the data period 2006–2015 (Valais). Further, we have one fewer observation for tax revenues as the corresponding value is missing in the raw data.

vestment is the difference between investment expenditures and income. The investment figures are much smaller than the ones for current expenditures or current revenues and they are very volatile. Therefore, the results for net investment need to be interpreted carefully. The tax multiplier is a surcharge on cantonal taxes (in percent of cantonal taxes; see Section 2.1). Municipalities can directly set the tax multiplier. In contrast, the other outcomes partly depend on economic and demographic factors beyond the control of municipalities and exhibit substantial year-to-year fluctuations. Thus, the tax multiplier captures political decisions without any noise. With less measurement error in this measure of municipal decisions, the coefficients will be more precisely estimated in the tax multiplier regressions. Tax revenues are a subcategory of current revenues.

The canton of Valais used different accounting standards in the periods 1987–2006 and 2006–2015. The data from these two periods are not directly comparable. Therefore, we use municipality $\times$ data period as the panel unit for fixed effects and time trends. For the year 2006, we use data from the earlier period.

For the municipal water fee revenues in the canton of Valais, we have the information from the same source as the fiscal outcomes. For the canton of Grisons, we mostly collected the relevant information from the municipalities.[11] Since some municipalities were unwilling or unable to share information on their water fee revenues, the corresponding data are missing for some municipalities and years.

We measure the water fee revenues with errors. First, the municipalities employ different accounting standards (e.g., accruals). In the canton of Grisons, for instance, the municipalities receive and report the water fee revenues either based on the calendar year (January 1 to December 31) or the hydrological year (October 1 to September 30). To harmonize the data, we approximately convert figures based on the hydrological year to the calendar year (see Data Appendix).[12] Second, for some municipalities and years, the figures may include other revenues related to hydropower production (see Section 2) or compensation payments for nature conservation.[13] The municipal accounts are inconsistent in this regard and additional information not always forthcoming. Whenever possible, we deduct such payments

[11] We complemented these data with information from the fiscal equalization scheme and an annual cantonal publication. This complementary information refers to two-year periods. Therefore, we use it only to determine municipalities that never received any water fee revenues.

[12] We lose one observation at the beginning for the municipalities concerned due to this conversion.

[13] Municipalities forgoing hydropower development in certain conservation areas obtain compensation payments, which are based on the federal water fee maximum. In our sample, 16 municipalities receive such payments. We include these payments in a robustness test.

from the water fee revenues. Third, in both cantons, the beneficiaries of water fees have to contribute a small share of their revenues to the cantonal fiscal equalization funds.[14] Again, municipalities handle these payments inconsistently in their bookkeeping and variously report either net or gross figures. Fourth, the data contain some blatant mistakes such as substantial differences in the figures from different sources or water fee revenues in all but one years. In such cases, we contact the municipality and, where appropriate, modify the data if we receive clear information and concrete figures (see Data Appendix). We strive to harmonize and correct the data. However, this is not always possible and some measurement errors remain. Our IV approach should correct any resulting biases.

To construct the water fee potential, the two key ingredients are the maximum rate and the hydropower potential of each municipality (see Section 3.1). We glean the information on the maximum rate from the relevant versions of the federal Water Rights Act. For the hydropower potential, we build on Schröder et al. (2012). They determine the theoretical hydropower potential of all natural streams in Switzerland by combining information on stream gradients and the area and typical annual runoff of watersheds. They report the potential for points every 50 meters of a stream. To calculate a municipality's potential, we simply add up the potential at all the points within its borders. We divide the potential of points located less than 10 meters from the border of two or more municipalities equally among the

[14] In both cantons, water fees enter the fiscal equalization schemes, resulting in two effects. First, the municipalities have to contribute a share of their water fee revenues into an equalization fund, leading to lower net receipts (*direct effect*). In the canton of Grisons the share was 6% (Grison's law on fiscal equalization, articles 3, 17, and 22, version entered into force on January 1, 2000), in the canton of Valais it varied across municipalities and years between around 5–8%, except for the last four years, when it could be up to 20% (Valais' tax law, article 196, version entered into force on March 1, 1977; *Gesetz über die Nutzbarmachung der Wasserkräfte*, article 69, version entered into force on January 1, 1991; law on fiscal equalization, articles 5 and 8, version entered into force on January 1, 2012). Ideally, we would correct the water fee potential for each municipality and year accordingly, but we lack the necessary information to do so. Given the small differences across municipalities and most years, a good approximation would be to multiply the water fee potential by a constant factor. Such an approximation would leave our second-stage results unchanged and, thus, we ignore it. Our second-stage estimates capture the effects of an exogenous net increase in water fee revenues by CHF 1. Second, as one of many factors, the water fees enter the fiscal equalization scheme for calculating the financial capacity of a municipality, thereby potentially lowering the amount it receives from the fiscal equalization fund (*indirect effect*). The fiscal equalization schemes are complex and opaque and water fees affect the transfers of only few municipalities and with considerable lag. Thus, municipal authorities can hardly predict the marginal effects of water fee revenues on transfers. We also lack the information to estimate these indirect effects, but we do not expect them to materially influence our results. At worst, they might slightly attenuate water fee effects, but they have no bearing on the distribution of water fee revenues between public and private consumption, which is our main object of investigation.

municipalities to account for border rivers. We ignore data points in protected areas (e.g., wetlands).

