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Abstract

This paper looks at the reasons for and results of make or buy in local public services, with specific regards to its possible effects on price and other performance determinants. It uses a rich city-level dataset of water utilities in France for several years. We find evidence that private management is associated with higher prices on average *ceteris paribus*. This pattern is consistent with the study of units switching from an organization to another. We find that municipalities switching from public to private management face increased price but the effect is not always significant. Our results also show that switching from private to public management does not always foster decreasing prices. We finally discuss several reasons for the price gap between public and private management using extra-samples. We also present some methodological implications for researchers working on the link between organization and efficiency.

JEL Codes: L14-L33-L95. Keywords: public-private partnerships, water, efficiency, ownership, differences-in-differences, propensity score matching.

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1 Introduction

For the last forty years, the role of the public sector in providing basic services such as electricity, gas, water or telephone with a natural monopoly component was hardly questioned. All over the world thousands of regulated monopolies have been opened to competition for service provision with different options to organize the supply of goods. A large part of the theoretical literature on the subject, based on organizational performance, heavily draws on landmark works by Coase [1937] and Williamson [1975]. For these authors[1], the governance structure of a transaction is a function of the relative costs of transacting in markets and organizing procurement within the firm. "Misalignment" between governance structure and transaction characteristics potentially has large efficiency effects: an organizational form that is superior will always result in large efficiency gains compare with how the same unit would have performed under the other alternative.

This paper studies the impact of private management on retail price in residential water industries in France. As an empirical laboratory, we use a representative dataset of 2,455 French cities observed four years: 1998, 2001, 2004 and 2008. A first look at simple patterns in the data is instructive. A first glance at Table (1) shows how the prices are related to the organizational form. The price premium is almost 30 euros on average for a standard bill. Other studies on the subject show that private management is often associated with higher prices, even if the price premium lowers when one takes into account panel data and sufficient controls for heterogeneity between utilities (see for example Chong et al. [2006] for a cross-sectional study of 5,000 French water utilities in 2001 and Chong et al. [2012] for a panel study of 3,700 water utilities between 1998 and 2008).

We first analyze average differences in retail prices between public and private provision using different regressors controlling for heterogeneity between observations and organizational outcomes. As the choice of a managerial form is never randomized, we need to find out an alternative methodology which at best mimics a natural experiment. We adopt a quasi-experimental differences-in-differences methodology. We then study price evolution for utilities switching from private to public management and from public to private management. Even if a switch may not be randomly carried out, municipalities switching from an organizational form to the other offer a privileged laboratory to assess public versus private performance. We then discuss potential endogeneity problems by connecting the decision of the municipality to outsource the public water service with its contractual capabilities.

We find two key results. First, private provision of water is more expensive than public provision, even controlling for the characteristics of privately provided water. However, the price premium is lower than simple means comparison would suggest. Second, focusing on switchers reveals expected yet small differences in retail prices for consumers. Municipalities switching from public to private management are characterized by increasing prices, while municipalities switching from private to public management experience price decrease. However, these price changes are not always significant. This means that public (private) provision is not directly associated with lower (higher) prices.

[1]See Williamson [1985] for the theoretical background and Bresnahan and Levin [2012] for a recent literature review on the state of the art.

Why, then, are prices higher under private management? We argue in section 5 that differences in price between public and private management can be rooted in several explanations. Difference in accounting rules for example can lead to cross-subsidies between different municipal budgets under private management. Here, we particularly document some important questions such as municipal debt and water quality. We find that private management is associated with lower municipal debt as compared to public management. This can explain why the gap between public and private management reduces through the time interval, as debt refund increases under public management. Water quality is also significantly improved under private management but the difference remains low. This is consistent with the fact that public and private management do not share the same goals.

The present study has several policy and methodological implications. First, municipalities that face a make-or-buy decisions must be aware that price differences are largely driven by structural characteristics of the network. In comparable cities, the price premium from private participation is low. Second, municipalities must take into account that lower prices under public management can be linked to higher future debt refunds. Third, our analysis underscores the difficulty of determining in advance how provision type impacts prices. Fourth, this paper highlights differences in results coming from several methodologies. It provides a clear structure for researchers focusing on the impact of a strategy or a choice in governance. It is in line with Angrist and Pischke [2010] who suggested that industrial organization would benefit from a more intense focus on "natural experiments", Hamilton and Nickerson [2003] who declared that research in management needed more robust results to draw conclusions about the veracity of theory and Masten [2002] who called for more robust results of the performance of organizational forms.

The water public service in France is a good candidate for an empirical study of the impact of private participation for several reasons. First, water is a quasi-homogeneous good with very little differences in quality[2]. Second, the market for water distribution is large, covering the whole French population. Third, private sector participation has been growing since the 1980s. As private firms now serve more than 60% of the French municipalities, the impact of private participation can thus be large. Fourth, there are no secondary markets that can mitigate the impact of the private sector participation or transfer it to other markets, as such was the case in telecommunications or wireless internet access. Fifth, this market is suitable for an empirical analysis given the availability of a comprehensive and representative municipal-level dataset built by the French Statistical Office and including thousands of municipalities for 1998, 2001, 2004 and 2008. Finally, perhaps the most salient motivation for investigating this industry is that the make-or-buy decision has been the focus of substantial policy attention with French administrative court giving several judgements on these matters.

The paper is linked to a long-established research theme in economics, management science and organization theory that studies the link between ownership and performance. Economists have been keen on analyzing the public vs. private ownership debate in public utilities (see Villalonga [2000] for a theoretical and empirical literature review[3]) but also

[2]Water quality in France has long been guaranteed and is drinkable across the whole French territory, even in overseas territories.

[3]Theoretical backgrounds are usually based on fundamental arguments of welfare economics: a competitive

in the competitive market (see Davies [1971],Caves and Christensen [1980] and Vining and Boardman [1992] for early empirical studies on the subject). A substantial body of empirical evidence documents the superior efficiency of private firms relative to comparable public firms and the improvement of efficiency after privatization (see La Porta and López-de Silanes [1999] and Chong and López-de Silanes [2004] for comprehensive studies and Megginson and Netter [2001] for a large literature review). Empirical comparisons of private and public ownership in developing countries have been widely studied in the managerial literature (see Ghorpade [1973] for an early paper on India and Peng et al. [2004] for a comprehensive study of ownership and performance in China) and shed light on public versus private strategies. Firms' strategies are also analyzed in Schargrodsky [2003] who compares public and private firms in the US newspapers industry and finds that private ownership lowers selling price. This results from different managers' strategies and tastes, such as the quality vs. diffusion trade-off, something that is observed in the public management literature (see Boyne [2002] for a review). Organization theorists such as Perry and Rainey [1988] and Klein et al. [2010] proposed an agenda on more research on the effectiveness and efficiency of alternative governance mechanisms than the market.

The paper is organized as follows. Section 2 presents water provision regulation and section 3 presents briefly the dataset. Section 4 describes the empirical strategy and discusses results of the impact of private participation on prices. Section 5 discusses the results regarding their methodological implications. A brief conclusion follows.

2 Water Market Regulation

2.1 The Provision of Water in France

In France, as in most European countries, municipalities must provide local public services that have public good characteristics. Municipalities monitor prices, control entry and exit of firms into the market, organize competition and ensure uninterrupted service. Water provision refers to the production and the distribution of water and sewage implies wastewater collection and treatment. Water provision and sewage are two distinct public services and can be managed by two different operators. We focus in this paper on water provision. If the responsibility for public services' provision is public however, its management can be either public or private. Although some municipalities manage production through direct public management and undertake all operations and investments needed

equilibrium is pareto-optimal. In this sense, government intervention is required in the case of natural monopolies, externalities, public goods and to a certain extent, for distributional concerns. In regulated industries with natural monopolies, the argument for a competitive equilibrium is weaker but still holds for several reasons. Government's goals can be inconsistent with efficiency (see the public choice literature, e.g. Niskanen [1975]), be malevolent (see Spiller [2008] on public actors' opportunism) or fund inefficient firms (the soft budget constraints as noticed by Kornai [1986]). A major theme in the literature is that public ownership is inherently less efficient than private ownership (Alchian and Demsetz [1972]) since ownership is diffused among all members of society, and no member has the right to sell their share. Given these aspects of public ownership, there is little economic incentive for any owner to monitor the behavior of the firm's management. Ownership may not be as important as regulation itself. Agency models suggest deviations from cost-minimization by effort-averse managers, especially when managers lack high-powered incentives or proper monitoring (see Laffont and Tirole [1993] for the theoretical analysis of agency-models). Overall, we would expect markets to better allocate resources and reduce prices.

for the provision of the service, the dominating organizational form is private management. Under private management, the main contractual form is delegated management.

An official report by Dexia, a French financial intermediary, states that 63% of French medium-sized cities contract out the services of drinking water treatment and distribution and 58% also contract out their sewerage services. It is however difficult to have an accurate estimation of how many municipalities and communities have contracted out both services with the same operator. According to the Cour des Comptes [2011], the highest financial court in France, 71% of the population is covered by a private operator for water provision and 56% for water sewage. In this case a private operator, independent of the local government, is hired to manage the service and operate facilities through one of the four different private-public arrangements. The most common is the *lease* contract in which the operator manages the service, invest in the network and gets a financial compensation through consumer receipts. Under a *concession contract*, the external operators also undertakes construction risk, as it must finance a large part of investments over the duration of the contract. These contractual agreements differ from the previous ones in that operators share risk in exchange for greater decision rights and claims on revenues. Other contracts can be chosen by the local authority such as the *gerance* in which it pays an external operator a fixed fee, or an *intermediary management contract*, i.e. a gerance contract but with a small part of the operator's revenues depending on its performance. Such contracts provide few incentives to reduce costs and transfer no risks and decision rights to a private operator. Although there is a large range of contracts, the participation of the private sector is characterized by a concentration on three major companies. These companies share more than 90% of the private market with their subsidies and other private companies operate mainly in small cities.

Contrary to other industrialized countries, there is no price-cap or rate-of-return regulation for water utilities in France as there is no national regulator. Such regulation has been replaced by a contract in the case of a private operator, or a decision of the municipality board in the case of public operation. In the case of delegated management, rules have been defined to ensure that standards are respected during the operation to limit the opportunistic behavior of operators and preserve competition between firms. First, since the "Sapin Law" (1993) a national legislative framework governs the form of the private sector participation and the conduct of the bidding process. The institutional framework to select the private partner is the following. If the public authority chooses a lease or a concession contract, it selects its partners in two steps. First, the public authority launches a classical invitation to tender which is open to all interested private water companies. Second, there is a negotiation phase between the public authority and potential entrants that it shortlisted. At the end of the negotiation, the public authority chooses its final partner for the duration of the contract. The selection of the private company follows the *intuitu personae* principle according to which the municipality or the community sets a list of criteria to select the firm that is considered as the best partner[4].

Second, a strong regulation on contract duration and delegatee's obligations has been implemented in 1995 with the "Barnier Law". As a matter of fact, water quality in France has increased and is now relevant for more than 99% of the tests and a lot of investments

[4]However, the number of bidders remains low, around 1.9 for each bidding process (Guérin-Schneider and Lorrain [2003]).

have been made to prevent leaks. However, because regulation is made through contracts between the two parties, depending on the respective power of negotiators and with some contracts signed a century ago, there are doubts about the possibility of the parties to regularly adapt the tariffs to the needs of the utilities.

