"Let the cat out of the bag"
The rationality behind remunicipalizations

Marion Chabrost[1], Simon Porcher[2], and Stéphane Saussier[3]

[1]University Paris 1 Pantheon-Sorbonne
[2]IAE-Sorbonne Business School
[3]IAE-Sorbonne Business School

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Abstract

Remunicipalization, especially in the water distribution sector, is a novel and widespread phenomenon disrupting the "make-or-buy" theory. Very little attention has been paid to this change in the landscape of public procurement. We address more widely the question of remunicipalization of water services in France. Gathering information on the 1998-2015 period on how more than 1 200 French municipalities are organizing their water services at contract renewal time, we identified nearly 300 remunicipalization cases. Using an endogenous switching regression model in a two-stage probit estimation we found that the choice of municipalities is driven by expectations concerning price and leak: efficiency consideration are thus important drivers. However we also find evidence of mimetic behaviors suggesting that municipalities that are uniformed or not skilled enough to anticipate the consequence of their choice on efficiency might rely on observed decisions coming from municipalities from the neighborhood. (JEL: H0, H7, K00, L33)

1 Introduction

Contractual theories and especially transaction cost economics (TCE) derive firm boundaries as an efficient response to market transaction costs (Bresnahan and Levin (2012); Lafontaine and Slade (2007)). By extension, they give predictions on the make-or-buy issues for public services. TCE predicts a relationship between underlying features of transactions and observed decision to make or to contract out. Considerations of asset specificity as well as contractual complexity are then central (Levin and Tadelis (2010)). As a result, some services are customarily provided in a way that usually remains the same. However, few literature has been devoted to focus on regime switching, namely shifts from private to in-house provision or conversely, from in-house to private provision. We refer to the first case as remunicipalization whereas the second is referred as privatization.

Remunicipalization, also referred to as 'reverse privatization' is a growing phenomenon in industrialized countries. Hefetz and Warner (2007) show that in the US, remunicipalization increased from 12% in the 1992-1997 period to 18% of all government service delivery from 1997 to 2002. This phenomenon is especially widespread in the water public services, as illustrated by the cities of Berlin, Paris and Hamburg in Europe, or Atlanta in the United States, where remunicipalization of water services took place during the last decade. In a recent book Kishimoto et al. (2015) found that between 2000 and 2015 more than 200 cases of water remunicipalisation took place in 37 countries. The number of cases doubled in the 2010-2015 period compared with the 2000-2010 period, illustrating a remunicipalization tendency, especially in high-income countries, where the majority of remunicipalizations took place.

In theory, when choosing between contracting in-house or privately, the municipality should account for the two main dimensions of the TCE, namely asset specifity and contractual complexity (Williamson (1975), Levin and Tadelis (2010)). On one hand, asset specificity describes the condition where the assets cannot be redeployed to alternative users or uses without loss of productive value (Williamson (1975),Klein et al. (1978)). Situations where asset specificity is strong may lead one of the parties to be locked in this contractual scheme. On the other hand, contractual complexity refers the completeness of the contract. Complexity is made of two main dimensions, that are measurability of ex-post performances and need for flexibility. Thus, public ownership is more likely as asset specificity and contractual complexity is stronger (Brown and Potoski (2003a), Levin and Tadelis (2010)). Other dimensions such as sensitivity to quality should be accounted for. In-house provision is more likely when the adverse effect of cost reduction over quality is large (Hart et al. (1997)).

In this respect, the water sector is of special interest since the two main dimensions of TCE namely, asset specificity and contractual complexity are relatively strong compared to many other public services. Indeed, Beuve and le Squeren (2017), Brown and Potoski (2003b), and Levin and Tadelis (2010) show that water distribution services are characterized by a relatively weak measurability and flexibility, and a strong potential for hold-up. This service is also subject to a strong sensitivity to quality. Therefore, water distribution services should be a good candidate for in-house management.