We capture the annual percentage deviation of local precipitation from its long-term average with grid data from the Federal Office of Meteorology and Climatology. As snowmelt significantly contributes to runoff (over 60% according to Bernhard and Zappa, 2012), we use for year t precipitation in the relevant hydrological year, i.e., the last three months of year $t-1$ and the first nine months of year t.

Panel A of Figure 3 highlights the large variation in water fee revenues across municipalities for the year 2015. Over our sample period, 158 of the 235 municipalities received water fees in every year, 59 municipalities never received any water fees, and 18 municipalities received water fees in some, but not other years.[15] Panel B of Figure 3 depicts the large variation in the local hydropower potentials, which closely mirrors the variation in water fee revenues.

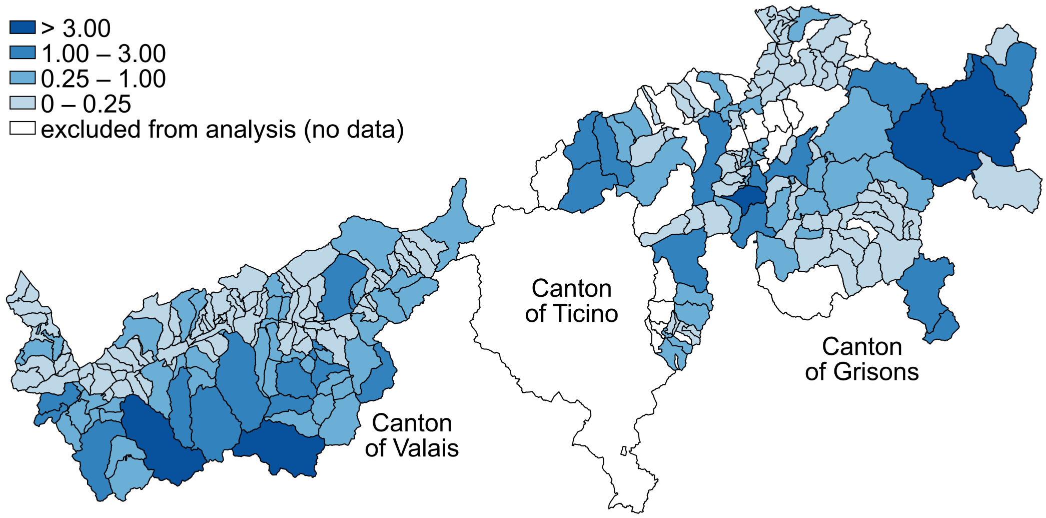
Municipal mergers during our sample period complicate the data preparation. We retrospectively merge municipalities, so that all our data refer to the set of municipalities existing on December 31, 2015. If two or more municipalities merged to a single municipality, we combine the data from the original municipalities in the pre-merger years and use the new municipality's data thereafter. For the canton of Valais in the period 2006–2015, we have no data for the original municipalities in pre-merger years. For most fiscal outcomes and the water fee revenues, we simply sum the figures from the original municipalities. For the tax multipliers, we estimate a weighted average with taxable income from the first year as weights (similar to Staubli, 2018).[16]

Table 1 provides summary statistics. Two observations have negative values for the water fee revenues, which reflect repayments due to erroneously high water fees in previous years. One observation has a negative value for current revenues, which is related to the municipality's bankruptcy. All fiscal outcomes vary greatly across municipalities.

[15]Of the 18 switching municipalities (all in the canton of Valais), the majority has zero water fee revenues in the first data period (1987–2006) and rather negligible water fee revenues in the second data period (2006–2015). Thus, the water fee revenues variable contains measurement errors in the earlier years for some municipalities. The use of municipality $\times$ data period as the panel units in Valais mitigates any resulting biases.

[16]Specifically, we use taxable income of 1986 (1987 not available) for Valais, 2004 for Grisons, and 1998 (2000 not available) for Ticino.