Furthermore, rules have been defined to ensure that standards are respected during the operation to limit the potential opportunistic behavior of operators. These rules support water quality, duration of contracts and information about management and provision quality. In the case of water quality, a precise definition of more than 60 verifiable quality parameters has been set by the 1992 Water Act to ensure that water services, would they be private or public, respect quality standards. Consequently, water quality is respected and is rarely below a 95% score of conformity to the standards of the microbiological analysis. Moreover, limits on duration have been implemented and management and provision information is now required to be publicly reported. To ensure competition among operators, the "Barnier Law"(1995) clearly limit the duration of contracts and includes an automatic renegotiation of the contract every five years. To struggle against information asymmetries, the executive power passed a decree in 2007 that forces municipalities and communities to provide 14 performance indicators in the mayor's *Annual Report on Prices and Service Quality* (RPQS in French). These performance indicators and other data about water and sewerage services have been collected from 2009 on by the *French National Observatory of Water and Aquatic Environments* (ONEMA in French) to provide iusers and citizens with information about their water services.

2.2 Price Settings

In the case of delegated management, public authorities face the classic regulatory problem: they find themselves in an information asymmetry position and have few tools to carry out their essential tasks. However, rules have been implemented to limit opportunistic behavior by private operators. For example, in renegotiating prices, operators are constrained by the fact that in administrative contracts, all renegotiations that significantly change the value (by more than 5% of the value of the initial contract) of the contract trigger a new selection process of the private operator. Even if this power is rarely used, it provides a credible power to local authorities in order to prevent opportunistic behavior from an operator.

As we have seen above, price setting is different whether the local community has chosen to delegate the service to a private firm or not. Under direct public management, the municipality council designs rates in order to generate revenues that allow the utility to cover its costs. French legislation requires the water utility budget to be balanced following the so-called "revenue-recovery principle". Prices are thus set to cover operating and capital costs[5]. Administrative account rules are devised so that municipalities hold two separate accounts for the water utility budget. The first account is an operating budget and the second is an investment budget. Net revenues from the operating budget are

[5]There is little historical evidence of the application of this principle. However as large cities' accounts are now published every year, there is strong evidence of the application of this principle in recent years. The highest financial court in France, the Cour des Comptes [2011], has notified several municipalities that their rates were too high, therefore using municipal budgets to fund non-water spendings, or too low, i.e. subsidized by another municipal budget.

automatically transferred to the investment budget in order to limit operating costs. This is usually the case if the municipality undertakes a multi-year investment program. While the "revenue-recovery principle" usually implies a zero-margin cost structure, margins are however possible but the way they are used is highly controlled by administrative rules.

Under private management, the rate structure is determined by projecting financial accounts provided by the operator over the duration of the contract. The contract includes periodic revisions of water rates using a price index adjusting formula. The relationship between the local municipality and the firm is formalized by means of a contract that specifies a price structure, a formula of price revision and negotiated clauses allowing for exceptional conditions. Since the bargaining power is often considered to be favorable to firms, the price structure is likely to reflect a monopolistic behavior rather than social welfare maximization.

In the water sector, empirical results on the impact of a governance form on prices are not clear. Chong et al. [2006] use a 5,000 French municipalities' database for 2001 and find *ceteris paribus* an 11-euro premium of private management relative to the direct public management on baseline bills of 120 cubic meter consumption. This result is confirmed by Carpentier et al. [2006] using treatment effects. They however conclude that private management copy with harder operating environments. Both papers conclude that local governments are keener to outsource the organization of water public services if they are more technically difficult to provide. The price premium of private management is found also in other countries (see Hall and Lobina [2005] for case studies on the UK and all over the world and García-Valiñas et al. [2012] for a literature review on France, Germany and Spain). Such a body of evidence is nevertheless contrary to the common intuition that private participation lowers prices.

3 Data

3.1 Descriptive Explanations for Outsourcing

The unique dataset we use in this study merges three datasets. Data come from the French Environment Institute (IFEN-SOeS), the French Health Ministry (DGS) and the French National Institute for Economics and Statistics (INSEE). The unit of observation is a municipality. We observe a set of 2,455 cities in France over four years: 1998, 2001, 2004 and 2008. These cities are taken from a representative set of municipalities. The final dataset is made of 9,820 observations over the four years. Mean covariates and standard deviation are presented in Table (1) for the whole sample and separately by management type. We also built an extra subsample to test the impact of public debt on the marginal price of water that is presented in subsection 5.1.

The IFEN-SOeS, collected by the French Environment Institute and the Environment Minister, is a nationally-representative municipal survey of the public service of water. This sample is representative of the total French population and the local public authorities where they are living: all sizes of local authorities are proportionally represented and municipalities with more than 5,000 inhabitants are all represented. The IFEN-SOeS database provides detailed information about water public services and municipalities'

characteristics. There were four data collection in the last ten years. The data collection proceeds as follows. Municipalities fill in the database, then the data is checked by the Environment Minister. The IFEN-SOeS is the only representative national dataset on water public services available.

The database includes a lot of information about water supply at the municipal level - e.g. billed water in thousands, water sources, treatments and municipalities' characteristics that can influence water consumption. It includes also some data coming from the census made by the INSEE. We know for example whether the city is located in a touristic area or in which region the city is located. The latest variables are important controls when one tries to explain the price of water: on the one hand, touristic areas face larger levels of consumption during some periods of the year and need more performing networks; on the other hand, water consumption is low in some regions such as the south of France. We can moreover create dummies to take into account the density of water consumption in the network. We can also compute also some characteristics of the cities. For example, using regulatory indicators provided by the National Bureau of Water (ONEMA in French), we consider a city to be rural if the ratio of billed water and the length of mains is smaller than 10 cubic meters and to be urban if this ratio is larger than 30 cubic meters. Cities with a ratio between 10 and 30 are considered semi-urban. These dummies provide helpful controls to normalize consumption levels from a municipality to another.

An important feature of the IFEN-SOeS dataset is that, in addition to characteristics about the contract such as ownership structure, it provides high-quality information about water bill structure. The standard consumption is 120 cubic meter a year per household as defined by the National French Statistics Institute. At the baseline consumption level, we know for example the price paid by consumers, the amount of the fixed-part and the share of the variable consumption[6].

The Health Minister (DGS) dataset finally reveals interesting information about water quality. Local authorities responsible for the quality of water have to systematically fill in a database containing information about the number of quality tests and whether these tests have been rejected or not. This provides helpful control over the quality of water when one is interested in the difference in pricing from one city to another.

Descriptive statistics relative to the price equation are presented in Panel (A) of Table 1. The main result from the descriptive statistics can be summarized as follows: municipalities under private management face higher prices but also higher costs. Some variables do not have a clear impact. High consumption density for example ensures that fixed costs are covered but demands regular interventions on the network to avoid interruptions. Network performance also can be considered as the result of high investments or can only be inherited from the previous operator.

Panel (A) in Table 1 illustrates how private management is associated with more difficult services. For example, ground water is usually associated with higher treatment

[6]An assumption that is related to the computation of the marginal price is that there is no multi-tier rates in water industries for consumption that are close to the baseline level. This assumption holds for French water industries, see Porcher [2012].

complexity because it is more polluted than underground water. Overall, ground water is associated with higher production costs compared to underground water. Water treatments performed by the operator before the water is distributed are important cost-shifters. Indeed, water treatment does not only approximate the complexity of service provision but also the level of specific investments needed to operate the service. A tell-tale story is that underground water is generally more stable over time and that has two advantages. First, it reduces uncertainty about the evolution of costs. Second, treatment costs are usually lower when water is pumped from the underground. Under mixed sources of water, costs may be higher than for ground or underground sources as the utility may need a treatment factory for each type of water. Treatments are sixfold and coded between 1 and 6 in the IFEN-SOeS dataset. In the simplest case, there is no treatment. In this case, the *treatment* variable takes value 1. When raw water needs disinfection, *treatment* takes value 2. The value is equal to 3 if raw water needs a heavy disinfection treatment and equals 4 if water needs a heavy disinfection treatment plus extra controls. The variable takes 5 and 6 when mixed treatments are needed, the most difficult treatment being 5. As Table 1 shows, private management is associated with higher complexity and less underground water; that can explain differences in costs and thus in prices.

Information for other controls is presented in Panel (B) of Table 1. Controls are mainly about water quality which turns to be higher under private management than under public management. The number of tests that do not meet the compliance level is also on average lower under private management. Panel (C) finally gives information about contract renewals and switches for the whole sample. On average, 280 contracts are renewed every year for our 2,455 cities, which represent 16% of the stock of contracts in our dataset. Moreover, we observe switches from public to private management and vice versa. There are on average every year 71 switches from private to public management and 53 switches from public to private management. Obviously, there are rather low organizational changes in our dataset because of the length of the contracts is on average 20 years in the dataset and 12 years for contracts signed after 1995. There are two reasons fof this low rates of organizational change: on the one hand, the longer are the contracts, the higher are adjustment costs to switch from an organizational form to another; on the other hand, inertia can be the outcome of such embedded relationships. These contractual characteristics are useful to test the validity of the argument according to which private participation is associated with higher prices.

Descriptive statistics give some patterns of municipalities and utilities that are directly managed or outsourced. It is clear that private management occurs in municipalities with difficult context, such as limitation of water consumption, complex treatments, low raw water quality and touristic area for example. We also observe that private management is more frequent in cities with contracting capabilities, for example cities that contracted out the sanitation public service. Moreover, large cities are more keen on contracting out their local public services, probably because they have more resources to monitor contracts. Another argument, following Joskow [1987], is that large (or urban) municipalities have relatively easy access to multiple water suppliers, while small (or rural) municipalities have fewer options to outsource their water public service. Contrary to Monteverde and Teece [1982] for example, we do not observe a positive relationship between complexity or specificity and in-house production. We will use in the further more detailed econometric analysis above a model that consider complexity as impacting price but not selecting

private management. We discuss more deeply the hypothesis of endogeneity in section 5.2.

3.2 Graphical Analysis

This subsection analyzes water price evolution under public and private management in France between 1998 and 2008. Although our ultimate objective is to measure the real impact of private sector participation on prices, the graphs depicted here show the gross difference and evolution of prices between public and private management. Moreover, results are of independent interest in that they provide a comprehensive assessment to date of the magnitude and timing of price differences.

Figure 1 depicts the evolution of the price of a standard bill between 1998 and 2008. The dark line represents price under private management and the light line scatters price under public management. All prices are deflated at the 1998-level. The gap between public and private management remains almost constant at 30 euros. We only observe some slight convergence between 2004 and 2008.

Figures 2 and 3 show the evolution of the price of a standard bill between 1998 and 2008 in municipalities switching from an organizational type to another. Figure 2 shows the evolution of price under public management between 1998 and 2008 (solid line, circle markers) and for municipalities switching from public to private management between 1999 and 2001 (dash-dot line, triangle markers), municipalities switching between 2002 and 2004 (dot line, square markers) and municipalities switching between 2005 and 2008 (dash-dot-dot line, plus markers). We observe that municipalities switching from public to private management have a tendency to increase price faster than municipalities remaining under public management for the whole period. Municipalities switching between 2002 and 2004 experience a large increase in price by 2004 but this tendency is counterbalanced between 2004 and 2008. Municipalities switching between 2005 and 2008 experience an increase in price that is similar that in the non-switching municipalities. Overall, only municipalities switching between 1999 and 2001 clearly demonstrates how switching to private management can increase price for two reasons. First, we observe price evolution after switching on a longer time period. Second, the price evolution between 1998 and 2001 is strongly similar and validates the positive impact of a switch in prices for the remaining period. For municipalities switching in 2004 and 2008, the graphical analysis is not conclusive.

