Taking Back Control of Urban Water Distribution: The Effect of Remunicipalization on Water Bills

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Abstract

Governments around the globe are considering taking back direct control as an option to reform privatized public services, particularly on the local level. Using a difference-in-differences framework, we find that remunicipalization of urban water leads to price reductions of about 3-6 cents per cubic meter in larger municipalities, but the effect does not extend to smaller municipalities. Given our finding of unchanged water usage, these reductions in large municipalities translate directly to consumers' bills. As remunicipalization typically happens when a contract with a private firm expires, we investigate whether the threat of competition or remunicipalization arising from expiring contracts itself also leads to price reductions. After contract expiry without remunicipalization, water prices decline by 2-3 cents per cubic meter. Thus, while remunicipalization reduces prices particularly in larger municipalities, threats at contract expiry have a smaller, but more uniform price effect.

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1 Introduction

Whether private or public production of goods and services is more advantageous for citizens has been one of the major debates among economists, policy makers and the public for more than a century. Contributions to this debate have spanned from theoretical arguments about the viability of a state-owned centrally planned economy (Lange, 1936; Lerner, 1938; Mises, 1920) to the concrete realities of privatized or socialized entities on the ground (Money, 1920; Parker, 2004). Wherever national and local governments consider to deprivatize and take back direct control of formerly privatized services today, these concrete realities capture attention in the decision-making process. This is particularly the case for debates around the deprivatization of *local* public services: Above all in energy and urban water, but also in waste collection and local transportation, remunicipalization has emerged as a popular reform alternative for privatized services in the 21st century (Albalate et al., 2024b; Warner and Hebdon, 2001). Despite the policy interest, there is a dearth of empirical evidence on the concrete effects of remunicipalization.

This work investigates how remunicipalizing water management affects citizens' water bills. In Europe, water supply services have not only been remunicipalized most frequently, but take center stage in the political and economic debate. The water sector is a particularly interesting case because already its privatization has sparked major public controversies about efficiency and prices, and its promised benefits have hardly ever materialized.

To measure the effect of remunicipalization on prices, we exploit a unique empirical setting in Catalonia, where in just over a decade, several dozen urban water privatizations were reversed. Specifically, we build on a comprehensive administrative panel covering 436 municipalities from 2013 to 2024, and complete it with our own survey. This allows us to conduct the first quasi-experimental analysis of the effect of remunicipalization on the prices of a public service. We use a difference-in-differences strategy, which considers the staggered nature of remunicipalization. We argue that an unconditional parallel trends assumption for the treated and control municipalities is likely to hold: Exogenous expiry dates of long-term service contracts introduce random variation into remunicipalization timing, and we show that important drivers of remunicipalization are not associated with remunicipalization decisions in our sample. However, including controls helps to increase precision. Since our parallel trends assumption builds on an

argument about random treatment timing, we also use an estimator which directly exploits this (stronger) assumption to improve power.

Given previous findings that prices are lower in public compared to private firms, we expect remunicipalization to lead to declining unit prices, but the effect on bills is theoretically ambiguous, because used quantities and prices interact in complex ways: First, such a price-quantity relationship exists particularly because ever-stricter adherence to the principle of full cost recovery or general budgetary pressures push water firms to balance their budgets. As water prices to a large degree cover fixed network costs, any quantity adjustments by consumers are therefore likely to induce price changes. Secondly, changes to management themselves, and thereby to pricing and demand policy, could lead to water savings or increased use. We thus take quantity adjustments into account when considering how unit price changes translate to consumers' overall bills.

We find that in larger municipalities making up our longer sample, remunicipalization leads to a decrease in prices of about 3-6 cents, or about 3-5% of the price of $1.17€/m^3$ at the beginning of the period. These results are significant both when including controls and when exploiting random treatment timing to increase precision. Water use remains mostly unaffected, reassuring us that price changes were not a mechanical consequence of quantity changes induced by remunicipalization, because municipalities tried to balance budgets. The null effect on usage also implies that the average bill for citizens in these municipalities declined by an equivalent 3-5%. When considering all municipalities over a shorter period, the effect is near zero and not statistically significant. We provide an interesting baseline against which to interpret our results, namely that contract expiry itself leads to a reduction of prices by about 2-3 cents, independently of municipality size. Thus, remunicipalization seems to reduce prices slightly more than competition for contracts in larger municipalities, but an ending contract itself reduces prices in a wider group of municipalities. However, there remains an interesting question as to whether the threat to remunicipalize is part the reason why prices decline after a contract expiry.

Our work contributes to three strands of the literature. First, the empirical debate around economic differences between public and private management goes back decades, with some initial disagreement on whether private or public production is more efficient (Bruggink, 1982; Crain

and Zardkoohi, 1978; Mann and Mikesell, 1976; Morgan, 1977), but an emerging consensus that there are no efficiency differences (Bel et al., 2010; Suárez-Varela et al., 2017). While efficiency is important, citizens' or consumers' satisfaction may depend at least as much on the bills they face when consuming the good or service. But do prices reflect efficiency? Both some older empirical studies (Carpentier and Nauges, 2006; Chong et al., 2006; Martínez-Espiñeira et al., 2009) and the newest evidence (González-Gómez and García-Rubio, 2018; Zhang et al., 2022) find higher prices under private management, with just few studies disagreeing (Romano et al., 2015; Thorsten et al., 2009). This evidence suggests that in heavily regulated industries like water, prices can deviate from costs. There are a number of explanations offered for this observation: A higher rate of return offered to private firms (Zhang et al., 2022), more investment in networks under private management when rates of return are guaranteed (Chabrost et al., 2017), or higher cost recovery through user prices (and thus lower subsidies from the general budget, Albalate et al., 2024a). However, since all the above evidence on price and cost differences alike is exclusively based on cross-sectional comparisons, the exact role of the public-private decision remains notoriously hard to pin down. Our study makes an important step forward in this literature by documenting that price differences in larger municipalities are causally arising from the transition from private to public urban water delivery. The closest work to ours is Albalate et al. (2024a), who compare the change in water prices in municipalities that remunicipalize to the changes in prices of municipalities that privatize, and find that prices increase more after privatization than after remunicipalization.

Secondly, in identifying price reductions as a causal effect of remunicipalization, our work also speaks to a narrower and newly evolving literature investigating effects of moving from private to public delivery or vice versa. This literature has mostly focused on outcomes for employees: Petersen et al. (2022), Hansen et al. (2023) and Hansen and Petersen (2024) investigate the effects of out- and insourcing on the employees of the outsourced firm. Our contribution to this literature is to offer the first causal investigation into pricing behavior in public services after changes to management.