Panel A. Water fee revenues (in mio. CHF), 2015



Panel B. Hydropower potential (in MW)

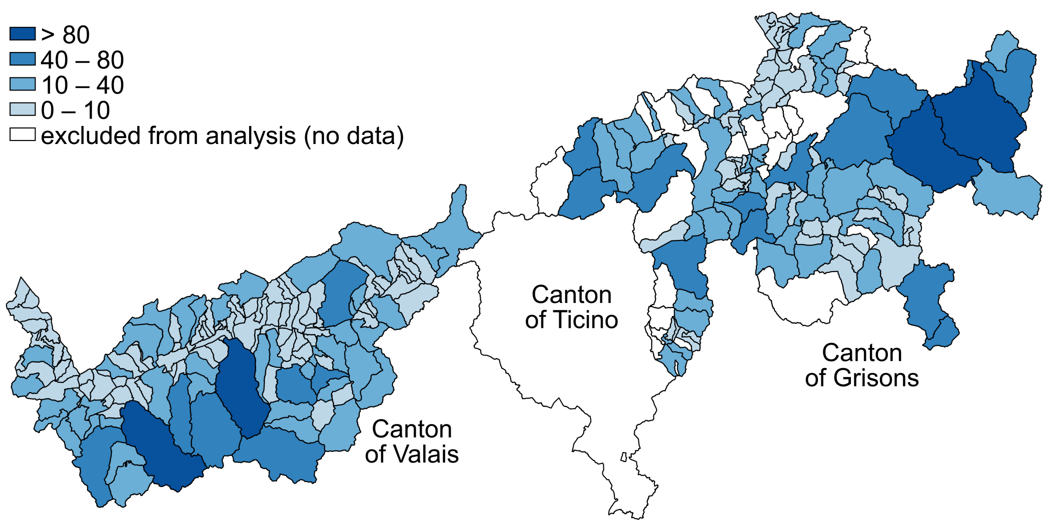


Figure 3: Water fee revenues (2015) and hydropower potential for municipalities in the cantons of Grisons and Valais

Table 1: Summary statistics

	Mean	SD	Min	Max	Obs.
Water fee revenues	303	559	-31	6479	5004
Instruments					
Water fee potential	481	764	0	10539	5004
Precipitation (mean deviation)	-0.04	0.16	-0.50	0.55	5004
Fiscal outcomes					
Current expenditures	9365	20513	101	314377	5004
Current revenues	10036	21716	-1384	316561	5004
Net investment	1790	3716	-14888	55210	5004
Tax multiplier	119.60	18.58	30.00	150.00	5004
Tax revenues	5383	10504	24	126299	5003
Net debt change	-58	3925	-156568	94774	4744
Control variables					
Total taxable income	48136	95561	367	1186951	5004
Population	1930	3418	18	34600	5004
Foreigners	333	809	0	9062	5004
Age 0–14	322	554	1	5042	5004
Age 15–64	1302	2373	11	23558	5004
Age 65 and above	306	558	4	7059	5004

Notes: Water fee revenues and potential, total taxable income and fiscal outcomes (except the tax multiplier) are expressed in CHF 1000. Current revenues are excluding water fees. See footnote 10 for a discussion of the lower number of observations for tax revenues and the net debt change.

4 Results

4.1 Baseline estimates

Table 2 presents our baseline results with different fiscal outcomes in columns.[17] The conventional fixed-effects estimates in Panel A mirror much of the previous flypaper effect literature. They suggest that municipalities spend all the water fee revenues and return nothing to private households through tax reductions, though possibly through lower debt.

The picture differs markedly if we only use the exogenous long-term variation with the IV estimates in Panel B. The first-stage estimates confirm that the water fee potential strongly predicts water fee revenues. They increase by about CHF 0.50 for every CHF 1 rise of water fee potential. The reduced-form and second-stage estimates reveal that exogenous changes in water fee revenues have a statistically insignificant spending effect, but a negative effect on tax multipliers.

We use the tax multiplier as a dependent variable for its high signal-to-noise-ratio (see Section 3.2), but not to assess the economic magnitude of water fee effects. The revenue implications of a given change in the tax multiplier hugely differ across municipalities of varying size and prosperity. Therefore, municipalities will adapt their tax multipliers very differently in reaction to a CHF 1 change in water fees. To assess economic magnitudes, we consider the effect on tax revenues in column (5). The second-stage estimate suggests that a CHF 1 increase in water fee revenues lowers tax revenues by CHF 1.28. In contrast to the broader defined tax revenues, the tax multiplier only applies to the municipalities' income and wealth taxes.[18]

The effects on current revenues and net debt change are negative but imprecisely estimated. This lack of precision affects all our estimates and many 95% confidence intervals of the second-stage estimates in Panel B contain the corresponding ordinary fixed-effect estimates in Panel A. It stems from our very demanding specification. By controlling for municipality-specific trends, we remove identifying variation. We will discuss this issue in Section 5.3. We refrain from interpreting the net investment result. The investment figures are very volatile and the estimates become statistically insignificant with the exclusion of influential municipalities (see

[17] Models without controls ($\boldsymbol{X}_{it}$ in equation (4)) yield similar results (see Appendix Table A1). Thus, the inclusion of controls that are potentially affected by water fees induces no bias (Angrist and Pischke, 2009, pp. 64-68; St. Clair and Cook, 2015).

[18] For our period and municipalities, revenues from income and wealth taxes account for roughly 60–70% (Grisons) and 70–85% (Valais) of total tax revenues, respectively (FFA, 2020).