The case of France is particularly interesting. For more than a century, privatization has there been the rule more than the exception in the water sector (more than 70% of the population is served by privatized water utilities). This way of providing such utility seems

to be against the principles stated by the TCE. However there is a new tendency toward remunicipalization, illustrated by the remunicipalization of public water services in the city of Paris in 2009. As mentioned by Kishimoto, Lobina and Petitjean (2015), nearly 50% of their worldwide observed cases of remunicipalization takes place in France. It is thus interesting to find out why a system which has been adopted for a long time – the privatization of water services – seems to be put into question now, and to investigate what the main drivers of remunicipalization are. Finding out those factors is especially relevant since we expect relatively high switching costs due to the strong asset specificity. This new tendency for remunicipalization may have several explanations. Some remunicipalization might be constrained. For example, there could be early terminated contracts, and municipalities are thus forced to remunicipalize because there are no bidders for a contract. However, according to some authors such as (McDonald (2016)), the main reason lying behind remunicipalizations is dissatisfaction with private management performances. Rising prices and underinvestment issues are from this respect important parameters. Besides these efficiency concerns, other matters might be part of the explanation, especially political concerns such as ideology or willingness to be re-elected by politicians (Boycko et al. (1996)) or mimetic behaviors. Because water is often considered a 'special' public service, with emotional dimensions, the search for more efficiency (through efficient pricing and investments) might not be the only or the principal motivation for remunicipalization. It is fair to say that studies looking at the relative efficiency of public versus private management of water services leads to mix conclusions. In addition, those studies often look at only one dimension of efficiency, frequently prices or operating costs. For example, in a study concerning water services in France on the 1998 – 2008 period, Chong et al. (2015) found that water prices are (slightly) higher when municipalities chose to go private, but only for small cities (i.e. less than 10,000 inhabitants). They also found that efficiency consideration partly drives the decision to remunicipalize for big cities, suggesting that they are important for those cities but may be not for smaller ones. Other performance dimensions, equally important, are not included in the study, such as, investment efforts on the network to reduce leakages. Conversely, a similar wave of privatizations has been observed. As we expect high transaction costs, it is interesting to shed light on the factors that makes privatization more likely.

In this paper we address those questions using a new data set on water services in France. Gathering information on the 1998-2015 period concerning the way more than 1 200 French municipalities are organizing their water services; at contract renewal time, we identified nearly 300 remunicipalization cases and more than 200 cases of privatization. In order to investigate why municipalities decide to switch from one regime to another, we focus on efficiency indicators (i.e. price and leak) as well as on other indicators that might capture the willingness of municipalities to pursue other objectives (i.e. political party, debts, unemployment levels at the municipality level) or their lack of information (i.e. mimetic behavior). We use an endogenous switching regression model in a two-stage probit estimation to obtain consistant estimators that account for endogeneity and simultaneity issues. Our results suggest that municipalities decision to remunicipalize a water service is connected to expectations concerning efficiency but only toward prices: the leak dimension is not accounted for. On the contrary, decision to privatize accounts for the leak dimension, and to a less extent, the price. Macroeconomic variables such as taxes or personnel expense are not decisive factors. We find evidence of mimetic behaviors for small municipalities (less

than 5,000 inhabitants) suggesting that those that are uniformed or not skilled enough to anticipate the consequences of their choice on price and leak might rely on observed decisions coming from neighboring municipalities.

2 Remunicipalization in the French Water Sector

2.1 The specificity of water distribution services

See Table 1 [TBD]

2.2 The Institutional Environment

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 for the provision of the service, the dominating organizational form is private management. Under private management, the main contractual form is the lease contract in which the operator manages the service, invests in the network and gets a financial compensation through consumer receipts.

Contrary to other industriad 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 regulation by contract in the case of a private operator, or a decision of the municipality board in the case of public operation. Price setting is different whether the local community has chosen to privatize the service 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 'cost-recovery principle' (or 'water pays water'). Prices are thus set to cover operating and capital costs and no payment for water provision may be diverted to other uses. No subsidies

Table 1: Transaction costs in the water distribution sector

	Country	Service sensitivity	Service measurability	Contractual Flexibility	Asset specificity
Brown and Potoski (2003)[1]	USA	-	2.36	-	4.12
Levin and Tadelis (2010)[2]	USA	0.38	-0.13	0.09	0.53
Beuve and le Squeren (2017)[3]	France	0.524	0.16	-0.172	0.356