Thirdly, previous work on remunicipalization has centered on the drivers of remunicipalization. It typically revolved around the question whether remunicipalization is driven by pragmatic reasons

or rather by ideological motivations (Albalate et al., 2024b; Clifton et al., 2021; McDonald, 2024; Voorn et al., 2021). Understanding the motivation for remunicipalization is particularly important because although popular, remunicipalization has never attained the inexorability of privatization in the late 20th century (Warner and Hebdon, 2001). Pragmatism based on dissatisfaction with outcomes of private management has been emphasized in most quantitative work (Desmaris and Van De Velde, 2024; Mayol and Saussier, 2024; Warner and Aldag, 2021), although political motivations have occasionally been found to have some influence (Campos-Alba et al., 2021; Gradus and Budding, 2020). In contrast, qualitative case studies on specific remunicipalization experiences tend to place more weight on politics and ideology (Garcia-Arias et al., 2022; Paul, 2024). However, meta-regression results of Lu and Hung (2023) suggest that pragmatic and political motivations both play a role. Our results identify price reductions as a potential pragmatic reason for remunicipalization.[3]

The remainder of this article is structured as follows: Section 2 provides the institutional context and motivates the need to consider water use. Section 3 describes the data used in the analysis, Section 4 presents the estimation equation and identification strategy, and Section 5 presents the baseline results. Section 6 then extends our analysis to competition when contracts expire, and Section 7 concludes with a discussion of the results and their implications for policy.

2 Institutional and Theoretical Background

Urban water supply in Catalonia is a municipal service, whether it is managed directly by the municipality or delegated to a public body or company, or to a private company. While having a high share of private water delivery, Catalonia is at the forefront of water remunicipalization: More than 4.3% of municipalities and almost 10% of municipalities with private management opted out of private delivery in the last 15 years. This is a record from an international perspective. In the same period, Spain overall saw 0.5% of its municipalities taking back their water services, in the US it was 0.4%, 0.3% in France and 0.2% in Germany (Bel and Bühler, 2026). In comparison to the rest of Spain, while Catalonia is home to 12% of all Spanish municipalities and 16% of those

[3] However, using contract renewal negotiations wisely could be an effective alternative in some contexts.

with private water management, more than half of all remunicipalizations took place there. Bel and Bühler (2026) argue that a key factor in the intensity of remunicipalization in Catalonia is resistance to monopolistic abuse. In fact, the private firm AGBAR (controlled by the French multinational Veolia) dominates the private market with a share of almost 80% of municipalities with private management, and almost 90% of the population served by private management. In this context, remunicipalization is often conceived as a means to bring water back under democratic control, and new forms of interlocal cooperation are being developed to facilitate remunicipalization in smaller municipalities - particularly to stand up against threats of litigation by AGBAR (Bel and Bühler, 2026).

Under what regulatory environment does remunicipalization take place in Catalonia? Urban water delivery is being remunicipalized despite different obstacles facing a local government intending to do so. The requirements that a municipality must meet depend on the type of remunicipalization envisaged (see, for example, Feliu, 2017). To terminate the contract before its expiration, European Union regulations for the expropriation of contracts must be complied with, in particular EU Directive 2014/23. For example, the termination of the contract must be justified for reasons of public service efficiency and cannot be based solely on financial motivations; especially when the objective is to expropriate a contract that has become highly profitable for the operator.

There are fewer regulatory obstacles if remunicipalization is implemented when the contract with a private company expires. Still, the municipality must provide information demonstrating that remunicipalization will satisfy the principles established in the Spanish Law 2/2012 on Budgetary Stability and Financial Sustainability. Although this is far from an insurmountable obstacle, it can be a deterrent for small municipalities due to administrative burden. And, more importantly, all the rules that regulate the remunicipalization process can be used by private companies as an entry point for litigation to delay remunicipalization and make it more costly (see Planas Martín et al., 2022).

When a firm sets its water rates, they are approved by the corresponding city council and must be submitted to the Price Commission of Catalonia (Comissió de Preus de Catalunya, CPC). The Price Commission establishes a maximum price, which cannot be higher than the one proposed by

the municipality.[4] The price of urban water services should allow the recovery of costs of service expenses such as energy (mainly for pumping water), personnel expenses, the purchase of water mainly from upstream operators, treatment for its purification, maintenance costs and the depreciation of infrastructure (reservoirs, transport network), among others.

Beyond this procedure to approve municipal prices, the regional regulatory body of water services is the Catalan Water Agency (Agència Catalana d'Aigua, ACA), the regional public company responsible for water planning and management. ACA enjoys special powers regarding upstream water services and sanitation. In this role, ACA approves the rates that upstream urban water networks receive to supply water to urban networks. ACA is funded with an environmental tax on urban water services ("Cànon de l'aigua"), which is generally managed (on behalf of ACA) by the company or administrative unit that manages the service in each municipality.

2.1 The Role of Use Quantities

2.1.1 Usage May Affect Administered Prices

When investigating urban water in the context of Catalonia, water quantities need to be considered for several reasons. First and foremost, municipalities are increasingly under pressure to follow full cost recovery as set out in the 2000 Water Framework Directive (European Union, 2000; Unnerstall, 2006). This principle is becoming more widespread in EU member states (Farnault and Leflaive, 2024), because regulators are stepping up their requirements for policy makers to follow it (Albalate et al., 2024a). Municipalities therefore tend to set prices according to the following equation,

$$c(q)(1 + markup) * q = p * q$$

where c are average costs, q is water quantity and p is the price set by the municipality (within the cap set by the regional Price Commission). The markup, in the case of private management, will typically be a compensation for management activities added as a share of costs. It is a regulatory and contractual parameter rather than a discretionary profit margin, and is therefore not adjusted

[4] Note that in 2018, there was a slight change to the law which turned the binding maximum price into a recommendation; however, this change had little practical effect, as the price commission already tended to set the prices according to the municipalities' proposal before that.

in response to short-run demand fluctuations..[5] Since the costs of providing water are determined to a large part by fixed costs of the network and marginal costs are low, it is reasonable to assume that the service is subject to decreasing average costs $c(q)$, that is, $\frac{\partial}{\partial(q)} c(q) < 0$. This effect is even stronger because when water networks are not used comprehensively, this can pose threats to quality and require further changes to the network.

Solving the above equation for p yields

$$p = c(q)(1 + markup)$$

and taking partial derivatives,

$$\frac{\partial p}{\partial q} = (1 + markup)\frac{\partial c(q)}{\partial q} < 0$$

That is, as quantity decreases, average prices have to increase to keep recovery of fixed costs stable, and to cover costs arising from under-utilizing the network.[6] Price increases can either be attained through increasing the unit price, or, where progressive pricing schemes are in place, by increasing block prices or lowering consumption thresholds, with potentially different distributional implications.

2.1.2 Direct and Indirect Reactions of Water Use to Policy at Management Changes

The literature and policy makers primarily name two sets of reasons why water usage may change after remunicipalization:

1. Mandated reductions for resource saving purposes, substitution of grey water or rainwater for treated water, campaigns initiated by water firms or municipalities, or improved coordination with other policy areas all affect water use. But particularly private water firms may be hesitant to support such measures, because their general incentive is to sell more water to increase profits.
2. A reaction to price changes following remunicipalization or continued private provision, particularly where non-linear tariffs increasing in usage have been introduced.

[5] We disregard network investment here, as municipalities almost always keep ownership rights to the network, and investments are therefore compensated for separately under private management.

[6] This mechanism is also discussed in McDonald (2025)

In this setting, it is not totally straightforward to determine whether reductions in water usage are a desired or undesired outcome, but quantities need to be investigated *at least* to meaningfully interpret potential changes in price. Assuming a standard downward-sloping demand curve, if prices are found to decrease after remunicipalization, but quantities do not adjust, this means that demand elasticity of water use with respect to price is either too small to be detected in the data, or there is a compensating factor, such as simultaneous water savings campaigns.