Table 2: Baseline results

	Current expenditures (1)	Current revenues (2)	Net investment (3)	Tax multiplier (4)	Tax revenues (5)	Net debt change (6)
Panel A. Fixed-effects estimates (OLS)						
Water fee revenues	1.059***	0.562	0.217	-6.90e-08	-0.119	-1.640***
	(0.283)	(0.641)	(0.246)	(5.19e-07)	(0.158)	(0.509)
Panel B. IV estimates (2SLS)						
First stage						
Water fee potential	0.515***	0.515***	0.515***	0.515***	0.514***	0.468***
	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.128)
Reduced form						
Water fee potential	0.401	-0.192	-0.929*	-3.31e-06**	-0.656	-0.926
	(0.976)	(1.513)	(0.514)	(1.47e-06)	(0.490)	(0.869)
Second stage						
Water fee revenues	0.779	-0.372	-1.806*	-6.43e-06**	-1.275*	-1.979
	(1.883)	(2.768)	(0.973)	(2.65e-06)	(0.773)	(1.743)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Canton × year effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-statistics	24.315	24.315	24.315	24.315	24.306	13.373
No of observations	5004	5004	5004	5004	5003	4744
No of clusters	235	235	235	235	235	235

Notes: Cluster-robust standard errors at the municipality level in parentheses. The data for the canton of Valais in 1987–2006 (first data period) and 2006–2015 (second data period) are based on different accounting standards. In the canton of Valais, we therefore use municipality × data period as the panel units for fixed effects and time trends. In the canton of Grisons, the panel unit is the municipality. Controls are total taxable income, population, foreigners, and the population in different age groups (0–14, 65 and above). The Kleibergen-Paap rk Wald F statistic is reported as the first-stage F-statistics. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Section 5.2).

Overall, the IV estimates imply that the municipalities pass much of the water fee revenues to citizens through tax reductions. They support the finding of Lutz (2010), that local authorities spend part of the exogenous revenues on tax cuts if they face strong participatory institutions. They also suggest that the flypaper effect found in the fixed-effects regressions is an artifact caused by omitted variables, such as an active economic policy, or reverse causality.

Might we fail to identify certain effects because the authorities react to water fee revenue shocks with substantial lag? We think not. First, water fee rate increases were known months or even years in advance. On average 950 days elapsed between the final vote in the second parliamentary chamber deciding on the increase and its actual implementation. Second, municipal revenues from hydropower are fairly persistent over time. Municipalities could thus anticipate well in advance the date and the amount of the reform-induced changes in their water fee revenues. They had sufficient time to adapt to the new circumstances, to determine their policy response, and to implement it simultaneously with the increase of the maximum water fee rate (see also the evidence on effect dynamics in Section 5.1).

4.2 Predictable long-term vs. unpredictable short-term variation

Our instrument captures the salient and predictable long-term variation in water fee revenues. However, our setting also uniquely allows us to simultaneously observe weather-induced short-term variation. For this purpose, we interact our main instrument with the annual percentage deviation of local precipitation from its long-term average ($(P_{ict} - \overline{P_{ic}})/\overline{P_{ic}}$, see Equation (3)).[19] As weather-induced variation is unpredictable, we would not expect the municipalities to react to it with permanent policy changes such as altering the tax multiplier.

The reduced-form estimates in Table 3 allow us to separate the effect of the short-term variation (*water fee potential* $\times$ *precipitation*) from the long-term variation of the main instrument (*water fee potential*). The results show that the short-term variation has indeed no effect on the tax multiplier. Surprisingly, however, it still only affects tax and, therewith, current revenues. How can we reconcile the short-term results regarding the tax multiplier, tax revenues, and current revenues? Because we lack disaggregated data on municipal accounts, our answers necessarily remain spec-

[19] As $\overline{P_{ic}}$, we choose the 1981–2000 period to be consistent with the construction of our main instrument based on Schröder et al. (2012).

ulative. First, municipalities have the authority to adjust the rates of other taxes than the income and wealth taxes. Second, they can quickly change the way they enforce tax collection and, for example, show leniency in tax assessment in good times. Third, they can change a broad range of user charges and fees.

5 Validity and Robustness Tests

5.1 Placebo test and event study

One might be worried that the water fee potential correlates with unobserved factors influencing fiscal outcomes. To address this issue, we estimate placebo reduced-form regressions for the mountain canton of Ticino, which lies between the two cantons in our sample. In this canton, hydropower also plays an important role, but water rights belong entirely to the canton (Ticino's *Legge sul demanio pubblico*, article 1) and municipalities do not directly share in the water fee revenues.[20] Thus, the canton provides the ideal opportunity for a placebo test. Reassuringly, as Table 4 shows, we find no statistically significant effect of our instrument on tax multipliers, tax revenues, or other fiscal outcomes.