[1] Scores over 5

[2,3] Standardized scores

Table 2: Contract renewals in France and Remunicipalizations

	Municipalities		New Contracts	Remunicipalizations			Privatizations		
Year	Count	Population	Count	Count	% Contract Renewal	Population	Count	% Contract Renewal	Population
1998-2001	4987	41 851 320	395	39	10%	436 417	105	27%	640 994
2002-2004	4987	42 014 224	413	14	3%	44 401	17	4%	55 724
2005-2008	5215	42 582 788	851	113	13%	696 283	50	6%	165 779
2009	9915	21 509 758	83	52	63%	2 644 153	15	18%	106 457
2010	9858	21 367 100	111	11	10%	117 431	17	15%	221 298
2011	9753	21 154 976	102	16	16%	154 561	7	7%	15 815
2012	9666	21 078 094	97	13	13%	110 703	9	9%	69 112
2013	9429	20 654 816	86	19	22%	84 608	13	15%	19 616
2014	9197	20 275 608	80	4	5%	105 446	3	4%	1 061
2015	9040	15 800 907	71	9	13%	26 116	0	0%	-
Total	**82 047**	**268 289 591**	**2289**	**290**	**13%**	**4 420 119**	**236**	**10%**	**1 295 856**

can be used, regardless of the governance form used. 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. The successful bidder benefits from a local monopoly for the duration of the contract, that is on average 12 years in France. At the renewal time of the contract, the municipal authority chooses to either put a new contract to tender, in which case there is a new round of competitive bidding, or to remunicipalize.

One final interesting feature of the French water sector is that all infrastructure remains the property of the municipality. Contracts with private operators can stipulate specific infrastructure improvements to be carried out by the private operator, and stipulate that the private operator will maintain infrastructure to keep water loss below specified levels. The cost of the requisite work is priced into the operator's contract bid. Thus, when a municipality decides to remunicipalize, there is no payment required from public authority to the incumbent private operator.

2.3 Remunicipalizations: Evidences

Table 2 shows the total number of contract renewals and distinguishes between privatizations and remunicipalizations observed in our sample from 1998 and 2015 (the data set will be presented in details in the next section). The overall tendency of privatizations versus remunicipalizations shows that there have been some cycles of privatizations (1998-2001) and remunicipalizations (1998-2009), and some periods with almost the same number of privatizations and remunicipalizations (2010-2014). Overall, we observe more remunicipalizations than privatizations, respectively 290 versus 236 between 1998 and 2015, for a total of 2,289 new contracts.

3 Remunicipalizations: drivers and propositions

3.1 Efficiency considerations

At contract renewal time, the decision to remunicipalize is very similar to the traditional make-or-buy decision that has been widely studied in organizational economics for private transactions. Theoretical frameworks designed to tackle "make-or-buy" issues and contracting strategies between private firms may have provided some of the clearest insights into issues related to contracting with governments (de Bettignies and Ross (2009)). From an economic point of view, transactors that are looking for economic efficiency will choose to contract out if the expected gains (net of transaction costs) from doing so are greater than those of organizing the transaction internally. However, as stated by Masten and Saussier (2000) "The returns transactors expect from governing their transactions in different ways are difficult, if not impossible to observe".
As noted before, there is no regulator in the water sector in France. The role of a regulator would be to determine if observed prices paid by end-users are justified depending on the costs of identical water services. Through yardstick competition simple technics (Shleifer (1985)), municipalities could achieve the same result. They may even compare performances obtained from heterogeneous services as long as heterogeneity of water services is accounted for. Each service would be then compared to a "shadow service" constructed from suitably averaging the choices of other comparable municipalities.

Proposition 1. *Municipalities that are looking for efficiency should build their decision to remunicipalize (or privatize) on available information. When their observed performances are lower than comparable water services, they should change their organizational choice.*

Proposition 1. states that informed municipalities should base their decision to remunicipalize on their relative performance. In order to determinate if they achieve a fair level of efficiency compared to what other services in other municipalities are achieving, simple benchmarking methods can be used by municipalities to determinate what should be their efficiency, taking into account all the available information. A municipality that reaches the conclusion that their water services are inefficient, if provided through private management (public management), should decide to remunicipalize (privatize).

3.2 Information considerations

Even if information is available, some municipalities might not have enough resources or capacities to treat the information and develop simple benchmarking methods in order to determinate their efficiency level (i.e. what could be gain from changing their organizational choices).