2.1.3 Identifying The Effect on Overall Water Bills

Last but not least, changes in water use are important to determine the effect of remunicipalization on consumer's water bills. If strong water efficiency measures accompany a unit price reduction, they could amplify the effect on water bills. In contrast, rebound effects increasing the usage of water at a lower price could also dampen this effect.

3 Data

We use data provided by ACA, augment it with information obtained through two surveys administered by our research team and by other researchers, respectively, and combine it with additional administrative data.

Public or private production. For the period from 2017 to 2024, ACA provides us with information on whether a service in a specific municipality was produced publicly or privately. We augment this data with the database compiled by researchers at the universities of Granada, València and Barcelona used in Albalate et al. (2024b), and a list built by the Association of Municipalities and Entities for Public Water (AMAP, 2025, Associació de Municipis i Entitats per l'Aigua Pública), and the grassroots organization Water is Life (Aigua és Vida). We then confirm all remunicipalizations through surveys we sent to the responsible public servants in the municipalities, and we make several changes based on the facts on the ground, and to align our definitions with those common in the international literature.[7]

[7] In line with the international literature, we classify mixed firms as public whenever the public ownership stake is above 50%. Furthermore, some of the discrepancies with the ACA stem from municipalities being treated as under

Water prices. ACA provides information on the prices at different steps in the water process for domestic users. We focus on the price to provide water to households, which refers to the highest price allowed by CPC, and for a household of three consuming 12 m^3 of water per month. Note that this analysis does not take into account differences in progressive tariffs. We use nominal prices, as water prices tend to be very sticky, and there were large jumps in price levels and different averages in price levels at the start of our sample across treatment and control groups. Although not statistically significant, when deflating prices, these differences would lead to an artificial convergence in absolute real water prices, a convergence which is not related to pricing policy.

Water use is also obtained from ACA. It includes the total amount of water used in each municipality by domestic water supply networks, and for industrial or municipal use. We focus on domestic use here. To make results more interpretable, we divide total usage by population numbers provided by the Catalan Statistics Institute (Idescat).

Different sample periods. In our data, longitudinal information on prices between 2013 and 2017 is only available for a subset of municipalities larger than 5,000 inhabitants. We therefore cannot use the full price sample during the whole period. We thus focus on two samples: The period from 2017 to 2024, where we have complete data on prices, and where 23 municipalities decided to remunicipalize their water distribution and 330 kept it private (*short sample*). And a *long sample*, where we use all municipalities whose prices were continuously observed after 2013. This way, we can use part of both our treated group (12 remunicipalized water services, 2 of which we cannot follow in the *short sample*) and control group (116 always private services). Note that the municipalities we lose through this procedure are small municipalities (< 5,000 inhabitants) which remunicipalized, because there is missing pre-treatment outcome data. In return, we get additional treated observations of municipalities which remunicipalized early on, and we can follow those over an extended period. Overall, our *long sample* (2013-2024) will have fewer entities because municipalities below 5,000 inhabitants are not included, and fewer total observations as a

direct management (public) when the municipality itself paid the water tax, but there is actually a private firm managing the service. We classify these cases as private. See Appendix A for details.

consequence of this. To align the results with those for prices, we provide usage results for the *long* and *short sample*.

Figure 1 illustrates the geographical distribution of treatment and control units combining the two samples. Treated (remunicipalized) and untreated (always private) municipalities seem relatively evenly distributed in Catalonia, with the only exception that there are relatively few remunicipalizations in the big population centers in the center of the coastline, which is the lower-right edge of the triangle.

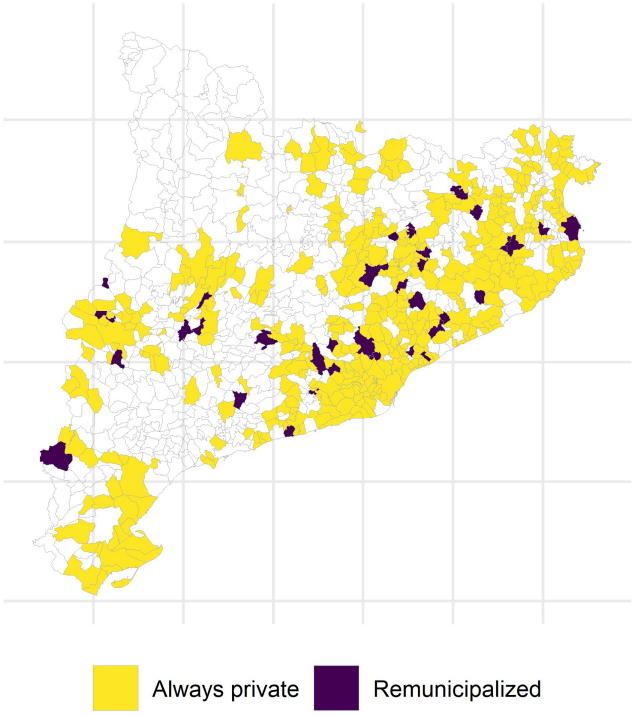

Figure 1: Geographical distribution of treatment and control units.

Note: The figure presents the geographical distribution of treatment and control municipalities in Catalonia. Treatment municipalities are those remunicipalizing from 2013 to 2017, water services in control municipalities remain in private hands during this period. Blank municipalities are those always in public hands since 2013.

3.1 Descriptive statistics

We provide descriptive statistics for each of the two samples we use throughout the analysis. Descriptive statistics for the *long sample* are depicted in Table 1, and those for the *short sample* in Table B1 in Appendix B. The descriptive statistics for both samples look very balanced, with only

the difference in the water prices statistically significant at 10% level in the *short sample* (see Table B1). Differences in means are not statistically significant for any variable in any sample.

Table 1: Means (standard deviations) of the main covariates and outcome variables, long sample

	Always private	Re-municipalized	p-value of diff.
Population	40435.93	39581.92	0.98
	(153245.11)	(60927.2)	
C-left parties	0.41	0.4	0.65
	(0.07)	(0.04)	
Pop. shr. 14 and younger	0.17	0.18	0.41
	(0.02)	(0.02)	
Pop. shr. 65 and older	0.16	0.15	0.34
	(0.03)	(0.02)	
Tertiary education	31.35	31.83	0.86
	(8.91)	(8.68)	
Shared basins	0.11	0	0.22
	(0.32)	(0)	
Hydrological drought	1.06	1.04	0.86
	(0.26)	(0.3)	
Water supply price	1.17	1.02	0.25
	(0.45)	(0.54)	
Per capita consumption	46.73	47.65	0.85
	(16.7)	(13.53)	
nobs.	116	12	

The table provides descriptive statistics for the main variables in the *long sample* (2013-2024), and includes outcome variables (per capita water use and the water supply price), and covariates for population; the share of parties left of the political center; the share of the population that is 65 years old or more, and the population share which is 14 years old and younger, respectively; the share of inhabitants with tertiary education; as well as drought indicators. Always private indicates that the service remained untreated throughout, while re-municipalized includes municipalities moving from private to public management. The last column indicates the p-value of the difference between the two groups. Standard deviations are in parentheses.