To assess the importance of differential trends before increases in the water fee maximum and of effect dynamics, we rely on a generalized event study (Schmidheiny and Siegloch, 2020) for the increases in the years 1986, 1988, 1990, 1997/1998, 2011, and 2015. The results in Figure 4 are very consistent with our baseline results: An increase of the water fee potential lowers the tax multiplier, tax revenues, and net investment. By the second year after an increase at the latest, the effects have fully materialized. It is not unreasonable that the reduction of tax revenues follows the reduction of the tax multiplier with a one-year lag. Contrary to current practice, municipalities previously seem to have entered actual tax revenue flows resulting from the tax obligations from the previous year in the books instead of predicted tax revenues from the current year (FDK, 2017). Further, there are no pre-increase differences for these three outcomes. In the case of the tax multiplier, there seems to be a slight downward trend in the years immediately around the water fee increase. However, none of pre-increase differences is statistically significant and the trend across all pre-increase periods is fairly flat. For the other outcomes, we find

[20] The canton of Ticino uses 30% of the water fee revenues to compensate rural municipalities for the costs associated with geographic and topographic factors. As the allocation formula is independent of the hydropower potential, this transfer does not invalidate the placebo test.

Table 3: Effects of exogenous long-term and short-term variations

	Current expenditures (1)	Current revenues (2)	Net investment (3)	Tax multiplier (4)	Tax revenues (5)	Net debt change (6)
Water fee potential	0.380	-0.567	-1.062*	-3.13e-06**	-0.846	-0.909
	(1.031)	(1.571)	(0.554)	(1.51e-06)	(0.541)	(0.959)
Water fee potential ×	-0.105	-1.676	-0.598	7.67e-07	-0.845*	0.062
precipitation	(0.640)	(1.039)	(0.535)	(5.89e-07)	(0.476)	(0.925)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Precipitation	Yes	Yes	Yes	Yes	Yes	Yes
Canton × year effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	5004	5004	5004	5004	5003	4744
No of clusters	235	235	235	235	235	235

Notes: Cluster-robust standard errors at the municipality level in parentheses. The data for the canton of Valais in 1987–2006 (first data period) and 2006–2015 (second data period) are based on different accounting standards. In the canton of Valais, we therefore use municipality × data period as the panel units for fixed effects and time trends. In the canton of Grisons, the panel unit is the municipality. Controls are total taxable income, population, foreigners, and the population in different age groups (0–14, 65 and above). Significance levels: $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Table 4: Placebo results for the canton of Ticino

	Current expenditures (1)	Current revenues (2)	Net investment (3)	Tax multiplier (4)	Tax revenues (5)	Net debt change (6)
Water fee potential	3.266	4.473	-0.102	-1.24e-06	0.605	-1.632
	(2.083)	(2.965)	(0.336)	(1.96e-06)	(0.465)	(1.719)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	2132	2132	2132	2160	1604	1974
No of clusters	135	135	135	135	135	135

Notes: Cluster-robust standard errors at the municipality level in parentheses. In constructing the water fee potential, we arbitrarily set the time-invariant municipal share of the water fee revenues to one. Numbers of observations vary because of missing values in fiscal outcomes for a few observations (see Data Appendix). The panel unit for fixed effects, time trends, and clustering is the municipality. Controls are total taxable income, population, foreigners, and the population in different age groups (0–14, 65 and above). Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

no effects. The only pre-increase difference concerns net debt change with rather erratic estimates.

5.2 Sensitivity checks

Another concern might be that some municipalities with very large water fee potentials and revenues drive the results. Thus, in Table 5, we repeat all estimations without the 10% most influential municipalities. We start by excluding one municipality at a time and determine the municipality whose exclusion produces the largest absolute deviation from the baseline estimates. We then use the result without this municipality as the new baseline and repeat this procedure until we exclude 10% of the municipalities. The results in the restricted sample are very similar to the baseline estimates, but the net investment estimate becomes statistically insignificant. The tax revenues estimate becomes more precise.

Table 6 probes the robustness of the estimates to changes in how we construct our instrument. Column (1) repeats the baseline results from Table 2. We divide the hydropower potential of river segments within ten meters from a municipality border among the neighboring municipalities (see Section 3.2). We use alternative ranges of 50 meters in column (2) and zero meters in column (3).[21] Using these alternative ranges has virtually no effect on the estimates. In column (4), we modify how we handle protected areas. For the baseline estimates, we ignore hydropower potential at sites that are either protected under national law or of national importance (Federal Inventory of Landscapes and Natural Monuments). In the latter case, hydropower production is restricted, but not prohibited. Thus, in column (4), we include the hydropower potential at such sites and only exclude hydropower potential at protected sites. Again, the results are very similar.

Further, we find that the inclusion of compensation payments related to losses in hydropower use (see Section 3.2) hardly affects the first-stage estimates. It remains practically unchanged at 0.513 (standard error of 0.104).

5.3 Alternative specification

As Figure 1 shows, the federal maximum water fee rate trends upwards. Thus, our instrument exhibits strong municipality-specific trends and trending confounders

[21] Of the roughly 200,000 data points in the cantons of Grisons and Valais (see Schröder et al., 2012), approximately 8% lie within the ten-meter range, 10% within the 50-meter range, and hardly any point lies exactly on a boundary.