Figure 3 shows the evolution of price under private management between 1998 and 2008 (solid line, circle markers) and for municipalities switching from private to public management between 1999 and 2001 (dash-dot line, triangle markers), municipalities switching between 2002 and 2004 (dot line, square markers) and municipalities switching between 2005 and 2008 (dash-dot-dot line, plus markers). We observe that municipalities switching from private to public management between 1999 and 2001 have a tendency to lower prices after switching management. Municipalities switching between 2002 and 2004 experience a decrease in prices by 2004 but this tendency is counterbalanced between 2004 and 2008. Municipalities switching between 2005 and 2008 experience a decrease in prices but the tendency is prior to the switching. Prices even increase between 2004 and 2008. As in the previous graph, only municipalities switching between 1999 and 2001 provides a

clear argument supporting the fact that switching to public management lowers price for two reasons. For municipalities switching in 2004 and 2008, the graphical analysis is not conclusive because prior tendencies are not always similar. We study more deeply these price evolutions in the next sections.

4 Empirical Strategy

4.1 The Impact of Private Participation on Prices

Our objective is to identify the average effect of private participation on the price of a standard bill of residential water use. We are specifically interested in comparing prices for a standard bill when water services are privately operated (our treatment group) compared to directly managed water services (our control group) at the same moment in time. To control for the unobserved heterogeneity and the unobserved time invariant heterogeneity we include *Département* fixed effects, time fixed effects and robust standard errors. We run alternatively a simple OLS model or a fixed effects model that takes the form of the following equation:

$$Price_{it} = \alpha_0 + \alpha_1 Private_{it} + \gamma\Theta_{it} + \eta_{it} \quad (1)$$

with the marginal price $Price_{it}$ as a dependent variable, $Private_{it}$ a dummy that equals 1 when water is distributed by a private operator and Θ_{it} a set of controls[7] that can shift prices. The results from this model are reported in Table 2.

Model (1) in Table 2 is a simple OLS regression. It shows the mean price difference between private and public management when we take into account all controls. While the gap between average prices is 30 euros, accounting for various characteristics of the municipality lowers it to 22 euros. Model (2) runs the same model but includes the lagged price. The price gap between public and private management is now 7.30 euros. This model gives a closer result of what a municipality could expect by switching from public to private management. One of the drawbacks of this simple approach is that it is often serially correlated and it does not control for omitted variables at the municipal level. However, it offers a lower bound of what can really be the impact of private management on prices.

Alternative approaches to standard regression include fixed effects that are designed to study the causes of changes within a municipality. This model controls for all time-invariant differences between municipalities. Fixed effects cannot be used to investigate time-invariant causes of the dependent variables. Time-invariant characteristics of the individuals are supposed to be perfectly collinear with the entity dummies. As a result,

[7]Price is deflated using 1998 prices in euros. Control variables are water sources fixed-effects, water treatments fixed-effects, year fixed-effects, *département* fixed-effects, population in log, a dummy for the touristic nature of the city, a dummy whether cities regrouped in a pool of cities to provide public services, a dummy if there is a limitation because of scarcity, a dummy if there is an investment program. We also include three continuous variables. The first one is the independence of the city regarding water measured as the ratio between water imports and billed water. The second one is network performance measured as the ratio between billed water and billed water plus leaks. The last one is consumption density, calculated as the ratio between daily billed volumetric charge of water and the length of the pipes.

we expect the impact of private management to be lower under fixed-effects than with cross-sectional estimates such as model (1). This is the case in model (3) in Table 2 where the impact of private management is 9.01 against 22.34 in model (1). This coefficient is however susceptible to attenuation bias from measurement error: first, because management type is likely to be persistent over time and second, because small changes in management type can drive up the coefficient of the impact of private management on price. If private management is considered as a treatment effect, then the coefficient of the fixed effects model are too strong and are considered as the upper bound of the real impact of a change to private management. Model (4) shows the results of the fixed effects model when one controls for serial correlation. We assume a simple cross-sectional time-series regression models when the disturbance term is first-order autoregressive. We find a 8.95 euros premium of private management on price. The AR(1)-FE coefficient is in the bound of models (2) and (3).

There are however several assumptions that should be made in order to correctly interpret α_1 in equation (1) as Galiani et al. [2005] noticed. The first assumption is that price in municipalities under public management is an unbiased estimate of the counterfactual - i.e. that it represents the price in municipalities under private management if water services were directly managed. The second assumption is that there are no unobserved characteristics that can affect both prices and the decision to outsource. We include in equation (1) several regressors that can take into account this concern and we discuss in 5.1 an example of missing variable. As a result, the coefficient in front of the private management is less likely to be correlated with location-specific or time-varying unobserved shocks. In subsection 4.3, we discuss the micro-validity of our estimation by focusing on municipalities that switched from public to private management and vice-versa.

Another concern is that the average impact of private management may not be homogeneous across municipalities. In this case, our estimation in equation (1) can be biased. One of the assumptions underlying the interpretation of the coefficients of equation (1) is that municipalities under public and private management are similar. Including controls is a good way to purge structural differences between observations but it does not mimic a differences-in-differences approach by estimating the impact of organizational changes assuming similar trends. Moreover, different distributions of the set of regressors that affect prices can be observable within privately and directly managed municipalities, thus referring to the first issue above, that public and private management are not randomly chosen.

To conclude this subsection, model (1) in Table 2 gives the average difference between public and private management. Models (2), (3) and (4) give estimates that are closer to the differences-in-differences approach. By controlling for fixed-effects and omitted variables, we purge all the differences between cities except the premium of private management. This gives a good proxy of the impact of organizational changes on price. In the following section, we discuss the possibility of pairing cities with similar characteristics to assess the impact of private management.

4.2 Matching Cities

We face two issues. The first one is that private and public management are not randomly assigned to municipalities. The choice to delegate water production and distribution can

be linked to some trade-offs between efficacy and the city's capacity to provide water. As a matter of fact, private operators often argue that differences in prices result in different difficulties in providing water. The second issue is related to the first one. As the counterfactuals are never observed, we have to build them using non-experimental methods that mimic them under reasonable conditions[8]. A major concern that lies in the first issue is that the choice to delegate water production and distribution may not be random, and that differences between municipalities could be correlated with differences in prices. In principle, a large part of the characteristics that may confound identification are those that vary across municipalities but are fixed over time.

Dealing with selection can lead to two strategies. The first one is the classical instrumented variable regression but one needs to have strong instruments which is difficult and rare. We discuss some potential instruments in 5.2. The second one is to consider some characteristics of the municipalities that can affect the decision to go for private or public management. Municipalities with the same characteristics should have the same price. These characteristics are thus linked to the outcome and to the organizational decision. Only the treatment can explain the price gap between cities that share the same characteristics. In order to approach a randomized experiment, we used a propensity score matching method to ideally pair privately-managed municipalities with publicly-managed municipalities that have similar observable attributes. This method deals with the biases underlined earlier. First, conditional on the observed variables θ_{it}, the matching is done on the basis of the propensity score, i.e. the probability of being privately managed, following Heckman et al. [1998]. Instead of aiming to ensure that the matched control for each participant has exactly the same values of θ_{it}, the idea is to compare individuals who have the same or a similar probability of being in the treatment group. This is done in two steps. The first step is a Logit of the probability of being privately managed on different characteristics. We thus run the following equation linking the probability of being privately managed and the observable characteristics:

$$Private_{it} = \gamma\theta_{it} + \epsilon_{it} \tag{2}$$

The propensity score is the predicted value that you get from the first step. This value is then used to match comparable municipalities given their propensity score depending on the observable characteristics, i.e. $P(\theta) = Pr(Private = 1|\theta)$, to estimate the mean difference between public and private management. The distribution of the propensity scores is showed in figures (4) and (5). Matching treated and control units is made using a standard Kernel density. When there is a lot of comparable units, Kernel matching gives more accurate estimates. Indeed, Kernel density matches units using a bandwidth while other methods match units one by one.

As Angrist and Pischke [2009] noted, a question that arises when one uses matching models is how to best modelize and estimate the propensity score or how much smoothing or stratification to use when estimating $E[Y_i|p(X_i), D_i]$, especially if the covariates are continuous. The regression analog of this question is how to parametrize the control

[8]Heckman and Hotz [1989] on differences-in-differences show that when the secular time trends in the control treatment municipalities are the same in the pre-intervention periods then it is likely that they would have been the same in the post-intervention period if the treated municipalities had not turned to private management. This is however difficult to implement with our dataset as we observe organizational forms for given years with municipalities that turned to private management years ago.

variables. As propensity score matching lacks theorems and clear rules, the answer is application-specific. Dehejia and Wahba [1999] argue that a Logit model with a few polynomial terms in continuous covariates works well. Caliendo [2006] argues that one can change the propensity score model to improve the balancing of variables. They propose to include higher order terms and interactions and to re-run different equations until the overall matching is of good quality.

Results are reported in Table 3. The impact of private management is 30 euros and is larger than the impact in Table 2. It gives however the upper bound of the marginal impact of private management and corrects upwards a part of the gross difference in marginal prices between public and private management.

Tables 4 and 5 show bias reduction in the propensity score matching. In Table 4, we check the selection bias for each variable included as a criterion for the matching process. Bias reduction has been decreased by more than 75% for each variable. All the t-tests reject the null-hypothesis of different means between treatment and control groups at the 0.05 threshold. Treated units are compared with control units that have on average the same characteristics as Table 5 shows. The mean bias is 1.8% after matching while the unmatched sample compares utilities with a 34.1% bias on average. The Pseudo-R^2 is close to 0 after the matching. It means that variables used in the selection equation do not explain anymore differences in management types anymore. Compared units are thus unbiased regarding the variables of the selection function. For units sharing the same characteristics used in the selection equation, we can conclude to a price premium of 30 euros when the water service is outsourced.

These results are however upward biased for several reasons. Propensity score matching is associated with a trade-off between bias and estimation efficiency. One of the drawbacks of this method is that it assumes no selection bias based on unobserved characteristics, i.e. it is not possible to include fixed effects that could alter the impact of the treatment variable. Moreover, reducing bias can lead to drop variables such as the regional fixed effects from the selection equation. This can alter estimation efficiency. However, propensity score matching can be a very powerful instrument as it helps the researcher to determine the region of common support more precisely.

We finally use the propensity score matching from equation (2) to restrict the sample on the common support and re-run the differences-in-differences equation (1). As Crump et al. [2009] noticed, an important concern in implementing matching methods is the need for overlap in the covariate distributions in the treated and control subpopulations. Even if the supports of the two covariate distributions are identical, there can be parts of the covariate space with limited numbers of observations for either the treatment or control group. Such areas of limited overlap can lead to conventional estimators of average treatment effects being biased or having large variances. There are several possibilities for researchers to reduce the support. Researchers often discard units for which there are no close counterparts in the subsample with the opposite treatment. The other means is to drop units with extreme values of the propensity score. Crump et al. [2009] propose the range [0.1,0.9] for the propensity score. Figures 4 and 5 depict the density of the propensity score for the treated and control groups. As one can see, none of our observations receives a propensity score lower than 0.2. 80% of the units have a propensity score

between 0.35 and 0.91. We choose to focus on this subsample to re-run regressions[9].

We consider municipalities that have propensity score between 0.35 and 0.91 as there is a fairer distribution of control and treatment groups within this interval. The results are shown in Table 6. The main impact of private management on price is similar to those in Table 2. However, as the propensity score matching result indicates, the magnitude of private management is a little upward under the reduced support. Even if some of the observables of the municipalities may not be the same at the bottom and at the top of the distribution of the propensity score, running estimations on the common support surely gives the most faithful impact of private management on marginal price. Moreover, as results in Table 2 may be biased by the differences in observable characteristics while results in Table 3 assume no unobserved differences, the results in Table 6 are a trustworthy estimate of the real impact of private management on price for at least three reasons. First, it takes into account the fixed differences not related to the management form. Second, it focuses on a sub-sample that have similar propensity to be privately managed. Third, the representation of privately and publicly managed municipalities is fairly balanced.