Proposition 2. *Municipalities that are looking for efficiency should build their decision to remunicipalize (or privatize) on available information. When they cannot assess if their observed performances are lower than comparable water services, they should base their decision on observable choices made by other informed municipalities.*

Proposition 2. states that mimicking behaviors due to a lack of information (Brown and Potoski (2003b) might drive the decision whether to remunicipalize (privatize) or not a service previously contracted out (provided in-house). Such behaviors can be rational and analyzed as a delegation of decision or a weak form of yardstick competition. As stated by Aghion and Tirole (1997), when a principal is not informed, it might be efficient to let an agent to decide as long as he has a higher probability to be informed and his objectives are congruent with those of the Principal. Uninformed municipalities can rationally base their decisions on observed decisions made by other supposed informed municipalities that are looking for efficiency. Revelli and Tovmo (2007) also showed that such behaviors being the result of municipalities' willingness to base their choices on yardstick competition are responsible for observed patterns of local interaction.

3.3 Political considerations

Public contracts differ from private ones. As stated by Spiller (2009):

> A fundamental difference between private and public contracts is that public contracts are in the public sphere, and thus, although politics is normally not necessary to understand private contracting, it becomes fundamental to understanding public contracting (page 45).

Because water contracts are public contracts, it is natural to believe that considerations other than economic efficiency, such as political considerations might drive municipalities' decisions. Le Squeren (2016) showed, for example, that public contracts are more often renegotiated around election times and that the political color of the municipalities is an important driver of the decision to provide a public service in direct public management or through private management.

Proposition 3. *The decision to remunicipalize (or privatize) a public service might be driven by political considerations such as stakeholders pressures (consumer associations, citizens perceptions) or municipalities' private agendas around election times.*

Proposition 3. states that, in order to understand remunicipalizations, it is necessary to consider a broader set of drivers than only efficiency considerations would suggest. The timing of the decision (i.e. near or far from election times) as well as political colors of the municipalities might be important drivers.

4 Dataset and Empirical Strategy

4.1 Dependent Variables

4.1.1 Remunicipalization and Privatization of Water Services

In order to investigate the determinant of remunicipalization, we merged three datasets: data from the French Environment Institute (IFEN-SOeS), the National Agency for Water (ONEMA) and the French Health Ministry (DGS). The unit of observation is a municipality. IFEN-SOeS collected data from roughly 5,000 water authorities four times in 1998, 2001,

Table 3: Samples for in-house and private provisions

	Whole Sample			Remunicipalization Sample			Privatizations Sample		
Year	**In-house provisions**	**Private provisions**	**Population**	**Contract renewals**	**Remunicipalizations**	**Population**	**In-house provisions**	**Privatizations**	**Population**
	Count	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**	**Count**
1998-2001	1 115	2 265	26 733 813	294	24	1 248 057	1 091	46	7 945 120
2002-2004	1 110	2 288	29 119 123	303	13	1 582 447	1 097	10	7 457 634
2005-2008	1 491	2 293	30 696 108	635	90	3 378 051	1 401	43	8 412 040
2009	247	391	10 108 737	29	18	2 527 549	229	9	2 891 604
2010	438	507	9 103 594	29	2	125 416	436	4	5 137 145
2011	640	490	8 974 893	29	6	131 820	634	1	5 308 610
2012	733	483	9 033 077	20	3	101 462	730	1	5 466 913
2013	850	476	8 904 524	24	5	217 936	845	1	5 616 351
2014	1 130	487	9 169 616	30	2	131 859	1 128	0	5 999 543
2015	991	353	4 774 212	11	3	73 895	988	0	2 653 726
Total	**8 745**	**10 033**	**-**	**1 404**	**166**	**-**	**8 579**	**115**	**-**

The whole sample refers to the case where all the variables of interest are populated. It is split between a total of 8,745 cases of in-house provisions and 10,033 of private ones. The remunicipalization sample only deals with municipalities where contrats are renewed or remunicipalization takes place. There is a total of 1,404 observations, of which 166 remunicipalizations. The privatization sample is made of 8,694 observations, that is the sum of the number of in-house provision cases and of privatizations.

2004 and 2008. The sample represents more than 75% of the entire French population for which services are provided and is representative of the total population of French municipal public water authorities. Starting from 2008, ONEMA collected data on every existing French water services on a yearly basis until 2015.