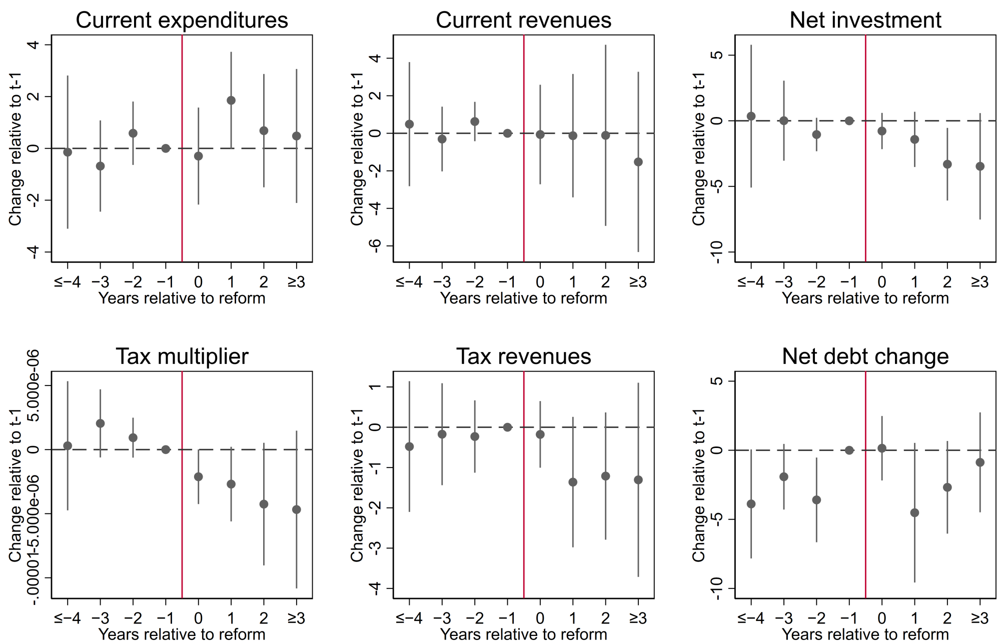


Figure 4: Event study

Notes: The figure depicts the coefficients and corresponding 95% confidence intervals from six separate regressions of our fiscal outcomes on the changes in the water fee potential induced by a water fee maximum increase for seven different event periods and the usual control variables (see Table 2). The event periods are four or more years ahead of a water fee maximum increase, three years before an increase, two years before an increase, the year of an increase, the year after an increase, two years after an increase, and three or more years after an increase. The year before an increase is the reference period. The red vertical line separates pre- and post-increase periods.

Table 5: Results for restricted sample

	Current expenditures (1)	Current revenues (2)	Net investment (3)	Tax multiplier (4)	Tax revenues (5)	Net debt change (6)
Panel A. Fixed-effects estimates (OLS)						
Water fee revenues	0.728***	0.422	0.226	-1.55e-07	-0.102	-1.446***
	(0.230)	(0.324)	(0.204)	(3.92e-07)	(0.075)	(0.360)
Panel B. IV estimates (2SLS)						
Water fee revenues	0.406	-0.220	-1.773	-7.17e-06**	-1.193***	-1.308
	(0.934)	(1.189)	(1.177)	(3.17e-06)	(0.315)	(1.897)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Canton × year effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-statistics	21.452	18.575	44.583	41.045	20.384	68.020
No of observations	4550	4515	4481	4548	4532	4302
No of clusters	211	211	211	211	211	211

Notes: Cluster-robust standard errors at the municipality level in parentheses. The table shows the estimates after an iterated elimination of the 24 most influential of the 235 municipalities in our sample. The data for the canton of Valais in 1987–2006 (first data period) and 2006–2015 (second data period) are based on different accounting standards. In the canton of Valais, we therefore use municipality × data period as the panel units for fixed effects and time trends. In the canton of Grisons, the panel unit is the municipality. Controls are total taxable income, population, foreigners, and the population in different age groups (0–14, 65 and above). The numbers of observations and clusters refer to the IV estimates. The Kleibergen-Paap rk Wald F statistic is reported as the first-stage F-statistics. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Additional robustness tests (IV estimates)