4.3 Micro-validity: Focusing on Switchers

As Masten [2002] underlines, an organizational form that is superior will always result in large efficiency gains compared to how the same unit would have performed under the other alternative. Such a counterfactual is better approached by utilities switching from an organizational form to another[10]. The aim of this section is not to understand why municipalities switch from an organizational form to another but rather to properly measure the impact of switches on performance. Our identification strategy is close to the standard differences-in-differences method as developed by Card and Krueger [1994] or Gruber [1994]. We focus on switchers from public to private management and from private to public management. We apply the standard differences-in-differences model :

$$Price_{it} = \beta_0 + \beta_1 Switch_{it} + \beta_2 After_t + \beta_3 Switch_{it} \cdot After_t + \lambda \Theta_{it} + \epsilon_{it} \qquad (3)$$

with $Switch_{it}$ a dummy that equals 1 if the city i has changed its management type between 1998 and 2008, $After_t$ a dummy equal to 1 for the period after the switch and β_3 the coefficient of the standard differences-in-differences. As we have a dataset including four years, we allow $After_t$ to cover three different periods (after 2001, after 2004 and after 2008). Moreover, we can differentiate between cities switching from public to private management and those switching from private to public management. We run four regressions using OLS with city-clustered robust standard errors. Results are reported in Table 7. Models (1) and (3) analyze the impact of a switch from private to public management. Models (2) and (4) study the impact of a switch from public to private management. All controls from equation (1) are included. We did not report their coefficients as they are barely the same in previous regressions. For ease of reading, we report in the first rows the differences-in-differences coefficients. The main results are emphasized.

[9] We could alternatively focus on ranges of the propensity score that have balanced densities of treatment and control groups. There is no clear theory about how to select the appropriate reduced support.

[10] We discussed in the graphical analysis above the similarity in outcome trends before the switch. Moreover, for municipalities under private management, this is almost intuitive that price would increase in a similar trend as all contracts include an escalator clause for prices.

Model (1) focuses on the sample of cities under private management in 1998. All switchers from private to public management are compared to cities that remain under private management for the whole period. We expect the β_3 to be negative as public management should have a negative impact on price. This is the case in column (1) even if results are only significant for cities switching between 2004 and 2008. In the latter case, switching from private to public management leads to a decrease in price by 7.755 euros on average. Model (3) uses as a sample the whole dataset. The control group is made of all other cities, no matter if they were under public or private management in 1998. The results are negative as in model (1) but the main impact is more important. However, this regression gives a good robustness test of model (1) as coefficient are barely the same. Results show that switching from private to public management can decrease price in the short-term but not necessarily in the long-term. This is a strong proof that differences in prices between public and private management are rather structural than linked to the organizational form itself.

Model (2) uses cities under public management in 1998 as a sample. The treatment group is made of cities switching from public to private management. Cities that remain under public management for the whole period are control units. In this case, the β_3 is expected to be positive if private management is by itself associated with higher prices. It is the case for cities switching between 1998 and 2001. However, it is not the case for cities switching between 2001 and 2004 and 2004 and 2008. The differences-in-differences is significant at 13.96 euros for 2001. Cities that experienced a management change from public to private have to deal on average with a large price premium for the remaining period. It is negative and non-significant for municipalities switching between 2001 and 2004 and between 2004 to 2008. The interpretation is twofold. It means that price change after a change from public to private management is not immediate. It also means that switching is related to a potential decrease in prices. Model (4) uses the full dataset to estimate the real impact on price of switching. We observe here results that are similar to model (2) for the first period. Switching from public to private is associated with higher prices. However, for the next periods, switching from public to private is not associated with significant increasing prices. Indeed, the gain from switching is about 15.12 euros in 2001. The β_3 is positive but not significant for 2008 and negative and non significant for 2004. It indicates that switching from public to private does not lead to higher price on average in the most recent time periods. This can be interpreted as the result of inertia in long-term contracting. Prices tend to increase after several years when a city switched from public to private management.

The impact of organizational change on performance has rarely been studied empirically in scientific articles. A recent paper by Chong et al. [2012] studies the reason for switching - and not the impact of switching - from public (private) to private (public) management using the same dataset as in this paper. They conclude to a switch from private to public management when there is scope for improving efficiency, measured by potential price decrease for a typical bill[11]. The authors build counterfactual price of water by regressing price on a set of observables. They identify the degree to which each municipality is "overpaying" or "underpaying" under its current organizational form, and

[11]Their conclusion is somewhat close to the one of Nickerson and Silverman [2003] who study the link between transaction and organization on the one hand, and on the other hand, the link between alignment of the organization to the transaction and performance.

compared to the alternative organizational form. Other controls, such as political bias from mayors or switches in mayors have no impact. Results differ between large and small municipalities, small municipalities being less sensitive to efficiency gains. They find that large municipalities respond to excessive prices by switching provider or organizational form. Overall, cities switch to the form that is expected to be the lowest-price form. They interpret the results as evidence that large municipalities' ability to constrain franchiser opportunism rests on its ability to credibly threaten to bring service in-house and to promote competition when contracts are to be renewed. Overall, our results add to those of Chong et al. [2012]. Switching from private to public management decreases price. Switching from public to private management potentially decreases price in the last periods, even if the effect is not significant.

How much then can we trust the robustness of our estimations? Focusing on switching municipalities gives a micro-validity to the main argument that private participation leads to higher prices. Two interpretations can be made. The first one is that contracting-out leads to increasing prices over time. Cities switching from public to private management between 1998 and 2001 are observed during a longer time span and are associated with higher prices. Another reason is that competition has increased between 1998 and 2008. Cities contracting out in 2008 can benefit from lower prices, what was not the case in 2001. However, there are also some limits to our results. We miss a set of variables that could explain the amplitude of price evolution after a switch. One might argue that changes in prices are related to the level of competition during the bidding process. In this case, the impact on price of a switch may also be related to the number of bidders or to the relative level of bids between the incumbent and competitors. However, our estimations are interesting because they give a precise idea of the counterfactual price under another organizational form using real-life data.[12]. A similar methodology is used in Hastings [2004] to study the impact on gasoline retail price of competing stations after a merger between a gas retailer and an integrated refiner-retailer and more recently, in Ashenfelter and Hosken [2010] to estimate the likely price effect of five completed mergers in the United States.

Using differences-in-differences is justified for several reasons. First, it shows the impact of staggered management changes throughout the period. Secondly, standard models as equation (1) evaluate only private management relatively to public management. The differences-in-differences approach focuses on switchers relatively to their control group at the beginning of the time period. The present results thus mitigate previous results overall concluding to a positive impact of private management on price. There is however at least one drawback to our results. As we do not control for endogeneity, decision to change can be endogenous if they are linked to bids or to price evaluation made by the municipality, as Chong et al. [2012] studied. We discuss in the next section limits to our findings.

[12]See the debate between Angrist and Pischke [2010] and Nevo and Whinston [2010] for more information on credible exogenous variables and research design in industrial organization.

5 Discussion, Extension and Methodological Implications

In this section, we discuss the previous results regarding possible omitted variables. We also list several explanations for the price-gap between public and private management. We then extend the analysis of the previous section by including endogeneity considerations. We finally tackle the methodological implications of our work.

5.1 Discussion of Possible Explanations

Private companies may show higher prices than public management because management structure affects pricing. But it may also be the case that the management variable is spuriously capturing the effect of another variable correlated with it. Despite controls for selection and market-based analyses, difficulties remain to explain the price-gap between public and private management. Five reasons are often pointed out by the literature but few empirical tests clearly quantify their impact.

The first reason is competition. Regional or sector-level competition is a usual argument to explain differences in prices between public and private management (see for example Borenstein and Rose [1994] on airline industries or Joskow [2005] for a global perspective): high margins are the result of low competition-intensity due to the nature of the market, i.e. local monopolies protected by a contract. When there is no national regulator as in France (see above), margins are highly related to the ability of the municipality to negotiate with the private operator. Nevertheless, global margins remain low[13] in France, far below the difference in rates between public and private management. Pricing strategies are usually based on previous prices for at least two reasons: first, because prices are fixed to cover previous costs, no matter if there is room for cost-efficiency, and second because a given level of price gives the quantity at which market clears. One of the reasons why private management has higher prices is that contract renewals are based on previous prices and thereby maintain the price gap between public and private management. An increased competition at the renewal generally lowers prices [14]. The bidding process at the end of the contract can itself create competition and thus price decreases.

Because of a lack of longitudinal data on water contracts, there are few studies which focus on contract renewals. In France, Guérin-Schneider and Lorrain [2003] examined contract renewals between 1998 and 2001 and found that renewals were usually associated with decreasing prices (-10% on average). Increased competition, measured as ending contracts, can thus provide lower prices. The results suggest also that prices are set too high, as a result of extra-margins before renewals or inefficient cost structures.

As we have neither information on bids or geographical competition in our dataset, we use incumbents' renewals as a proxy for competition. In natural monopolies such as water provision, we can expect low competition to have a negative impact on consumers (Coase

[13]See Porcher [2012] for a study of margins in French water industries for 2008. According to the French private operators, net margins are on average 10% before taxes.

[14]The recent case of Antibes, a city in the south of France, is probably one of the best examples. Contract renewal with the same operator led to a 40% decrease in price. A private competitor bade at a 30% lower price.

[1946]) or to be associated with a low-monitoring efficiency of the principal (Laffont and Tirole [1993]). Table 8 shows the impact of the bidding process on price. The model is similar to equation (3). For ease of reading, the first rows of Table 8 report coefficients of the differences-in-differences. The control group is cities under private management in 1998. The $Switch_{it}$ variables are dummies that take 1 if the city i switches from an operator to another at a given year t. The $Renew_{it}$ variables are dummies that take 1 if the city i renews its contract with the same operator at year t. Table 8 shows that switching is associated with lower prices. However the coefficient for the differences-in-differences is only significant for cities switching in 2004. The magnitude of the impact is however important and larger than a switch from private to public management (the maximum is 24.30 euros here against -9.39 euros in Table 7). Renewals have a negative significant impact in 2001 and 2008 but a positive significant impact in 2004. The impact is smaller than under a switching hypothesis. The gain is 4.12 euros in 2001 and 8.10 euros in 2008. Overall, it seems that the bidding process has a negative impact on prices as switching and renewing contracts lead on average to lower prices. The bidding process acts as a realignment of price from the previous long-term contract.

The second reason is that the management variable may be capturing changes in quality. This is consistent with the general debate on privatization. Critiques of private management often argue that it leads to increased prices at the expense of society (see Vickers and Yarrow [1988] for a discussion) while proponents argue that increased prices result in large productivity gains (see La Porta and López-de Silanes [1999] for a comprehensive study). In regulated industries, proofs of efficiency gains for electricity in the United States are discussed in Fabrizio et al. [2007]. In our previous regressions, we systematically controlled for network performance. Another control can be water quality. The reason why we did not control for water quality is twofold. Firstly, water quality in France has been largely achieved since the 1995 water act. Secondly, we have only data for the tests carried out by the Health and Environment Ministry while a number of tests are also conducted at the local level or by the utilities themselves. As one can see in models (1) and (2) of Table 9, private management is on average associated with a quality premium of 2.2%. In model (2), we observe the potential quality change from a switch to private management. The quality change is evaluated to be 1.2%. Finally, in model (3) we present an OLS model to analyze the link between the number of failed quality controls and management type. Private management is associated with a higher number of failed controls but the coefficient is not significant. However, the number is quite low regarding the highest number of controls made on privately managed utilities. As far as price and final quality are related, pricing strategy may reveal differences in how managers care about quality. Public managers care more about price levels because their competitive advantage is the capacity to provide water at low price. Private managers have more experience in providing good water quality at the risk of higher price. This is however a limited result as quality is largely regulated and depends on the raw quality of the water source.