One of the main information provided in the dataset is about whether the distribution of water services is provided in-house or privately. Because we observed through time municipalities's choices, we can track remunicipalizations and privatizations all over the studied period. Based on these information we will define our two main dependent variables, *Remu* and *Privatization*, taking value 1 when we observe a switch from private (respectively public) to public (respectiveley private) management.

After removing observations with missing values, we obtain a dataset of 18,778 observations, of which 10,033 cases of private provisions and 8,745 of in-house ones.

Restricting our sample only to contract renewals and remunicipalization cases over the period 1998-2015 (i.e. remunicipalization can only occur when contract comes at an end that is to say at renewal time), we end up with 1,404 expiring contracts, of which 166 cases of remunicipalization. The remaining 1,238 contracts are related to cities keeping private provision of water distribution services. Similarly, considering only cases of privatization and in-house provision, we end up with a total of 8,694 observations, of which 115 switches to private provision and 8,579 cases of public management. Table 3 provides an overview of these sub-samples.

4.1.2 Water Service Performances

In addition to organizational choices, our data provide two performance indicators: prices paid by end-users and leak ratio. Price paid by end users in a given municipality and the cost to provide the water service are intertwined (remind that there is no subsidy). Leak ratio observed in a given municipality's network is a good proxy of investment efforts made to reduce water losses. Those two information build up our *Price* and *Leak* variables.

Basic statistics concerning the efficiency of water services show that private and in-house management significantly differ in terms of our main variables of interest namely, price and leak. Table 2 shows that, on average, the distribution of a cubic meter of water is significantly

more expensive under private provision (0.14 euro), whereas in-house management seems to be less efficient regarding the maintenance of the network since leaks are on average 4 points higher than under private management. This suggests that search for efficiency might play a role in the decision to privatize or not water services depending on which dimension (price or leak) appears as more important to the municipality.

Table 4: Average value for price and leak across management

	In-house	**Private**	**Difference**
Price	1.51	1.66	-0.14***
Leak	0.25	0.21	0.039***

4.2 Explaining variables

4.2.1 Water services heterogeneity

In order to test proposition 1., we need to construct variable assessing water services heterogeneity. Indeed, observed performances may be influenced by local characteristics of the water service. One main driver of observed performances is the water treatments at the municipal-level needed to produce water. That is why we control for the water treatment complexity. We distinguished between six types of treatments following the definition of the French Health Ministry: no treatment (*Water Treatment 0*); a simple disinfection (*Water Treatment 1*); an average disinfection (*Water Treatment 2*); a heavy disinfection (*Water Treatment 3*); or mixed treatments including a heavy treatment (*Water Treatment 4*) or only light and average treatments (*Water Treatment 5*).

We control for the origin of the water. Surface raw water is usually associated with higher risk since it is more easily polluted than underground water (*Surface*).
Scale economies are approximated by the number of inhabitants (*Pop*) or the density of the network (Variable *Density*). We add a control for tourist area, with variable *Touristic* that is a dummy capturing whether the city is considered as being tourist attractive or not following the French National institute of Statistics and Economic Studies (INSEE) definition. Touristic areas are usually characterized by oversized networks which can positively impact costs in order to be able to provide water to the population during peaks of consumption. We also account for the share of the price actually transferred to the firm in case of privatization (*Share Firm*). This variable reflects the firm's involvement into the water distribution network through the channel of incentives the share of price gives.

4.2.2 Mimicking behaviors

In order to test our proposition 2. we need to look for potential positive spillovers from of the number of neighborhood cities with in-house provision of water distribution services over decision to remunicipalize. We also suspect that the number of neighbors that remunicipalized may exert a positive influence over the switching decision. The same argument

is valid for the case of privatization where the number of neighboring cities with private management and cities that privatized might influence this decision.
We calculate for each pair of cities the distance between them and obtain a set of variables, *Neighbor_Inhouse_25*, *Neighbor_Inhouse_50*, *Neighbor_Remu_25*, and *Neighbor_Remu_50*, *Neighbor_Private_25*, and *Neighbor_Private_50*, *Neighbor_Privatization_25*, and *Neighbor_Privatization_50*. The first two variables represent the number of cities providing distribution of water in-house within a radius of respectively 25 and 50 kilometers. The next two represent the number of cities that remunicipalized this service within a radius of respectively 25 and 50 kilometers. Finally, the remaining ones represent respectively the number of neighbors having private management and those that switch to private provision in both radius.