4 Estimation Equation and Identification Strategy

We estimate a difference-in-differences model based on the following TWFE estimation:

$$Y_{it} = \tau \text{Remuni}_{it} + \gamma_t + \alpha_i + \epsilon_{it}$$

where Y_{it} is the outcome of interest for municipality i at time t, Remuni_{it} is a dummy variable that takes the value of 1 if the municipality had a remunicipalized water service in year t, γ_t are time fixed effects, α_i municipality fixed effects, and ϵ_{it} is the error term. The coefficient of interest is τ, the average effect of remunicipalization in municipalities treated by remunicipalization ("ATT").

The TWFE estimator has important weaknesses when it comes to its aggregation of individual 2x2 comparisons in settings where effects may be heterogeneous and treatment is not adopted at the same time (see Roth et al., 2023). We therefore estimate τ using estimators specifically developed for the staggered setting; Butts and Gardner (2022) provide a nice illustration of the differences of some common estimators. We chose the estimator by Callaway and Sant'Anna (2021) as our main estimator, because it allows for a flexible inclusion of covariates.

Parallel Trends Assumption. The main identifying assumption we rely on here is that municipalities being eventually treated with remunicipalization would have experienced, in the absence of remunicipalizing the water service, the same trends in their outcome as municipalities not/later treated - an unconditional parallel trends assumption. This allows us to compare the evolution of the remunicipalized water companies with the evolution of never-remunicipalized and not-yet-municipalized companies. To help us overcoming low power by increasing precision of the estimates, we provide estimates with a battery of baseline-period municipality control variables.

Alternative (stronger) assumption: random treatment timing. As we will argue in the next section, remunicipalization timing is strongly determined by contract expiry, and we will provide evidence for this by showing that it is entirely independent of current political, demographic or drought conditions. Thus, our case may be one where random timing of remunicipalization is a plausible assumption. This assumption allows us to make use of the estimator by Roth and Sant'Anna (2023), which substantially outperforms other Difference-in-Differences estimators in terms of precision.

5 Results

5.1 Remunicipalization Is as Good as Random

Municipalities autonomously decide whether they want to remunicipalize their water service. This can be due to a variety of reasons, which could also be associated with post-treatment potential outcome evolution: The very drivers of remunicipalization may have led these municipalities to change their prices, or their citizens to adjust water usage (e.g. through policies) independently of remunicipalization, when comparing to the control group. For example, municipalities less affected by drought could select into remunicipalization, because they expect a lower input price growth and are therefore able to decrease prices for consumers. To investigate the potential role of this problem, we test whether a number of covariates arguably related to remunicipalization possess predictive power for adoption of remunicipalization in our sample.

For this step, it would not be reasonable to *exclusively* rely on the literature's previous findings on remunicipalization or the public-private decision, because a priori, we also care about the timing of remunicipalization decisions, and because we are not considering those municipalities which either were always public or remunicipalized in and before 2013 or 2017, respectively. Thus, the factors below are either identified in the literature as drivers of remunicipalization, or have been mentioned by policy makers in interviews with us.

Population size. Smaller municipalities may have more difficulties mobilizing the necessary technical capabilities and staff to move to direct management of the service and comply with the extensive legal procedures (see Reppert, 2024 for this argument regarding energy grid remunicipalization). Bel and Bühler (2026) also show that in Catalonia, particularly small municipalities are increasingly forming voluntary associations of municipalities to mitigate these disadvantages and to pool expertise. Thus, it is plausible that the likelihood of remunicipalization in small municipalities increased during our sample. We should not control for the changing local presence of public cooperation mechanisms directly, because these dynamically changed over time. Therefore, they could themselves be part of the mechanism through which remunicipalization affects outcomes such as prices. More public presence in the water sector also allows for more public-public intermunicipal cooperation to benefit from economies of scale and

knowledge spillovers. If this was the case, controlling for the emergence of such institutions would bias our effect, so these cooperations are a "bad control". We therefore focus only on inhabitants in our study.

Political representation. The role of political party strength for remunicipalization is not yet settled in the literature; Reppert (2024) finds that remunicipalization is not associated with a particular party's strength and more with the political context, while Schoute et al. (2021) point out a relationship between more left-wing municipal councils and less private production. Recall that this is a static argument and it can at most give us some cues about the role of center-left political representation in the decision to remunicipalize, let alone the timing of its implementation. We expect that left-of-center parties remunicipalize more often, as they tend to be more susceptible to movement pressure, and public production aligns better with their political values.

Tertiary educated population. We expect that more highly educated inhabitants are associated with earlier remunicipalization, because citizens with tertiary education are more likely to be involved in activism, which has been pointed out to us as a key driver of remunicipalization.

Demographic structure. We expect that municipalities with a higher share of elderly people are less likely to remunicipalize, because the elderly are less likely to be involved in activism. In turn, municipalities with many young inhabitants may have a higher stake in remunicipalization in order to protect future generations from a perceived extractive threat and mismanagement through private production.

(Expected) drought exposure. Catalonia suffered a very serious drought from 2021 to 2024. Municipalities could have self-selected into remunicipalization based on exposure to this drought, and could have adjusted their water prices or use independently of remunicipalization. The drought index we calculate is a simple period-weighted average of the official seriousness of the drought, according to ACA.[8] However, since part of Catalonia is not subject to Catalan regulations, this only covers a part of the municipalities; we therefore also create a dummy for *shared basins*, where

[8] Classification of hydrological drought: Normality = 0, Pre-alert = 1, Alert = 2, Exceptional State = 3, Pre-Emergency = 5, State of Emergency = 5, State of Emergency I = 6, State of Emergency II = 7

water management is coordinated with non-Catalonian municipalities and regions within the catchment area of the shared Ebre river.

Service characteristics are constant across municipalities in our case, because we investigate a single-service case. When we estimate Cox proportional hazard models in Table 2 to identify baseline variables actually related to the implementation of remunicipalization, we find that all the variables are statistically unrelated to implementation in both samples. Table C1 of Appendix C provides the results of the same exercise for the *short sample*, and Table D1 in Appendix D provides significance levels for regressions of remunicipalization on each of the individual predictors.[9]

Table 2: Predicted factors driving the timing of remunicipalization, Cox proportional hazard model, long sample

	coef	p
C-left parties' vote share	1.348	0.477
Population size	0.000	0.739
Pop. aged 14 and below	0.290	0.978
Pop. aged 65 and above	4.007	0.593
Tertiary education	0.006	0.649
Hydrological drought index	0.063	0.883

The table provides coefficients and p-values of regressing treatment timing on potential drivers of remunicipalization in a Cox proportional hazard model for the *long sample* (2013-2024).

A potential explanation for the complete lack of explanatory power of these variables could be the timing of private service contract expirations: In Catalonia, service contracts often run for 20 to 30 years. Therefore, these contracts' expiry dates are in essence orthogonal to today's politics, and they may be the main factor determining the timing of remunicipalization. As such, they introduce randomness into remunicipalization timing. Given the legal and financial cost of cancelling a running contract, having a contract expiry may even be the main reason to remunicipalize *at a given moment*. Bel and Bühler (2026) argue that there is a strong perception of monopolistic abuse by the main water firm AGBAR in Catalonia. The contract expirations are then likely to be the

[9] The variable for shared basins had to be eliminated from multivariate models because of multicollinearity with drought exposure.

mechanism determining at what exact moment a new wave of political and public support for remunicipalization could express itself.