The third reason is partly linked to the second. Public and private organization may not reflect the same goals. Such a link between ownership and strategy is early discussed in Williamson [1963] who considers that managers can have expense preferences that are discretionary. Porter [1990] notices that "company goals are strongly determined by ownership structure, the motivation of owners and holders of debt". Public and private

management may want to use pricing strategy to indulge their consumption preferences. For example, public managers may want to decrease prices for consumers and fund a part of its investments using taxation for bureaucratic reasons. Private managers may seek to maximize their profits to satisfy stockholders. Studies made by researchers in public management do not use the same methodology but find a similar results: public managers have a stronger desire to serve the public interest (Rawls et al. [2002]). These arguments are used in many studies comparing public and private ownership such as in La Porta and López-de Silanes [1999], Schargrodsky [2003] and Peng et al. [2004].

Another explanation is that private firms and public administration are not subject to the same accounting rules. A complete comparison of public and private accounting rules is far beyond the scope of this paper. However, it is clear that private firms have to depreciate their investments over the lease term. In this case, higher prices may just be the results of increased investments coupled with the necessity to depreciate the whole value of the undertaken investments. In the case of in-house provisions, the depreciation period of the investment can spread over a longer term, thus alleviating the price increase. Such an argument is trustworthy and can rationally explain the differences in fixed-fees designed to cover capital expenditures. It is however difficult to explain the existing differences between marginal prices which reflect differences in marginal costs or per-unit margins.

Finally, the incidence of the municipal water budget's debt has largely been ignored in previous research on utilities. Until 1995, it was possible for private operators to endorse a part of the municipal water debt refunding. The growing participation of private firms from the 1970s until now is probably linked to the possibility for municipalities to reject the debt burden of private firms. If one assumes that public utilities *underprice* their output, e.g. by funding investments using municipal debt rather than increasing fees, then there should be significant differences of indebtness levels between in-house and privately managed utilities. Table 7 gives a comparison of debt, debt per customer, debt annual payments and debt annual payments per customer for 189 large water utilities in 2009 representing more than 40% of the French population and almost 50% of the French water consumption. Water budget's debt is largely higher in municipalities under public management than in privately managed water industries as Table 7 shows. Actual annual repayments per customer are almost 3 euros higher under public management. Additionally, Table 10 provides rescheduled debt payments under alternative assumptions. For simplicity's sake, we assume that debt interest rates are fixed, at 2%, a largely validated hypothesis[15] that corresponds to what is observed in the data. Under a 5-year refund hypothesis, annual debt payments per customer would increase by 28.25 euros under public management and 17.33 euros under private management. Under this hypothesis, the remaining differences in prices between public and private management would almost be cleared-up. Under a 10-year refund hypothesis, rescheduled annual payments per customer are very close to the actual payment for public management and 4.15 euros below for private management. One can thus consider that municipalities under private management have borrowed less or for shorter terms than municipalities under public management.

[15]State debt is on average refunded at 2.02% but only 1.3% on the short-term debt. Municipalities usually face rates at 2% in my dataset but it depends on their debt structure, i.e. whether they borrow to private or public banks or other public operators.

Assessing the impact of debt on price is not easy. Current price contains annual debt payments. Our fixed-effects regression in Tables 2 and 6 controls for the existing heterogeneity between utilities, debt including. Our argument here is that prices could increase under the hypothesis of large increase in debt interests. Such price increase and high debt levels can be distortive for consumers and producers alike. On top of that there is a risk with high-debt level that the municipality use taxation instead of market mechanisms to lower its debt. The welfare transfer between users and tax-payers could have distortionary impacts on other markets.

5.2 Endogeneity

To properly evaluate the impact of private participation on prices, we assumed that the make-or-buy decision was exogenous. Our argument above is that such an assumption can be supported if we include enough controls for fixed effects and check robustness with regime change. Yet we run in this section alternative models including instruments that account for selecting private management.

In our empirical analysis, we assume that complexity impacts price but not the organizational form. We assume here that contracting capabilities have an impact on the organizational form. For example, municipalities that are used to contract out other public services are more keen on contracting out the water public service. As simple theoretical framework can be used to describe the impact of organizational form on price. Assume that the principal, the municipality, can choose between two organizational forms for water provision: the market O^m procuring potential surplus V^m or the internal production option O^d giving surplus V^d. Under direct management, surplus is affected by overall costs C^d of production and distribution that only varies depending on complexity i such as $c'_i \succ 0$. Under private management, overall costs depend also on agent's effort e to reduce costs that depends on contracting capabilities a of the public manager, such as $e'_a \succ 0$. Effort monitoring has however a cost c(e(a)) that is positively related to the effort. These costs cover transaction costs for example. Overall costs for producing and distributing water are $C^m = C_0 + c(e(a)) + c(i) - e(a)$ under private management while they are only $C^d = C_0 + c(i)$ under public management. Under such hypothesis, the choice to contract out the public service occurs only if $Pr(O* = O^m)$=$Pr(V^m \succ V^d)$=$Pr(C^d \succ C^m)$ i.e. if $c(e(a)) \prec e(a)$, namely if the gain of the effort is superior to the cost of monitoring the effort. Ultimately, the intuition of the model is that we expect cities with contracting experience to outsource the public service, even though the impact on price is not straightforward.

Instrumented-variable regression is not easy to implement because one needs to find good instruments that fit the robustness checks. Table 11 reports the results for the two-stage-least-squares (2SLS) instrumented regressors. Instruments are a dummy equal to 1 if the public sanitation service is contracted out and the ratio between exports plus imports and billed water. The latter variable is a proxy for contractual capabilities as exports are made through subcontracts with other municipalities (see Demsetz [1988] and Argyres and Mayer [2007]). The table reveals that instrumenting for contractual capabilities decreases the impact of private participation on price, as opposed to to simple OLS regressions in Tables 2 and 6. The results of the first-stage are reported in columns (1)

and (3) and the results of the second-stage are reported in columns (2) and (4). While in OLS regressors, the impact of private management was 22 euros, it is now 19 euros. When we consider the lagged price, we get an impact of 3.73 euros with the 2SLS while it is 7.31 with OLS. The 2SLS isolates the variation in private management that is not correlated with the error term. The coefficient under 2SLS reduces the sampling variance. Cities have different profile in contracting, depending on their capabilities. Instruments chosen here induce a self-selection as contracting-out may not be randomized.

We report in Table 11 several relevance and exogeneity tests of the instruments. We first take a glance at the first-stage results. We reported in column (1) and (3) the coefficients of the two instruments for the first-stage (we did not report the coefficients of the excluded instruments). As we can see capabilities in subcontracting and contracting for other public services have strong and significant impacts on the make-or-buy decision. The partial R-squared is satisfying and the first-stage F-stat is quite high. We also report the p-values of the Hansen J-test. p-values are higher than 0.11 in column (2) and equal to 0.891 in column (4). A telltale story is that a p-value higher than 0.25 satisfies the over-identification restriction. The orthogonality condition has been checked for both instruments. Overall, our model is robust and provides an efficient model of the impact of private participation on price. We can include more instruments such as a proxy for production capabilities or being part of a group of municipalities, to increase the first-stage R-squared but at the possible expense of precision in the second stage. Finally, our present results are robust to the inclusion of extra-instruments.

5.3 Methodological Implications

Manipulating big data is now a common feature of research in economics, organization and management sciences. Exploiting big data often raises questions on the robustness of data analysis and research design. A famous quote from Ronald Coase (even if he never properly wrote it) is "if you torture the data long enough it will confess". Recent Bank of Sweden Nobel Prize winner Christopher Sims recognized in the 1980s that empirical research should be based on formal specification of priors and their incorporation into an elaborate multivariate framework. Leamer [1983] views applied econometrics research papers of the 1970s and early 1980s as lacking credibility. Leamer believed that more sensitivity analysis - including control variables and fixed-effects to compare results - was needed. From the 1990s and the papers of Card and Krueger [1994] onwards, randomized experimentations became very popular. The reason is simple: they offered research designs that dropped out inverse causality.

The success of empirical analysis in economics is also relevant in strategic and organization management. A growing management literature is based on big data analyses. Method papers such as Hamilton and Nickerson [2003] and Bascle [2008] discuss for example potential bias from empirical research that fail to control for endogeneity. Hoetker [2007] reveals that most researchers using Logit or Probit models in Strategic Management failed at interpreting correctly the results. In this paper, we clearly discuss the benefits and the drawbacks of each model. We also propose a toolkit to make research in management more robust by using marginal change interpretation and exploit potential natural experiments. A way to make empirical results more robust is to use matching to get a subsample of comparable units.

An advantage of the propensity score matching is that it forces researchers to get into the data and to design the evaluation framework before looking at the outcomes. It focuses researchers on the design of treatment assignment rather than on the outcomes of a standard regression. This is particularly important when the treatment is designed by a human institution - here the municipal council that decides to make-or-buy - and the outcomes are uncertain, depending on market factors such as competition. Another argument made by Angrist and Hahn [1999] is that in finite samples, focusing on the propensity score excludes automatically numerous variables that explain little variation of the outcomes. Moreover, these variables may bear some statistical burdens that it is better to prevent. Selecting finely the variables to design the treatment effect avoids large equations. Other technical advantages are the use of non-parametric or semi-parametric matching techniques that tend to focus on the common support condition.

However, matching on the propensity score also presents several drawbacks. First, it is asymptotically less efficient than regression. Indeed, we can get lower asymptotic standard errors by matching on any covariate that explains outcomes, whether or not it turns up in the propensity score. Second, a regression usually gives more accurate coefficients on the variables. Third, there is a cost on matching on some variables that could explain outcomes. Fourth, it often leads to reduce the dimensionality of the matching problem in a manner that can have real empirical consequences. Fifth, modeling propensity score matching is not yet standardized.

Nevertheless all things considered, propensity score matching can be a good prescreening estimation. Crump et al. [2009] suggest for example that the propensity score should be used as a tool for systematic sample selection before regression. In a second step, the researcher can limit its sample to observations that are in the common support or on a reduced part of the common support. For units it is difficult to find comparable units with the opposite treatment, analyses are sensitive to minor changes in the specification and lower precision of the resulting estimates. Reducing the sample using knowledge-based criteria gives stronger results for the internal validity. The main drawback is that some external validity is potentially lost by changing the focus to average treatment effects for a subset of the original sample.

Another methodological question that is raised in this article is the difference between the mean impact of the treatment and its marginal impact. We propose models that are efficient at capturing the mean impact and others that aim at isolating the marginal impact. Because of our dataset, we face two problems. The first one is that we cannot control for outcomes before and after the management change for the whole dataset. The second one is that management changes are staggered over time. These two issues make proper estimation of the impact of private management very difficult. We have two solutions. The first one is to include a lagged variable for outcome. In this case, all the difference between outcome at t and $t\text{-}1$ is explained by the potential management change and the controls. However, all controls can be correlated with the lagged outcome and results may be biased. Another solution is to use within fixed effects models to highlight the mean impact of a management change. However, within-FE gives mean results for the variable of interest and there is always a risk that its high variance draws the coefficient upward. We suggest to focus on a subsample of observations that switched from an

organization to another. Indeed, this method gives helpful results to really evaluate the impact of a variable on another, especially when one uses deep datasets covering several years. Such robustness checks on subsamples (or extra-sample) are always useful to endorse internal (or external validity) of the main implications.