	Baseline results	Calculation water fee potential		
		Buffer: 2×50m	Buffer: 2×0m	Protected sites
	(1)	(2)	(3)	(4)
Current expenditures	0.779	0.756	0.637	0.664
	(1.883)	(1.880)	(1.899)	(1.812)
Current revenues	-0.372	-0.397	-0.600	-0.593
	(2.768)	(2.771)	(2.800)	(2.691)
Net investment	-1.806*	-1.817*	-1.971**	-1.809**
	(0.973)	(0.973)	(0.963)	(0.877)
Tax multiplier	-6.43e-06**	-6.40e-06**	-5.99e-06**	-5.43e-06**
	(2.65e-06)	(2.66e-06)	(2.52e-06)	(2.47e-06)
Tax revenues	-1.275*	-1.298*	-1.355*	-1.359*
	(0.773)	(0.773)	(0.799)	(0.700)
Net debt change	-1.979	-1.999	-2.159	-2.116
	(1.743)	(1.745)	(1.771)	(1.677)
Controls	Yes	Yes	Yes	Yes
Canton × year effects	Yes	Yes	Yes	Yes
Municipality effects	Yes	Yes	Yes	Yes
Municipality-specific trends	Yes	Yes	Yes	Yes
First-stage F-statistics	24.315	24.190	23.645	28.111
No of observations	5004	5004	5004	5004
No of clusters	235	235	235	235

Notes: Cluster-robust standard errors at the municipality level in parentheses. In contrast to the baseline results in column (1), the construction of the instrumental variable uses slightly altered parameters in columns (2) to (4). In column (2), the hydropower potential less than 50 meters from the border of two or more municipalities is divided equally among the municipalities (buffer zone of 2 × 50 instead of 2 × 10 meters). In column (3), there is no buffer zone at all. In column (4), the water fee potential also includes hydropower potential at sites of national importance with restrictions on hydropower production. The data for the canton of Valais in 1987–2006 (first data period) and 2006–2015 (second data period) are based on different accounting standards. In the canton of Valais, we therefore use municipality × data period as the panel units for fixed effects and time trends. In the canton of Grisons, the panel unit is the municipality. Controls are total taxable income, population, foreigners, and the population in different age groups (0–14, 65 and above). The first-stage F-statistics and the number of observations and clusters differ for the net debt change estimates; the first two also for the tax revenues estimates. The Kleibergen-Paap rk Wald F statistic is reported as the first-stage F-statistics. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

pose a particularly severe threat in our setting. To avoid spurious results caused by unrelated trends in the fiscal outcomes of important municipalities, we always include municipality-specific trends. However, these absorb a lot of – potentially useful – identifying variation. As an alternative, we include municipality-specific period effects centered on years with federal water fee rate increases. By doing so, the specification controls for unobserved shocks (rather than trends) to municipalities. Specifically, we split the sample into three periods: the years 1987–1992 (rate increases in 1988 and 1990), the years 1995–2000 (rate increase in 1997, also affecting the figures in 1998), and years 2009–2015 (rate increases in 2011 and 2015). We drop intermediate years.

As Table 7 exhibits, replacing the municipality-specific trends with municipality-specific period effects, substantially affects the results. The estimates suggest that water fee revenues finance higher expenditures and lower tax rates and simultaneously raise revenues. Many coefficients are large and highly statistically significant. Every additional CHF 1 of water fee revenues seems to be reusable several times – the dream of every government.

So the obvious question is: Which specification is the appropriate one? We argue that it is the one with municipality-specific trends. First, although excessive spending effects are not uncommon in the literature, it seems unlikely in our case. Water fee revenues require no complementary spending (in contrast to the highway grants in Leduc and Wilson, 2017) and constitute a permanent revenue source (in contrast to the temporary resource shock in Berset and Schelker, 2020). Thus, excessive spending effects due to rent-seeking would imply that the municipalities sustain excessive spending for years or even decades. The results in Table 7 are only plausible with a local multiplier effect. Higher revenues despite lower tax multipliers suggest an increase of municipalities' tax base: higher incomes of residents, profits of businesses or new taxpayers. In Appendix Table A2, we find no evidence for these effects.

Second, we look at the statistical significance of the estimated municipality-specific trends in a restricted sample of panel units that never received any water fees. Focusing on panel units without any water fee revenues allows us to isolate trends in confounding factors that may otherwise overlap with the trend in water fees. In regressions analogous to the baseline model, the share of statistically significant municipality-specific trends at the 10% level is 28% in the expenditure regression, 16% in the current revenue and net investment regressions, 66% in the

Table 7: Estimates with municipality-specific period effects

	Current expenditures (1)	Current revenues (2)	Net investment (3)	Tax multiplier (4)	Tax revenues (5)	Net debt change (6)
Panel A. Fixed-effects estimates (OLS)						
Water fee revenues	1.781***	1.098***	0.339	-7.49e-07	0.089	-1.529***
	(0.410)	(0.367)	(0.452)	(5.20e-07)	(0.229)	(0.514)
Panel B. IV estimates (2SLS)						
Water fee revenues	2.980***	1.844***	-0.509	-3.21e-06**	0.218	-2.167
	(0.805)	(0.651)	(0.996)	(1.25e-06)	(0.424)	(1.429)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Canton $\times$ year effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality $\times$ period effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-specific trends	No	No	No	No	No	No
First-stage F-statistics	42.732	42.732	42.732	42.732	42.729	35.087
No of observations	3213	3213	3213	3213	3212	3044
No of clusters	235	235	235	235	235	235