5.2 Effects of Remunicipalization

We estimate the ATTs using the estimator by Callaway and Sant'Anna (2021), both with and without control variables. Since this serves as a way to increase precision of the estimates rather than to make the parallel trends assumption more plausible, we only provide results with all variables included. The results in Table 3 show that the effects for the used volume of water are insignificant, and the estimate for prices in the *long sample* is statistically significant when using controls, but in the *short sample* very close to zero. The *long sample* excludes some small municipalities because of missing data in earlier periods; it therefore has a smaller number of observations. None of the effects of remunicipalization on water usage are statistically significant.

Table 3: Effect of remunicipalization on water prices and use, without and with controls for population, education, political ideology and demography.

	Price (SS)	Price (LS)	Use (SS)	Use (LS)	Price (SS)	Price (LS)	Use (SS)	Use (LS)
	-0.013	-0.04	0.033	0.02	0.002	-0.035**	0.058	-0.146
	(0.018)	(0.036)	(0.657)	(0.463)	(0.026)	(0.017)	(1.064)	(0.638)
nobs.	3416	1872	2947	1705	2800	1680	2436	1551
controls	no	no	no	no	yes	yes	yes	yes

Note: SS = Short Sample; LS = Long Sample. The table provides ATTs calculated using the estimator by Callaway and Sant'Anna (2021) of remunicipalization on the price of water and water quantities for the *short sample* (2017-2024), and the *long sample* (2013-2024), and for estimations without controls in the four leftmost columns and with controls for population, education, political ideology, demography and drought exposure by using the doubly-robust method by Sant'Anna and Zhao (2020) in the four rightmost columns. Standard errors in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

When looking at the event studies in Figure 2, we see that there is no concern about non-parallel pre-trends, and that prices move into significantly negative territory in the *long sample* about 2 periods after treatment, independently of controls. In the *short sample*, there is no systematic movement away from the zero line, but just a transitory decrease in the first post-treatment period. In the sixth post-treatment period without controls, there is a large upwards jump in prices, likely driven by Terrassa, which remunicipalized the service in 2018 and increased prices abruptly in 2024, an action widely debated in the public (El Nacional, 2024). Because Terrassa is observationally very different from all municipalities in the control group, it cannot be used in

inverse-probability weighting, and gets excluded when applying the doubly-robust procedure in Sant'Anna and Zhao (2020) to control for covariates. These results are robust to excluding municipalities with expiring contracts from the control group, as we document in Figure E1 and Table E1 in Appendix E.

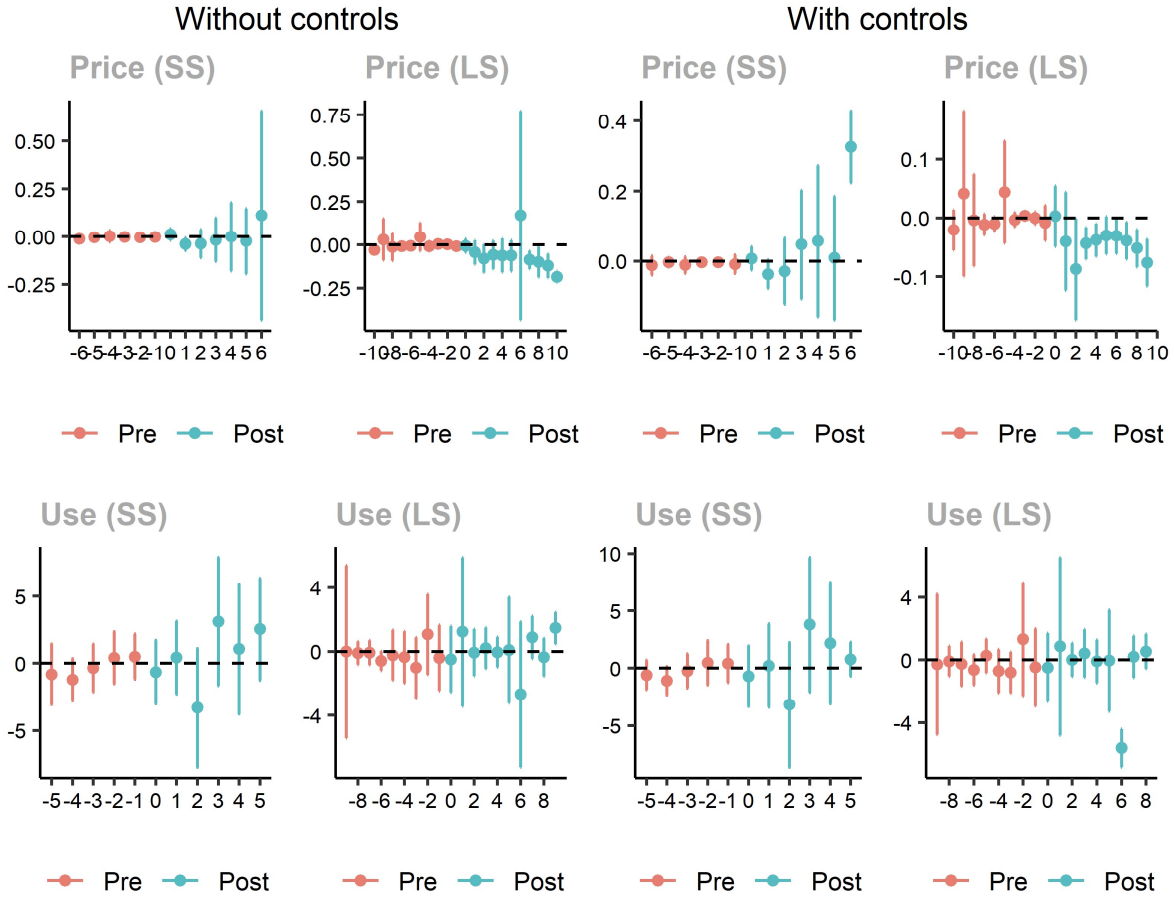

Figure 2: Event studies for the effect of remunicipalization on water prices and consumption with and without controls for population, education, political ideology, demography and drought exposure

Note: SS = Short Sample; LS = Long Sample. The figure provides event study estimates of remunicipalization on the price of water (upper row) and water quantities (lower row) for the *short sample* (2017-2024) in columns 1 and 3, and the *long sample* (2013-2024) in columns 2 and 4. Years pre- and post-treatment are displayed on the horizontal axis. Effects are calculated using the estimator by Callaway and Sant'Anna (2021). Columns 1 and 2 are without controls, columns 3 and 4 use controls for population, education, political ideology, demography and drought exposure by using the doubly-robust method by Sant'Anna and Zhao (2020). Error bars indicate bootstrapped standard errors at 5% significance level, clustered at municipality level.

As mentioned previously, we can be very confident that remunicipalization timing in our sample is as good as random. This allows us to re-estimate the effect of remunicipalization using the

estimator by Roth and Sant'Anna (2023), which uses a random treatment timing assumption for the not yet treated units instead of a parallel trends assumption. The results are shown in Table 4 and confirm our previous findings: Prices significantly decrease by about 3.7 cents in the *long sample*, but not in the *short sample*, and there is no significant effect on water usage in either sample.