6 Conclusion

In this paper, we analyzed the impact of private participation on retail price in residential water supply. We found that private management is on average more expensive for customers than public management, everything else being equal. We used econometric methods that isolates the impact of private participation on price. We then reduced our sample to utilities that have the same propensity score. We found that price are always marked-up by a premium under private management. We then checked the micro-validity of our results using differences-in-differences for switchers. We found that cities switching from private to public management experience decreasing tariffs. We discovered that cities switching from public to private management face higher prices at the beginning of the period but not at the end of the period. This is consistent with the idea that cities change organizations or contracts when they can expect lower prices. This results is confirmed by focusing on cities switching from an operator to another while remaining under private management. Cities renewing the incumbent at the end of the contract usually experience decreasing price after the renewal. We also discussed potential reasons for the price-gap between public and private management. Water budget debt is a possible explanation for the evolution of price. We also instrumented private management using proxies for contractual capabilities and obtained results that are consistent with the previous ones.

Broadly speaking, the price difference on a bill of 120 cubic meters of water is rather small, between 3 and 10 euros on average per year, for an average price of 144 euros. We think that advocates of private management may be surprised to learn that our best estimate of the price effects of private management are positive, not negative as it would have been the case if private management were operating in cities that are structurally more difficult. Likewise, we believe that some advocates of more public intervention may be surprised to learn that public management is not associated with huge price gaps and neither is more performance.

Our research carries several policy implications. First, municipalities must be aware that switching from a management form to another will impact their prices, but not in the proportion they expect. Structural reasons are probably more robust at explaining price than organizational choice itself. Second, comparing municipalities between one and another imposes a reasonably similar sample in terms of observables. Third, switching is costly. It demands to public managers strong organizational capabilities and a lot of financial resources to buy some fixed assets to the former operator.

Our results have several limitations. First, our paper studies difference in performance between public and private management between 1998 and 2008 but can fail to explain price differences in the coming years, as our data does not allow us to take into account competition intensity. Second, we are not able to account for the potential long-term effect of organizational change on performance. Our results suggest that long-term difference in price is not always significant. We lack indicators of debt and capital output investments

to properly measure the supposed long-term performance of a switch and of a renewal.

We also think that our results pave the way for much further research. First, it seems that the evaluation and the study of organizational changes is in its infancy. In view of the extensive use to which these models are put, a careful evaluation of their effectiveness needs to be done. Second, future research in economics and management could exploit such changes in organization, firm boundaries and ownership to question models interpretation and comparing results using different methods, including structural econometrics. We attempted to give some pathways to stronger methodological design such as the use of reduced samples to comparable observations and the focus on micro-validity. The broader conclusion of the paper is that we need more real-life data to assess the impact of organizational choices on market performance and structure. For public utilities, collecting data on costs and fixed assets could give us a more complete picture of the public-private management comparison. Future researches could use costs and stakeholders perception as an output of organization.

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Figure 1: Price Evolution under Public and Private Management

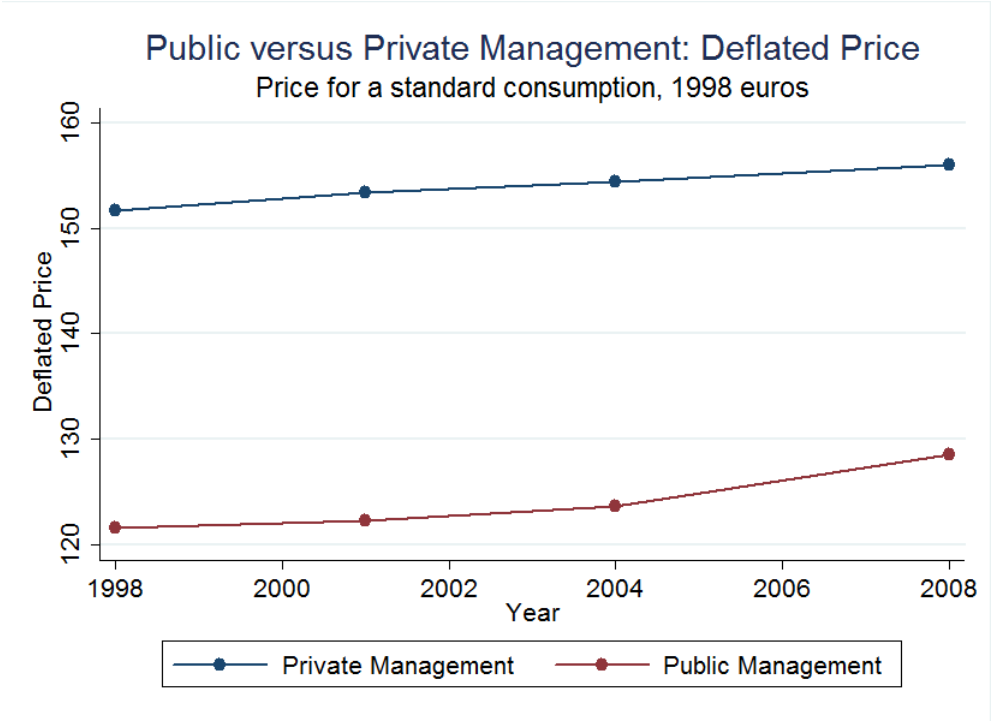

Figure 2: Prices Evolution in Cities under Public Management that Switched to Private Management

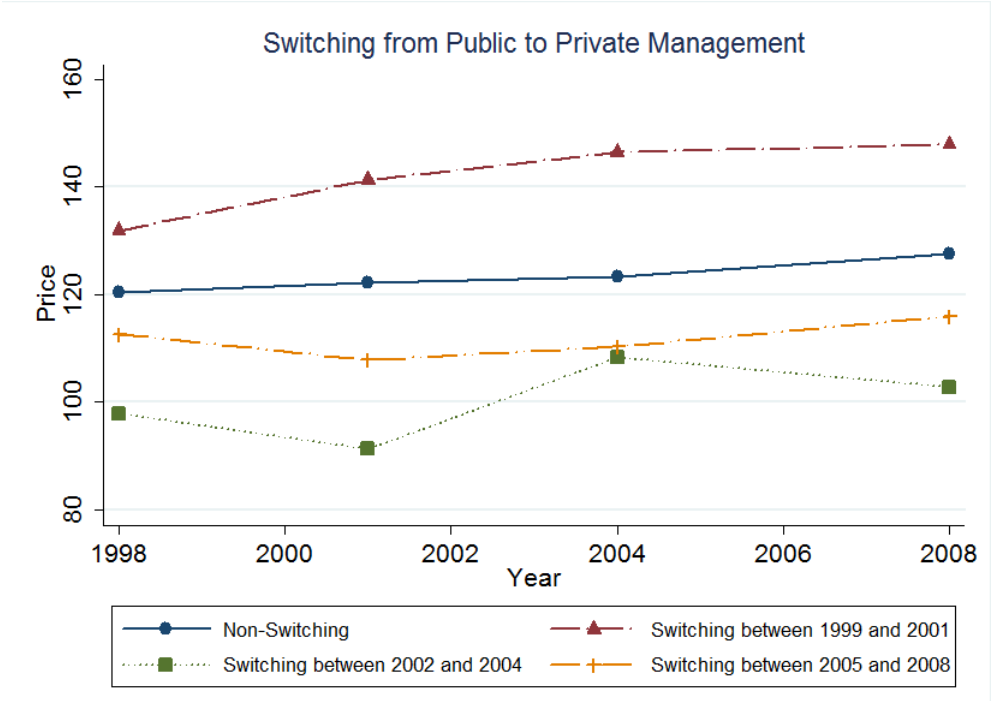

Figure 3: Prices Evolution in Cities under Private Management that Switched to Public Management