Notes: Cluster-robust standard errors at the municipality level in parentheses. All regressions include municipality-specific period effects for the periods 1987–1992, 1995–2000, and 2009–2015. The data for the canton of Valais in 1987–2006 (first data period) and 2006–2015 (second data period) are based on different accounting standards. In the canton of Valais, we therefore use municipality $\times$ data period as the panel units for municipality $\times$ period effects. In the canton of Grisons, the panel unit is the municipality. Controls are total taxable income, population, foreigners, and the population in different age groups (0–14, 65 and above). The Kleibergen-Paap rk Wald F statistic is reported as the first-stage F-statistics. Significance levels: $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

tax multiplier regression, 17% in the tax revenue regression, and 25% in the net debt regression. Thus, there are panel units that clearly show a trend over time, which indicates that one should control for municipality-specific trends.

6 Conclusion

We find that local authorities pass on much of the exogenous revenues to citizens through tax reductions. The spending effects of exogenous revenues are not statistically significant. Moreover, some of the spending might even be a way of sharing water fee revenues with citizens. As discussed in the Introduction, some municipalities dole out benefits such as shopping vouchers, shopping discounts, and subsidized health insurance premiums. The financial statements also indicate that some municipalities book extraordinary depreciation of administrative assets, thereby increasing expenditures but reducing net debt.

Our setting with strong fiscal autonomy, participatory institutions, and predictable long-term changes in exogenous revenues closely corresponds to the theoretical framework underpinning much of the flypaper literature. As our results reveal little evidence of distortions in the political process, they cast doubt on explanations based on taxation costs or decision failures and they are more in tune with explanations based on institutional aspects or agency problems. In future research, it would be interesting to identify, which aspects help to prevent excessive spending effects.

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Appendix

Table A1: Baseline results without controls

	Current expenditures (1)	Current revenues (2)	Net investment (3)	Tax multiplier (4)	Tax revenues (5)	Net debt change (6)
Panel A. Fixed-effects estimates (OLS)						
Water fee revenues	0.404*	-0.046	0.177	-5.63e-08	-0.204	-1.590***
	(0.233)	(0.654)	(0.220)	(5.51e-07)	(0.129)	(0.502)
Panel B. IV estimates (2SLS)						
First stage						
Water fee potential	0.518***	0.518***	0.518***	0.518***	0.518***	0.472***
	(0.107)	(0.107)	(0.107)	(0.107)	(0.107)	(0.132)
Reduced form						
Water fee potential	-0.572	-1.236	-1.097*	-3.17e-06**	-0.989	-1.111
	(1.187)	(1.830)	(0.598)	(1.45e-06)	(0.641)	(0.917)
Second stage						
Water fee revenues	-1.105	-2.387	-2.118**	-6.12e-06**	-1.909**	-2.355
	(2.035)	(3.009)	(1.011)	(2.65e-06)	(0.916)	(1.726)
Controls	No	No	No	No	No	No
Canton $\times$ year effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-statistics	23.541	23.541	23.541	23.541	23.531	12.875
No of observations	5004	5004	5004	5004	5003	4744
No of clusters	235	235	235	235	235	235

Notes: Cluster-robust standard errors at the municipality level in parentheses. The data for the canton of Valais in 1987–2006 (first data period) and 2006–2015 (second data period) are based on different accounting standards. In the canton of Valais, we therefore use municipality $\times$ data period as the panel units for fixed effects and time trends. In the canton of Grisons, the panel unit is the municipality. The Kleibergen-Paap rk Wald F statistic is reported as the first-stage F-statistics. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: Testing channels of multiplier effects

	Taxable income (1)	Taxable net profits (2)	Population (3)
Fixed-effect estimates	2.481	-6.376	-3.32e-05**
	(2.385)	(4.382)	(1.30e-05)
IV estimates	-0.126	-36.695*	-5.59e-05
	(3.606)	(18.848)	(3.45e-05)
Controls	Yes	Yes	Yes
Canton × year effects	Yes	Yes	Yes
Municipality × period effects	Yes	Yes	Yes
Municipality-specific trends	No	No	No
First-stage F-statistics	40.136	68.769	45.633
No of observations	3213	2275	3213
No of clusters	235	224	235

Notes: Cluster-robust standard errors at the municipality level in parentheses. Specification (1) controls for population, foreigners and the population in different age groups (0–14, 65 and above). Specification (2) additionally controls for total taxable income. Specification (3) only controls for total taxable income. All regressions include municipality-specific period effects for the periods 1987–1992, 1995–2000, and 2009–2015. The data for the canton of Valais in 1987–2006 (first data period) and 2006–2015 (second data period) are based on different accounting standards. In the canton of Valais, we therefore use municipality × data period as the panel units for municipality × period effects. In the canton of Grisons, the panel unit is the municipality. The numbers of observations and clusters for the fixed-effects profits estimates are slightly larger than those reported for the IV estimates because singletons are handled differently. The Kleibergen-Paap rk Wald F statistic is reported as the first-stage F-statistics. Significance levels: $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.