Table 4: Effect of remunicipalization on water prices and use, Roth and Sant'Anna (2023) estimator

Use (SS)	Use (LS)	Prices (SS)	Prices (LS)
-0.402	0.033	-0.009	-0.037*
(0.791)	(1.148)	(0.021)	(0.021)

Note: SS = Short Sample; LS = Long Sample. The table provides ATTs calculated using the estimator by Roth and Sant'Anna (2023) of remunicipalization on the price of water and water quantities for the *short sample* (2017-2024) and *long sample* (2013-2024). Standard errors in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

However, because the estimator by Roth and Sant'Anna (2023) requires at least two treated units per treatment time group, it excludes some municipalities in the *long sample* - in essence only estimating the effect using units treated in 2022 and 2023. In doing so, it limits the long-term insights we can gain from this exercise. Most importantly, however, Terrassa is excluded again, as it is the only larger municipality treated in 2018. To maintain more treated municipalities in the sample, Roth and Sant'Anna (2023) suggest to aggregate time periods into larger groups, or redate treatment timing of some observations back to larger groups. We follow these suggestions in Table 5. Note that for the results in the first two columns, we had to redate the first treatment for Terrassa from 2018 to 2014, a strong modification. We therefore tested the robustness to dating treatment forward, to 2022. Both of these approaches allow us to maintain Terrassa in the sample, even if imperfectly. Most importantly, we attribute the controversial one-time price hike in 2024 to remunicipalization in both cases. We find a statistically significant price reduction of 5.9 and 6.0 cents, respectively. This reassures us that the Roth and Sant'Anna (2023) estimator does not only find significant effects because it excludes Terrassa by design. In contrast, when pooling years into periods (pre-treatment: 2013, first period: 2014-2017, second period: 2018-2021, third period: 2022-2023), there are neither remunicipalizations in the three-years period prior to, nor after remunicipalization in Terrassa (2018). Thus, while this procedure assures all other treated units stay in the sample, Terrassa is again excluded by design. Nonetheless, this exercise allows us to

investigate longer-term effects of remunicipalization. In particular, our results suggest that prices decrease significantly, by about 6.5 cents. The effect on water usage is not systematically significant.

Table 5: Effect of remunicipalization on water prices and use, Roth and Sant'Anna (2023) estimator, redated and regrouped treatments

Prices (LS)	Use (LS)	Prices (LS)	Use (LS)	Prices (LS)	Use (LS)
-0.06***	-0.686*	-0.059***	-0.572	-0.065***	0.065
(0.013)	(0.362)	(0.018)	(0.43)	(0.012)	(0.503)
redated	redated	redated*	redated*	pooled	pooled

Note: LS = Long Sample. The table provides ATTs calculated using the estimator by Roth and Sant'Anna (2023) of remunicipalization on the price of water and water quantities for the *long sample* (2023-2024). Redated indicates that municipalities were dated up to 2 years back in terms of their treatment time, except for Terrassa, which had to be redated from 2018 to 2014. Redated* indicates that the redating of Terrassa was instead to 2022. Pooling was done into near-equally sized time periods of 3-4 years: Pre-treatment (2013), period 1 (2014-2017), period 2 (2018-2021), period 3 (2022-2024). Standard errors in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

Figure 3 provides the event-study plots for the specifications discussed before. For water prices, the pre-trends are generally nice, and there is a long-term reduction in water prices of between 10 and 15 cents. For water use, the pre-trends look somewhat more erratic and there is no systematic post-treatment effect.

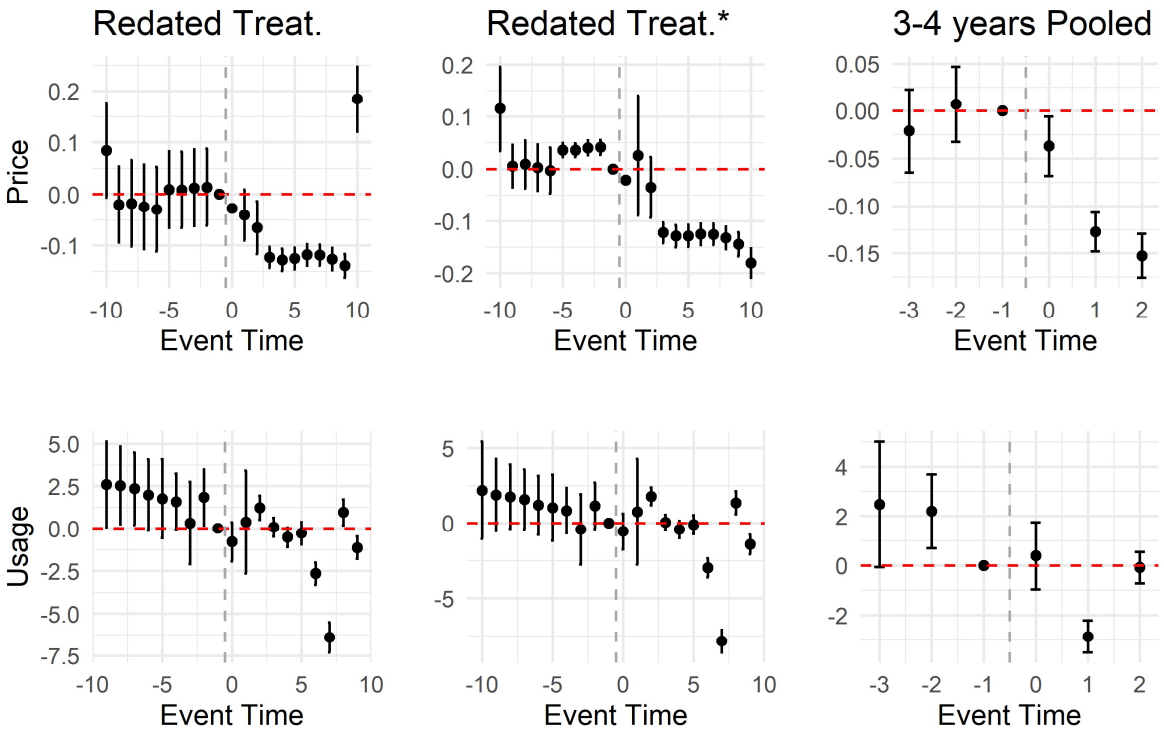

Figure 3: Figure C2: Event-study plot of the effect of remunicipalization on water supply price, sample starting in 2013.

The figure provides event study estimates calculated using the estimator by Roth and Sant'Anna (2023) of remunicipalization on the price of water and water quantities for the *long sample* (2023-2024), using different approaches to tackle the problem of small treatment groups. "Redated Treat." indicates that municipalities were dated up to 2 years back in terms of their treatment time, except for Terrassa, which had to be redated from 2018 to 2014. "Redated Treat.*" indicates that the redating of Terrassa was instead forward, to 2022. Pooling was done into near-equally sized time periods of 3-4 years: Pre-treatment (2013), period 1 (2014-2017), period 2 (2018-2021), period 3 (2022-2024). Error bars indicate standard errors at 95% significance level.

6 A Benchmark: The Effect of Threats At Contract Expiry

We have been arguing in the previous section that there is no association between covariates and remunicipalization dates, because contract expiry dates are highly exogenous, as contract durations are long (often 25-30 years) and determined at contract start. Thus, the timing of most potential remunicipalizations (or competitive bidding processes) is not really in the hands of the current local administration. Since contract holders almost by definition share an interest to remain in the contract, the period around contract expiry is one of heightened threat from competition - through competitive bidding, but in an environment of high politicization likely also through the alternative of remunicipalization. To investigate whether this threat has an effect on prices and usage, we use

the same DiD approach as in the previous section and data by AMAP (2025) to define municipalities as belonging to the treatment group if they face an expiring contract during the treatment period. Thus, we remove all municipalities experiencing a remunicipalization from our sample and define treatment as happening when a contract expired, or when there was a new bidding.