4.2.3 Political dimensions

In order to test proposition 3. we collected additional data that we believe to be more connected to other than efficiency objectives. As López-de Silanes et al. (1997) suggest, labor-market conditions, budget constraints and ideology may drive privatization decisions. Therefore, we include the yearly local unemployment rate (*Unemployment*), the amount of debt per capita of the municipality (*Debt*), and personnel expenses per capita (*Personnel Expenses*) in our model. We eventually account for the political party that won the first tour of the presidential elections (*Pol Party*). Using the political color of the mayor would have been more relevant to our model but such data are only available for municipalities with more than 3,500 inhabitants before 2007 in France. Using them removes a lot of observations and may create selection bias. Therefore we favored conservatism and assume that citizens preference over political parties is similar whatever the election, at least for the first tour. We expect that all of those variables might influence the mayor's decision to remunicipalize. We account for the year of the election using a dummy variable $Election\_Year$, since electoral cycle might influence switching decisions.
presents descriptive statistics for the variables of interest broken down by types of samples.

4.3 Econometric Strategy

4.3.1 Benchmarking of Water Services

Our proposition are based on the assumption that organizational switches (i.e. remunicipalizations or privatizations) made by municipalities should be based on the relative efficiency of their water services compared to other municipalities. In order to assess this relative efficiency, we need to measure, for each service, what should be its theoretical performances (i.e. what should be its price and leak ratio) and how far it is from observed ones. In other words, for a given service, we need to assess whether the municipality is experiencing an overpricing or an overleak situation. Under private regime, we build up variable *Overprice* that represents the difference between the actual price and the price that would have prevailed under in-house provision. On the opposite, under in-house management, it is the difference between actual price and price that would have prevailed under a private regime. The variable *Overleak* is obtained the same way.