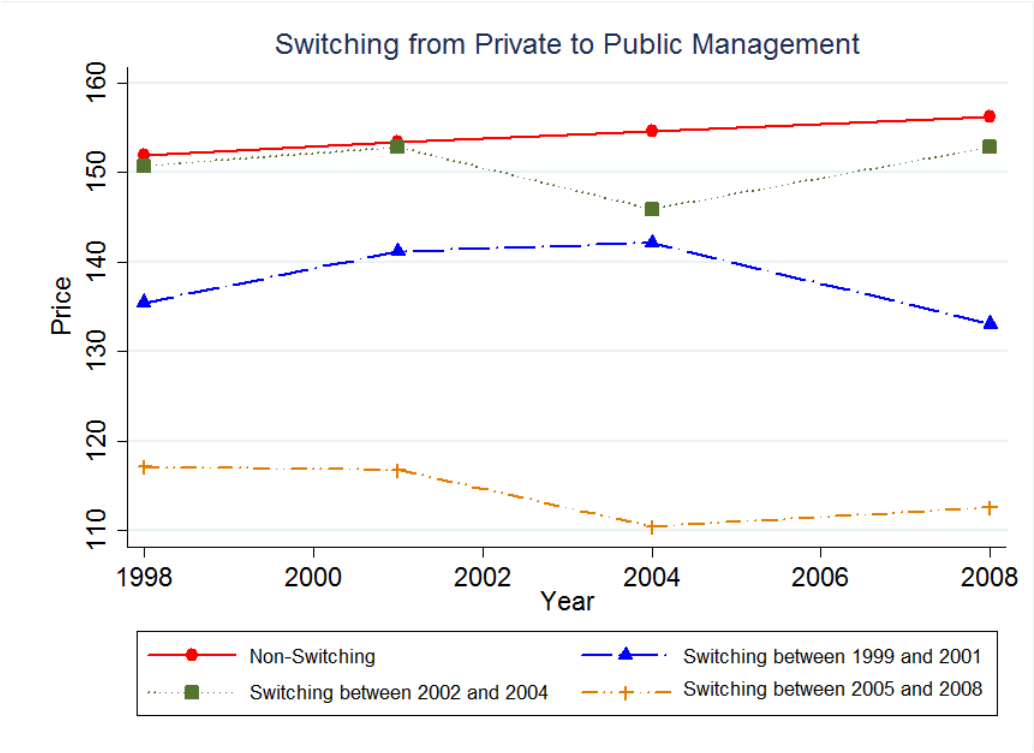

Figure 4: Propensity Score Distribution for Control Units

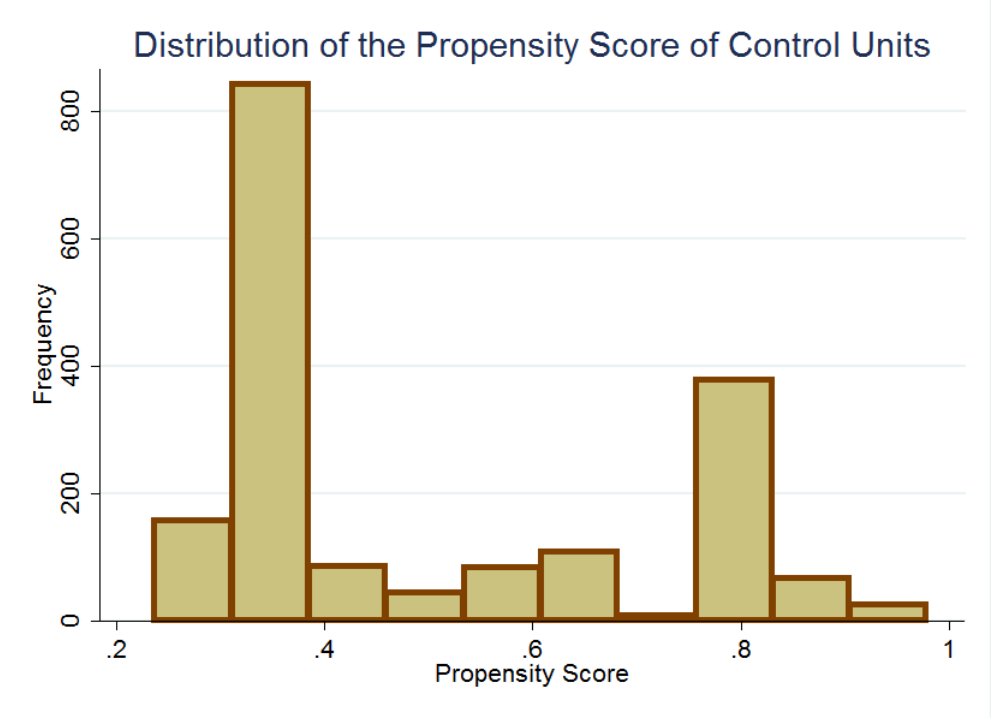

Figure 5: Propensity Score Distribution for Treated Units

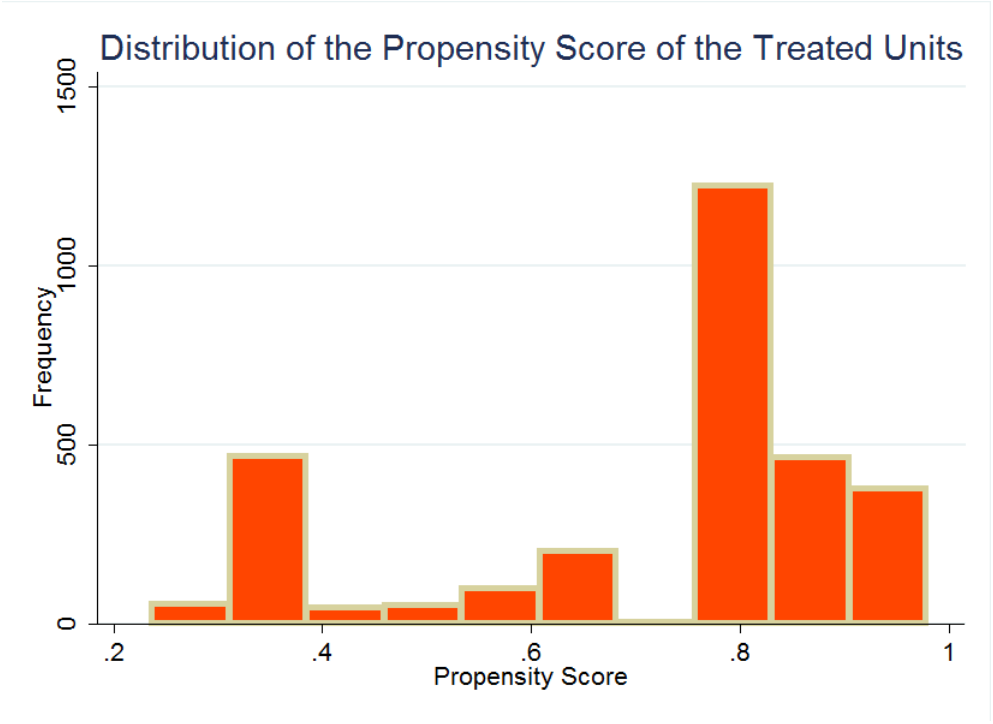

Table 1: Descriptive Statistics

	Definition	Whole Sample	Private Management	Public Management
Panel A: Price Equation, city-level data				
Price	Standard Price for 120 cubic meters (deflated in 1998 price)	144.605 (43.980)	153.902 (45.341)	124.018 (32.410)
Consumption Density	Ratio of billed units in thousands on network length in kilometers	17.188 (16.980)	17.742 (17.900)	15.960 (14.667)
Independence	Ratio of water production on production plus imports	0.911 (0.196)	0.899 (0.212)	0.938 (0.149)
Network Performance	Ratio of billed water on billed water plus leaks	0.753 (0.120)	0.758 (0.115)	0.742 (0.131)
Ln(pop)	City population logged	7.793 (1.617)	7.886 (1.596)	7.589 (1.645)
Touristic Area(=1)	City is touristic	0.131 (0.323)	0.124 (0.330)	0.106 (0.308)
Limitation (=1)	Water consumption can be limited	0.061 (0.238)	0.061 (0.239)	0.059 (0.235)
Investment Program (=1)	Investment program on the water networks	0.674 (0.469)	0.675 (0.468)	0.669 (0.471)
Pool of Cities (=1)	Cities are grouped to provide public services	0.726 (0.446)	0.751 (0.433)	0.671 (0.470)
Touristic Area (=1)	City is touristic	0.119 (0.323)	0.125 (0.331)	0.135 (0.342)
Treatment 2 (=1)	Simple disinfection of water	0.551 (0.497)	0.506 (0.500)	0.654 (0.476)
Treatment 3 (=1)	Heavy disinfection of water	0.155 (0.362)	0.167 (0.373)	0.127 (0.476)
Treatment 4 (=1)	Treatment 3 plus extra-controls	0.179 (0.382)	0.213 (0.409)	0.102 (0.334)
Treatment 5 (=1)	Mixed treatment including treatment 4	0.054 (0.226)	0.059 (0.236)	0.043 (0.203)
Treatment 6 (=1)	Mixed treatments including treatment 2 or 3	0.054 (0.227)	0.053 (0.223)	0.058 (0.234)
Ground Water (=1)	Water comes from a ground source	0.128 (0.335)	0.142 (0.349)	0.098 (0.297)
Mixed Water (=1)	Water comes from ground and underground sources	0.186 (0.389)	0.209 (0.407)	0.136 (0.343)
Panel B: Other Controls, city-level data				
Urban (=1)	Area considered as urban	0.159 (0.366)	0.165 (0.372)	0.145 (0.352)
PPP Sanitation (=1)	City has contracted out the sanitation service	0.567 (0.496)	0.704 (0.456)	0.261 (0.439)
Water quality	Compliance ratio of microbiological quality tests	0.958 (0.157)	0.967 (0.131)	0.933 (0.202)
Number of Tests	Number of tests to measure water quality compliance	103.841 (285.200)	120.93 (331.670)	65.942 (125.282)
Failed Tests	Number of tests that not meet the level of compliance	0.647 (1.565)	0.618 (1.434)	0.713 (1.821)
Subcontracting Capabilities	Ratio of water imports and exports on total billed water	0.192 (0.309)	0.212 (0.329)	0.148 (0.256)
Panel C: Contractual Renewal and Switches, annual data				
Contract Renewal (=1)	Incumbent is renewed at the end of the contract	280.750 (186.026)	-	-
Switch to Public Management (=1)	City in private management remunicipalizes the water service	71.333 (54.827)	- -	- -
Switch to Private Management (=1)	City under public management goes in private management	53.333 (34.025)	- -	- -
Switch from a Firm to another (=1)	City under private management changes the delegatee	61.000 (58.693)	-	-

Note: Panel (A) describes data concerning the estimation of prices. Panel (B) presents data used for other regressions. Panel (C) gives descriptive statistics about contracts' renewals and switches. All observations are represented for the four years. The panel includes 6,765 observations for private management and 3,055 observations for public management.

Table 2: The Impact of Private Management on Prices

	(1)	(2)	(3)	(4)
Model	**OLS**	**OLS**	**Within-FE**	**AR(1)-FE**
Variables	Price	Price	Price	Price
Private Management (=1)	22.34***	7.307***	9.010***	8.954***
	(0.875)	(0.889)	(1.988)	(2.137)
$Price_{t-1}$		0.744***		
		(0.0359)		
Consumption Density	-0.361***	-0.116***	-0.0756**	-0.108**
	(0.0319)	(0.0303)	(0.0295)	(0.0455)
Independence	-9.028***	-2.272	-7.870***	2.638
	(2.012)	(1.590)	(3.020)	(2.754)
Network Performance	-2.227	-7.965***	-1.298	-5.126*
	(3.725)	(2.961)	(3.384)	(2.852)
Ln(pop)	-4.036***	-1.170***	-12.11*	-7.781
	(0.301)	(0.297)	(6.461)	(4.881)
Limitation (=1)	-0.836	0.848	-1.215	-1.748*
	(1.673)	(1.145)	(1.052)	(0.970)
Investment Program (=1)	2.671***	0.432	-0.792	0.329
	(0.908)	(0.595)	(0.590)	(0.605)
Touristic Area (=1)	1.872	0.763	4.395**	3.941*
	(1.245)	(0.967)	(2.198)	(2.108)
Pool of cities (=1)	12.06***	1.292	10.77***	6.850***
	(1.147)	(1.090)	(1.693)	(1.898)
Ground Water (=1)	19.82***	4.433***	1.999	8.291***
	(2.123)	(1.225)	(3.745)	(2.740)
Mixed Water (=1)	4.645***	2.093**	-0.0215	3.927**
	(1.346)	(0.981)	(1.950)	(1.862)
Treatment 2 (=1)	-0.0343	4.094	-4.901	-14.01**
	(13.94)	(3.038)	(13.21)	(6.392)
Treatment 3 (=1)	5.394	3.778	0.604	-13.75**
	(14.46)	(3.144)	(13.54)	(6.566)
Treatment 4 (=1)	6.962	3.926	-2.533	-14.73**
	(14.73)	(3.283)	(14.51)	(6.595)
Treatment 5 (=1)	6.744	3.677	-4.263	-14.80**
	(14.91)	(3.451)	(15.05)	(6.711)
Treatment 6 (=1)	9.938	5.842*	-3.768	-14.46**
	(14.47)	(3.346)	(13.65)	(6.687)
Constant	160.8***	44.11***	235.5***	211.8***
	(19.43)	(9.425)	(49.48)	(27.29)
Year FE	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes		
Cities FE			Yes	Yes
Observations	9,820	7,365	9,820	7,365
R-squared (Within if FE)	0.427	0.759	0.030	0.018
Number of Groups			2,455	2,455

Note: The dependent variable is the price for a standard bill of water for a given municipality. Model (1) is an OLS regression using the full sample. Model (2) is model (1) including the lagged price. Model (3) is a within fixed-effects regression. Model (4) performs an auto-regressive model with fixed-effects. Robust Standard Errors in Parentheses with *** p<0.01, ** p<0.05, * p<0.1 for all models except model (4) that features standard errors.

Table 3: The Impact of Private Management on Prices

	(1)	(2)
Model	**Logit**	**Kernel Matching**
Variables	Private Management	Price
Private Management (=1)		31.78***
		(1.550)
Urban (=1)	1.145***	
	(0.103)	
Touristic Area (=1)	-0.563***	
	(0.151)	
PPP Sanitation	1.766***	
	(0.072)	
Touristic Area · PPP Sanitation	1.276***	
	(0.239)	
Independence	-0.779	
	(0.554)	
Indepedence^2	-0.0323	
	(0.502)	
Constant	0.201*	
	(0.117)	
Observations	4,814	4,814
Control Group	1,808	1,808
Treatment Group	3,006	3,006
Pseudo R-squared	0.166	-

Note: In model (1), the dependent variable is the private management dummy. Model (1) is the first-stage Logit that computes the propensity score. In model (2), the dependent variable is the price for a standard bill of water for a given municipality. Model (2) is a Kernel density function that matches units of observation from model (1) to compute the difference of the treatment. Robust Standard Errors in Parentheses with *** p<0.01, ** p<0.05, * p<0.1 in (1). Standard Errors in (2). The propensity-score is computed for the full-2008 sample.

Table 4: Selection Bias Before and After the Matching

Variables	Sample	Treated	Control	% biased	Bias reduction	t-test	p≻|t|
Urban	Unmatched	0.18097	0.0885	27.3		8.86	0.000
	Matched	0.18097	0.16113	5.9	78.5	2.04	0.041
Touristic Area	Unmatched	0.1314	0.12279	2.6		0.87	0.387
	Matched	0.1314	0.13015	0.4	85.4	0.14	0.885
PPP Sanitation	Unmatched	0.10679	0.01991	36.2		11.28	0.000
	Matched	0.10679	0.1041	1.1	96.9	0.34	0.735
Touristic Area·PPP Sanitation	Unmatched	0.68297	0.2594	93.7		31.25	0.000
	Matched	0.68297	0.68027	0.6	99.4	0.22	0.822
Independence	Unmatched	0.79706	0.86802	-22.7		-7.43	0.000
	Matched	0.79706	0.79786	-0.3	98.9	-0.09	0.930
Independence^2	Unmatched	0.75393	0.82998	-22.3		-7.33	0.000
	Matched	0.75393	0.7626	-2.5	88.6	-0.90	0.367

Note: The table shows mean comparison for the treated and control group before and after the matching process. The percentage of biased comparisons and bias reduction before and after the treatment are also reported. T-tests for equality of means in the treated and non-treated groups, both before and after matching, are reported in the last column. For good balancing, these should be non significant after matching. This is here the case except for the urban status.