Table 6: Effect of expiring contract / threat from competition on water prices and usage, including controls on population, education, political ideology, demography and drought.

	Prices (SS)	Prices (LS)	Use (SS)	Use (LS)
	-0.019**	-0.03**	-0.238	-0.646
	(0.008)	(0.015)	(1.016)	(0.786)
nobs.	2624	1536	2282	1419

Note: SS = Short Sample; LS = Long Sample. The table provides ATTs calculated using the estimator by Callaway and Sant'Anna (2021) of an expiring service contract / threat from competition on the price of water and water quantities for the *short sample* (2017-2024), and the *long sample* (2013-2024) for estimations with controls for population, education, political ideology, demography and drought exposure by using the doubly-robust method by Sant'Anna and Zhao (2020). Standard errors in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

Our results in Table 6, based on the same parallel trends assumption as the results for remunicipalization, show a statistically significant reduction in water prices after contract expiry by about 2-3 cents per cubic meter. The effect is slightly larger in the *long* than in the *short sample*. Again, the effect on water consumption is insignificant. Interestingly, the price decline only happens after the contract actually expired, suggesting that offering declining prices may be part of the bidding strategy. In contrast, price restraint is not observable immediately before the contract expires. We interpret the results as follows: Incumbents are willing to give up a piece of the pie to preserve the bakery, that is, they are willing to cede parts of their profits in order to continue making any profits at all. However, the pre-trends in prices in the *long sample* in the second panel of Figure 4, which appear 10 to 8 years prior to treatment should serve as a cautionary tale: Firms may actually have pushed for increases to their prices more when the contract end was still far, and then only made concessions from this higher price level at contract expiry. Note that the effect we find should be understood as a vulnerability effect of contract holders at the end of the contractual period, which allows the municipality to negotiate a better deal starting into a new or renewed contract.

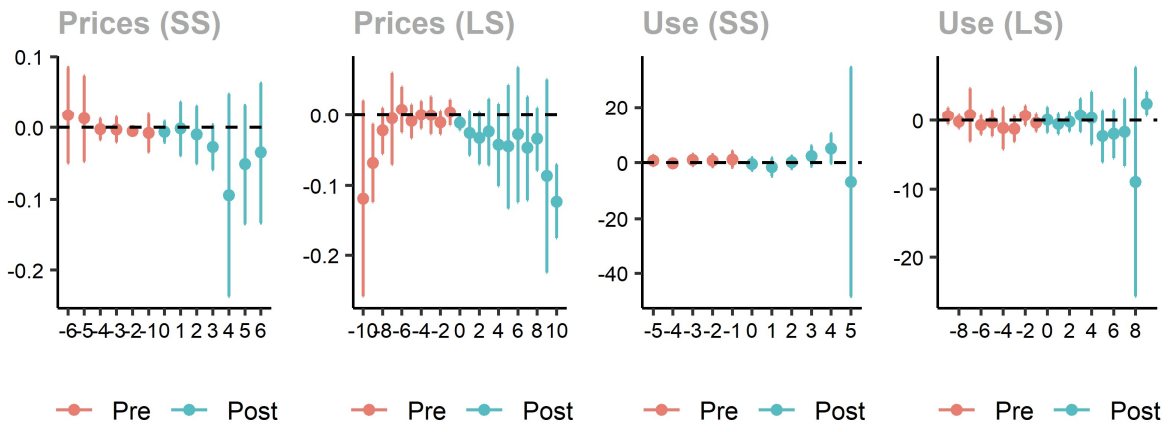

Figure 4: Event studies for effect of contract expiry / threats from competition on usage and prices under a parallel trends assumption conditional on population, education, political ideology, demography and drought

Note: SS = Short Sample; LS = Long Sample. The figure provides event study estimates of an expiring service contract / threat from competition on the price of water (left) and water quantities (right) for the *short sample* (2017-2024) in columns 1 and 3, and the *long sample* (2013-2024) in columns 2 and 4. Years pre- and post-treatment are displayed on the horizontal axis. Effects are calculated using the estimator by Callaway and Sant'Anna (2021) with controls for population, education, political ideology, demography and drought exposure by using the doubly-robust method by Sant'Anna and Zhao (2020). Error bars indicate bootstrapped standard errors at 5% significance level, clustered at municipality level.

7 Discussion and Concluding Remarks

We find that remunicipalization reduces water prices for larger municipalities, and this effect is significant when we include controls for precision or use estimators exploiting random treatment timing. Since water usage remains unchanged in all our estimations, such reductions of water prices per cubic meter in the range of 3% to 6% translate directly into reductions in water bills. The null effect on usage may imply that remunicipalized water firms introduce more effective water savings campaigns than private firms. By contrast, the price elasticity of water use may be too small for any reaction to be detectable. Price changes in our empirical setting can not only reflect increased operational efficiency or dividend payments, but also changes in upstream water supply contracts,[10] increased investment into network quality or public subsidies. For a sample including also smaller municipalities but a shorter time period, we do not find any effect on water prices. However, both our study and Albalate et al. (2024a) also suggest that looking at the effect

[10] Defenders of the remunicipalization project argued that this was the main driver for the price increase in Terrassa

on the average municipality may hide a large heterogeneity in the way prices are affected by an individual remunicipalization, as illustrated by our difficulties in treating Terrassa. One limitation of our work is that we cannot yet identify whether these extreme cases are driven by idiosyncrasies, or whether larger municipalities with remunicipalizations of their water supply experience short-term price reductions at the cost of having to increase prices very strongly at some point in the future.

We also find an effect of contract expiry on water prices. So far, we cannot distinguish which part of this effect is driven by private competition, and to what extent the threat of remunicipalization also played a role. Whether the remunicipalization movement caused a part of the apparent strategic concessions or spillovers to pricing policy of private firms needs to be investigated; there is interesting evidence of similar effects in the literature on cross-firms spillovers from trade union activity (Corneo and Lucifora, 1997; Farber, 2005) or communist revolutionary threat (Rasmussen and Knutsen, 2023). While the low levels of private competition in the water sector documented in Bel and Bühler (2026) would point to the presence of such an alternative "remunicipalization threat" channel, the mechanism is not obvious: A decision to launch a bidding already precludes remunicipalization as an option. Any such remunicipalization threat would thus have to operate through a more informal path, where potential bidders for the contract signal to the municipalities that they would be willing to compete and compromise on compensation if a bidding process is launched instead of remunicipalization.

Another avenue for further research is to investigate concrete policies and actions targeted at saving water. Network quality and the associated losses from spills are imporant parameters both for the environmental efficiency and reliability of water supply. Unfortunately, there do not exist long enough standardized time series for water spills to extend our analysis to these factors. We also lack comprehensive data to investigate the role of remunicipalization for social water tariffs or progressive pricing. Such schemes offer a basic use volume per person or household at a reduced price, while unit prices increase with usage. Proponents of remunicipalization consider such progressive pricing schemes an important lever to relieve poorer households from high water costs while complying with regulations that demand prices to cover costs, and at the same time set incentives to save on water. Digging into the environmental aspects of public versus private

production will also require a broader approach: The main environmental benefit of public control may lie in better coordination of the whole water cycle, in particular where supra-municipal entities coordinate with upstream water providers, regional authorities and municipalities to save water or tap new sources.