Figure 5: Summary statistics

		WHOLE SAMPLE						REMUNICIPALIZATIONS SAMPLE						PRIVATIZATION SAMPLE					
Variable	**Definition**	**Count**	**Mean**	**Median**	**SD**	**Min**	**Max**	**Count**	**Mean**	**Median**	**SD**	**Min**	**Max**	**Count**	**Mean**	**Median**	**SD**	**Min**	**Max**
Price	Average price per cubic meter, all taxes included	18 778	1,58	1,52	0,51	0,50	5,96	1 404	1,50	1,43	0,49	0,56	5,78	8 694	1,52	1,46	0,49	0,50	4,36
Leak	(Production – Billed water) x 100/ Production	18 778	0,24	0,22	0,14	0,00	0,94	1 404	0,23	0,21	0,12	0,00	0,88	8 694	0,26	0,24	0,15	0,00	0,92
Private	Dummy equal to 1 for privately managed services	18 778	0,53	1,00	0,50	0,00	1,00	1 404	0,88	1,00	0,32	0,00	1,00	8 694	0,01	0,00	0,11	0,00	1,00
Pop	Takes the value 1 if population<5000, 2 if 5000<population<10000, and 3 if population>10000	18 778	1,47	1,00	0,75	1,00	3,00	1 404	1,44	1,00	0,71	1,00	3,00	8 694	1,31	1,00	0,65	1,00	3,00
Surface	Dummy equal to 1 if the water is pumped out from the surface	18 778	0,11	0,00	0,32	0,00	1,00	1 404	0,13	0,00	0,33	0,00	1,00	8 694	0,08	0,00	0,27	0,00	1,00
Density	Number of inhabitants per km of network	18 778	59	34	96	0,30	2 400,00	1 404	62	42	90	1,00	2 400	8 694	49	23	101	0,30	2 400
Share Firm	Amount of the price of water transfered to the private firm if any	18 778	0,10	0,00	0,59	0,00	53,77	1 404	0,05	0,00	0,16	0,00	0,91	8 694	0,00	0,00	0,03	0,00	0,84
Inter Authority	Dummy equal to 1 if the municipality organizes water services jointly with other municipalities	18 778	0,50	1,00	0,50	0,00	1,00	1 404	0,70	1,00	0,46	0,00	1,00	8 694	0,38	0,00	0,49	0,00	1,00
Sanitation	Dummy equal to 1 if the water sanittaion service is provided privately	18 778	0,35	0,00	0,48	0,00	1,00	1 404	0,53	1,00	0,50	0,00	1,00	8 694	0,10	0,00	0,30	0,00	1,00
Touristic	Dummy equal to 1 if the municipality is a touristic area	18 778	0,12	0,00	0,32	0,00	1,00	1 404	0,15	0,00	0,36	0,00	1,00	8 694	0,09	0,00	0,29	0,00	1,00
Unemployment	Annual local unemployment rate (%)	18 778	8,60	8,35	2,27	3,30	18,00	1 404	7,60	7,40	1,85	3,30	16	8 694	8,85	8,50	2,39	3,30	18,00
Debt	Annual debt of the municipality per capita (thousand euros)	18 778	742	603	914	0,00	54 473	1 404	699	591	562	0,00	6 244	8 694	705	537	1 113	0,00	54 473
Taxes	Annual amount of local taxes of the municipality per capita (thousand euros)	18 778	344	295	235	0,00	3 733	1 404	333	285	214	33	1 864	8 694	318	270	219	0,00	3 429
Personnel	Annual personnel expenses of the municipality per capita (thousand euros)	18 778	339	290	220	0,00	3 788	1 404	325	281	203	0,00	1 597	8 694	304	259	197	0,00	3 739
Water Treatment 0	Dummy equal to 1 if raw water does not need a treatment before distribution	18 778	0,03	0,00	0,16	0,00	1,00	1 404	0,01	0,00	0,08	0,00	1,00	8 694	0,05	0,00	0,22	0,00	1,00
Water Treatment 1	Dummy equal to 1 if raw water needs a light treatment before distribution	18 778	0,64	1,00	0,48	0,00	1,00	1 404	0,55	1,00	0,50	0,00	1,00	8 694	0,74	1,00	0,44	0,00	1,00
Water Treatment 2	Dummy equal to 1 if raw water needs an average treatment before distribution	18 778	0,11	0,00	0,31	0,00	1,00	1 404	0,14	0,00	0,35	0,00	1,00	8 694	0,08	0,00	0,27	0,00	1,00
Water Treatment 3	Dummy equal to 1 if raw water needs a heavy treatment before distribution	18 778	0,13	0,00	0,34	0,00	1,00	1 404	0,19	0,00	0,39	0,00	1,00	8 694	0,06	0,00	0,24	0,00	1,00
Water Treatment 4	Dummy equal to 1 if raw water needs a mixture of treatments including a heavy treatment	18 778	0,05	0,00	0,21	0,00	1,00	1 404	0,07	0,00	0,25	0,00	1,00	8 694	0,02	0,00	0,16	0,00	1,00
Water Treatment 5	Dummy equal to 1 if raw water needs a mixture of light and average treatment	18 778	0,04	0,00	0,20	0,00	1,00	1 404	0,05	0,00	0,21	0,00	1,00	8 694	0,04	0,00	0,19	0,00	1,00
Neighbor Inhouse 25	Number of municipalities with in-house provision within a 25km radius	18 778	12	8,00	11	0,00	76	1 404	7,55	6,00	6,89	0,00	45,00	8 694	16	12	13	0,00	70
Neighbor Inhouse 50	Number of municipalities with in-house provision within a 50km radius	18 778	27	21	21	0,00	126	1 404	19	16	13	0,00	111	8 694	33	28	24,37	0,00	124
Neighbor Private 25	Number of municipalities with private provision within a 25km radius	18 778	15	7,00	30	0,00	239	1 404	16	10	22	0,00	184	8 694	7,19	5,00	9,28	0,00	193
Neighbor Private 50	Number of municipalities with private provision within a 50km radius	18 778	29	17	38	0,00	255	1 404	36	23	43	0,00	255	8 694	18	14	19	0,00	217
Neighbor Remu 25	Number of municipalities where remunicipalization took place within a 25km radius	18 778	0,19	0,00	0,73	0,00	15	1 404	0,40	0,00	1,25	0,00	14,00	8 694	0,16	0,00	0,63	0,00	15
Neighbor Remu 50	Number of municipalities where remunicipalization took place within a 50km radius	18 778	0,44	0,00	1,12	0,00	16	1 404	0,73	0,00	1,45	0,00	15,00	8 694	0,36	0,00	0,95	0,00	14
Neighbor Privatization 25	Number of municipalities where privatization took place within a 25km radius	18 778	0,20	0,00	1,29	0,00	26	1 404	0,11	0,00	0,42	0,00	5,00	8 694	0,25	0,00	1,76	0,00	26
Neighbor Privatization 50	Number of municipalities where privatization took place within a 50km radius	18 778	0,47	0,00	2,11	0,00	34	1 404	0,35	0,00	0,94	0,00	11,00	8 694	0,43	0,00	2,01	0,00	34