Table 5: Bias Comparison Before and After Matching

Sample	Pseudo-R^2	LR Chi-2	p≻Chi-2	Mean Bias	Median Bias
Raw	0.166	1059.04	0.000	34.1	25.0
Matched	0.003	24.61	0.000	1.8	0.9

Note: The table reports indicators for the raw and matched samples. After the matching the pseudo-R^2 is close to 0 which means that the only explanatory variable of the difference in price is the treatment. The mean bias is reduced from 34% to 1.8%.

Table 6: The Impact of Private Management on Price: Reduced Support

	(1)	(2)	(3)	(4)
Model	**OLS**	**OLS**	**Within-FE**	**AR(1)-FE**
Variables	Price	Price	Price	Price
Private Management (=1)	21.67***	7.953***	10.41***	9.955***
	(1.105)	(1.070)	(2.529)	(2.543)
$Price_{t-1}$		0.734***		
		(0.049)		
Consumption Density	-0.334***	-0.0950***	-0.0891***	-0.0835
	(0.0346)	(0.0322)	(0.0279)	(0.0569)
Independence	-6.576***	-2.507	-9.221***	1.473
	(2.289)	(1.760)	(3.118)	(3.153)
Network Performance	-0.860	-11.33***	-3.627	-7.506**
	(4.754)	(3.751)	(4.540)	(3.586)
Ln(pop)	-4.497***	-1.338***	-16.83**	-10.51*
	(0.348)	(0.381)	(7.581)	(5.664)
Limitation (=1)	-1.493	0.818	-1.294	-1.429
	(2.026)	(1.332)	(1.274)	(1.143)
Investment Program (=1)	3.424***	0.330	-1.321*	0.0770
	(1.100)	(0.695)	(0.677)	(0.726)
Touristic Area (=1)	0.169	-0.919	6.078	4.619
	(1.702)	(1.389)	(3.731)	(2.926)
Pool of cities (=1)	11.39***	1.340	13.41***	8.779***
	(1.422)	(1.392)	(1.853)	(2.181)
Ground Water (=1)	19.12***	6.459***	-0.556	9.328***
	(2.676)	(1.479)	(4.776)	(3.192)
Mixed Water (=1)	3.590**	2.889**	0.450	4.646**
	(1.568)	(1.124)	(2.289)	(2.201)
Treatment 2 (=1)	-14.87	4.114	-15.72	-16.85**
	(26.41)	(5.088)	(22.05)	(8.150)
Treatment 3 (=1)	-10.99	2.553	-11.34	-18.77**
	(27.21)	(5.213)	(22.46)	(8.313)
Treatment 4 (=1)	-10.22	2.874	-14.29	-19.82**
	(27.55)	(5.342)	(23.61)	(8.344)
Treatment 5 (=1)	-11.27	1.949	-17.76	-21.25**
	(27.69)	(5.503)	(24.32)	(8.482)
Treatment 6 (=1)	-6.482	5.666	-16.03	-18.28**
	(27.20)	(5.428)	(22.56)	(8.443)
Constant	191.7***	61.20***	286.8***	239.1***
	(27.35)	(12.23)	(57.77)	(32.24)
Year FE	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes		
Observations	7,208	5,406	7,208	5,406
R-squared (Within if FE)	0.437	0.758	0.036	0.020
Number of Cities			1,802	1,802

Note: The dependent variable is the price for a standard bill of water for a given municipality. Model (1) is an OLS regression using the full sample. Model (2) is model (1) including the lagged price. Models (3) is a within fixed-effects regressor. Model (4) performs an auto-regressive model with fixed-effects. Robust Standard Errors in Parentheses with *** p<0.01, ** p<0.05, * p<0.1 for all models except model (4) that features standard errors.

Table 7: Differences-in-differences of the impact of management change on price

Switching From	(1) Private	(2) Public	(3) Private	(4) Public
to	Public	Private	Public	Private
Variables	Price	Price	Price	Price
Switch 2001 · After 2001 (=1)	-6.561	**13.96*** **	-7.634	**15.12*** **
	(8.729)	(3.033)	(7.189)	(2.822)
Switch 2004 · After 2004 (=1)	-6.949	-1.603	-9.096	-4.585
	(11.22)	(10.69)	(10.19)	(10.53)
Switch 2008 · After 2008 (=1)	**-7.755** **	-1.456	**-9.393*** **	1.824
	(3.590)	(5.332)	(3.201)	(4.653)
Switch 2001 (=1)	-15.08*	7.686**	-4.807	0.488
	(8.484)	(3.493)	(5.994)	(4.031)
Switch 2004 (=1)	-7.779	-11.45	-2.378	-33.15***
	(8.565)	(8.483)	(9.898)	(6.570)
Switch 2008 (=1)	-16.90*	-2.773	-3.138	-19.41***
	(10.20)	(5.727)	(7.755)	(6.338)
After 2001 (=1)	-0.377	1.201	-0.121	-0.437
	(0.731)	(1.049)	(0.616)	(0.611)
After 2004 (=1)	1.263**	0.900	0.612	0.530
	(0.640)	(0.712)	(0.486)	(0.478)
After 2008 (=1)	0.442	2.984***	1.142**	0.890*
	(0.643)	(0.700)	(0.492)	(0.486)
Constant	198.4***	133.6***	166.3***	168.8***
	(51.35)	(13.35)	(30.27)	(30.38)
All Controls	Yes	Yes	Yes	Yes
Observations	6,810	3,064	9,820	9,820
R-squared	0.416	0.395	0.388	0.392
Sample	Private	Public	Full	Full

Note: All models are OLS regressions. The dependent variable is price for a standard bill of a city i. City-Clustered Robust Standard Errors are reported in parentheses with *** p<0.01, ** p<0.05, * p<0.1. Models (1) and (3) analyze the impact of a switch from private to public management. Models (2) and (4) study the impact of a switch from public to private management. Models (1) compares switchers relatively to non-switchers under private management. Model (3) evaluates switchers regarding non-switchers under public management. Models (3) and (4) examine switchers regarding the whole sample. A switch to public (private) management means that the municipality switched from private (public) management to public (private) management between t and t_{-1}.

Table 8: Differences-in-differences for Private Firms Switching Operators and Contract Renewal

Model	(1) OLS
Variables	Price
Switch 2001 · After 2001 (=1)	-2.188
	(5.857)
Switch 2004 · After 2004 (=1)	**-24.30*** **
	(5.815)
Switch 2008 · After 2008 (=1)	-2.500
	(3.854)
Renew 2001 · After 2001 (=1)	**-4.119***
	(2.136)
Renew 2004 · After 2004 (=1)	3.766*
	(2.273)
Renew 2008 · After 2008 (=1)	**-8.104*** **
	(1.529)
Switch 2001 (=1)	-7.110
	(6.332)
Switch 2004 (=1)	-2.904
	(7.480)
Switch 2008 (=1)	-7.279
	(4.554)
Renew 2001 (=1)	1.527
	(2.584)
Renew 2004 (=1)	-6.637**
	(2.706)
Renew 2008 (=1)	-5.439***
	(1.815)
After 2001 (=1)	0.235
	(0.780)
After 2004 (=1)	1.096*
	(0.663)
After 2008 (=1)	2.058***
	(0.746)
Constant	215.0***
	(49.42)
All Controls	Yes
Observations	6,810
R-squared	0.418

Note: City-Clustered Robust Standard Errors in Parentheses with *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is price for a standard bill. Switchers are cities that keep their public water service outsourced but switch from an operator to another. Contract renewal means that the incumbent is renewed to manage the public water service. All comparisons are made regarding cities that have private management in 1998.

Table 9: Controlling for Quality Differences

Model	(1) OLS	(2) OLS	(3) OLS
Variables	Water Quality	Water Quality	Number of "Failed" Tests
Private Management (=1)	0.022***	0.012***	0.063
	(0.005)	(0.004)	(0.085)
Water Quality$_{t-1}$		0.590***	
		(0.030)	
Constant	0.807***	0.359***	-0.522
	(0.036)	(0.041)	(0.454)
All Controls	Yes	Yes	Yes
Observations	9,724	4,209	9,724
R-squared	0.216	0.561	0.127

Note: Observations are city-leveled. All models are standard OLS regressions. Robust Standard Errors in Parentheses with *** p<0.01, ** p<0.05, * p<0.1 for all models. The dependent variable in (1) and (2) is water quality measured as the compliance rate to the standards of water quality controls. The value takes between 0 and 1. The dependent variable in (3) is the number of water controls that do not meet the compliance rate. All controls from the previous regressions are included.

Table 10: Descriptive Statistics, Extra Sample Including Water Municipal Debt

	Public Management	Private Management
Water Debt (in thousands euros)	6,599.79	5,858.392
	(9,445.962)	(17,080.28)
Water Debt per Customer (in euros)	**277.0582**	**211.0306**
	(298.0969)	(577.4516)
Annual Debt Payments (in thousands euros)	710.941	822.473
	(1,012.309)	(2,346.025)
Annual Debt Payments (ADP) per Customer (in euros)	30.525	27.644
	(36.302)	(72.057)
Rescheduled ADP per Customer, under 5-year hyp.	**58.780**	**44.772**
	(63.244)	(122.511)
Rescheduled ADP per Customer, under 10-year hyp.	30.844	23.493
	(33.186)	(64.286)

Note: Descriptive statistics from the complementary dataset on 189 big water utilities covering 24.3 millions inhabitants out and 1.87 billions cubic meters out of 60 millions inhabitants and 4 billions cubic meters at the national level. Debt and annual debt payments are expressed in thousands euros. Debt per customer and debt annual payments per customer are expressed in euros. Reschedules debt annual payments are computed under two assumptions: a 5-year debt refund in the fifth raw and a 10-year debt refund in the sixth raw, both under a 2% debt interest rate hypothesis.

Table 11: 2SLS results of the impact of private management on price

	(1)	(2)	(3)	(4)
Stage	First-Stage	**2SLS**	First-Stage	**2SLS**
Variables	Private Management	Price	Private Management	Price
Subcontracting	0.123***		0.173***	
	(0.030)		(0.034)	
PPP Sanitation (=1)	0.337***		0.322***	
	(0.009)		(0.010)	
Private Management (=1)		19.35***		3.734**
		(2.170)		(1.771)
Price_{t-1}				0.755***
				(0.0362)
Constant		116.1***		37.21***
		(15.50)		(10.62)
All other controls	Yes	Yes	Yes	Yes
Instruments		2		2
First-Stage F-stat		657.79		484.77
p-value of Hansen J-test		0.112		0.850
Difference-in-Sargan Stat		Yes		Yes
Observations		9,780		7,352
R-squared		0.718		0.758
Partial R-squared	0.141		0.140	

Note: Robust standard errors in parentheses with *** p<0.01, ** p<0.05, * p<0.1. Results of the First-stage equations are reported for the instruments. Second-stage are reported in raws (2) and (4) after the first-stage equations. First-stage F-stat of excluded instruments is reported. p-values of Hansen J-test are also reported. A telltale story is that a p-value higher than 0.25 satisfies the overidentification restriction. The orthogonality condition has been checked for both instruments.