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Appendix

A: Corrections Compared to the ACA Data

Below is an exhaustive list of all corrections we applied compared to the database by the Agència Catalana d'Aigua. For this, we used the surveys we conducted in all the municipalities that were listed as remunicipalized in any of the sources used.

- El Brull was always public and can be excluded from the sample
- In Olèrdola, a majority of the municipality was always served private
- Constantí was privatized and is therefore also excluded from the sample
- Additional remunicipalizations happened in Argençola and Tagamanent, in 2017 (after privatized in 2012) and in 2022, respectively
- The same holds for Sobremunt, which was remunicipalized in 2014
- In Piera, the network providing the majority of the municipality was remunicipalized, so we treat it as a remunicipalization
- We correct Torelló and Sant Quirze from being remunicipalized in 2021 resp. 2022 to remunicipalized in 2022 and 2023, respectively.

B: Descriptive Statistics for Short Sample

Table B1: Means (standard deviations) of the main covariates and outcome variables, short sample

	Always private	Re-municipalized	p-value of diff.
Population	15368.16	20910.22	0.78
	(93053.46)	(47353.68)	
C-left parties	0.37	0.38	0.43
	(0.08)	(0.05)	
Pop. shr. 14 and younger	0.16	0.17	0.17
	(0.03)	(0.02)	
Pop. shr. 65 and older	0.18	0.16	0.11
	(0.05)	(0.03)	
Tertiary education	32.72	32.76	0.98
	(8.44)	(8.61)	
Shared basins	0.18	0.09	0.24
	(0.39)	(0.29)	
Hydrological drought	0.91	0.94	0.68
	(0.29)	(0.27)	
Water supply price	1.15	0.97	0.07
	(0.44)	(0.52)	
Per capita consumption	49.96	44.09	0.28
	(25.78)	(10.9)	
nobs.	326	23	

The table provides descriptive statistics for the main variables in the *short sample* (2017-2024), and includes outcome variables (per capita water use and the water supply price), and covariates for population; the share of parties left of the political center; the share of the population that is 65 years old or more, and the population share which is 14 years old and younger, respectively; the share of inhabitants with tertiary education; as well as drought indicators. Always private indicate that the service remained untreated throughout, while re-municipalized includes municipalities moving from private to public management. The last column indicates the p-value of the difference between the two groups. Standard deviations are in parentheses.

C: Cox Model Results for the Short Sample

Table C1: Predicted factors driving the timing of remunicipalization, Cox proportional hazard model, short sample

	coef	p
C-left parties' vote share	0.160	0.875
Population size	0.000	0.863
Pop. aged 14 and below	2.021	0.555
Pop. aged 65 and above	2.502	0.314
Tertiary education	0.002	0.768
Hydrological drought index	0.008	0.975

The table provides coefficients and p-values of regressing treatment timing on potential drivers of remunicipalization in a Cox proportional hazard model for the *short sample* (2017-2024).

D: Individual Variable Significance in Cox Model

Table D1: P-values of individual variables in Cox model predicting the timing of remunicipalization

	short sample	long sample
C-left parties' vote share	0.765	0.705
Population size	0.813	0.987
Pop. aged 14 and below	0.311	0.442
Pop. aged 65 and above	0.184	0.415
Tertiary education	0.984	0.885
Shared basins	0.373	0.317
Hydrological drought index	0.736	0.884

The table provides coefficients and p-values of regressing treatment timing individually on potential drivers of remunicipalization in Cox proportional hazard models, for the *short sample* (2017-2024) and the *long sample* (2013-2024).

E: Robustness Check, Remunicipalization With Municipalities Without Expiring Contract in the Control Group

Table E1: Effect of remunicipalization on water prices and usage, including controls for population, education, political ideology, demography and drought exposure. Sample excluding municipalities with an expiring contract.

	Prices (SS)	Prices (LS)	Use (SS)	Use (LS)
	0.001	-0.037**	0.011	-0.432
	(0.025)	(0.016)	(1.095)	(0.707)
nobs.	2312	1368	2009	1265

Note: SS = Short Sample; LS = Long Sample. The table provides ATTs calculated using the estimator by Callaway and Sant'Anna (2021) of remunicipalization on the price of water and water quantities for the *short sample* (2017-2024), and the *long sample* (2013-2024) for estimations with controls for population, education, political ideology, demography and drought exposure by using the doubly-robust method by Sant'Anna and Zhao (2020). Municipalities with an expiring contract are excluded from the control group. Standard errors in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

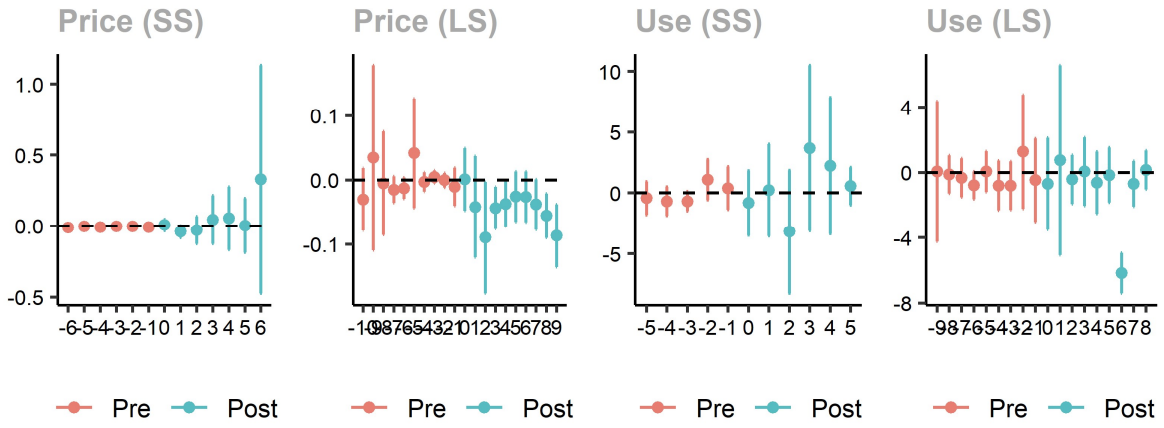

Figure E1: Event-study plot of the effect of remunicipalization on water supply price (two leftmost columns) and use (two rightmost columns), sample starting in 2017 (columns 1 and 3) and in 2013 (columns 2 and 4), excluding those facing contract expiry.

Note: SS = Short Sample; LS = Long Sample. The figure provides event study estimates of remunicipalization on the price of water (left) and water quantities (right) for the *short sample* (2017-2024) in columns 1 and 3, and the *long sample* (2013-2024) in columns 2 and 4. Years pre- and post-treatment are displayed on the horizontal axis. Effects are calculated using the estimator by Callaway and Sant'Anna (2021) with controls for population, education, political ideology, demography and drought exposure by using the doubly-robust method by Sant'Anna and Zhao (2020). Municipalities with an expiring contract are excluded from the control group. Error bars indicate bootstrapped standard errors at 5% significance level, clustered at municipality level.

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