$$Overprice = Price_{t-1}^{Private} - Price_{t-1}^{Inhouse} \quad (1)$$

$$Overleak = Leak_{t-1}^{Private} - Leak_{t-1}^{Inhouse} \quad (2)$$

However, this specification requires counterfactual calculations depending on the actual management regime. As said earlier, when the municipality decides whether or not to remunicipalize, it does not observe the price and leak ratio that would have prevailed under in-house provision. Thus we need to estimate price and leak equations while accounting for the regime in order to predict the counterfactual:

$$Price = X\beta + \psi I + \nu \quad (3)$$

$$Leak = X\alpha + \delta I + \omega, \quad (4)$$

where X denotes a set of exogenous variables controlling for water services heterogeneity. One important issue with equations (4) and (5) is that the type of regime I may not be exogenous to the model. Indeed, organizational choices and the performance (price and leak ratio) may be correlated with unobserved factors. Also, simultaneity issue is suspected since performance might influence the organizational choice. Thus, a least square regression may lead to biased estimates. In order to overcome those two issues, we use an endogenous switching regression model following the methodology introduced by Lee (1978):

$$\begin{aligned} Price &= X\beta + \psi I_{Private} + \nu \\ I^*_{Private} &= X\zeta + Z\eta + \epsilon \\ I_{Private} &= \begin{cases} 1, & \text{if } X\zeta + Z\eta \geq \epsilon \\ 0, & \text{if } X\zeta + Z\eta < \epsilon \end{cases} \end{aligned} \quad (5)$$

and,

$$\begin{aligned} Leak &= X\alpha + \delta I_{Private} + \omega \\ I^*_{Private} &= X\gamma + Z\kappa + \varepsilon \\ I_{Private} &= \begin{cases} 1, & \text{if } X\gamma + Z\kappa \geq \varepsilon \\ 0, & \text{if } X\gamma + Z\kappa < \varepsilon \end{cases} \end{aligned} \quad (6)$$

Where ϵ and ε represent the error terms. These equations are solved using the whole dataset. We apply an endogenous switching regression model using a two-stage probit estimation from equations (5) and (6) so that we obtain a reduced-form probit model. We use a set of instruments for the selection equation, namely the local unemployment rate, the debt of the municipality, the personnel expenditure, the tax amount, the number of neighbors with private provision of water distribution services in a radius of both 25 and 50 km, a dummy for the political color, and a dummy for the election year. Estimates from the price and leak regressions allow to predict the value of the counterfactual prices and leaks from equations (1) and (2). We obtain $\widehat{Overprice}$ and $\widehat{Overleak}$, so that we can include them into equation(7) and estimate the counterfactual probit.

4.4 Remunicipalization

In order to investigate the determinants of remunicipalization, we estimate the following probit model:

$$\begin{aligned} Remu &= \beta_0 + \beta_1 Overprice + \beta_2 Overleak + \beta_3 Overprice * Pop \\ &+\beta_4 Overleak * Pop + \beta_5 Surface + \beta_6 Touristic \\ &+\beta_7 Density + \beta_8 Unemployment + \beta_9 Debt \\ &+\beta_{10} Personnel + \beta_{11} Inter\_Authority \\ &+\beta_{12} Share\_Firm + \beta_{13} Treatment \\ &+\beta_{14} Neighbor\_Inhouse\_25 + \beta_{15} Neighbor\_Inhouse\_25 * Pop \\ &+\beta_{16} Neighbor\_Inhouse\_50 + \beta_{17} Neighbor\_Inhouse\_50 * Pop \\ &+\beta_{18} Neighbor\_Remu\_25 + \beta_{19} Neighbor\_Remu\_25 \\ &+\beta_{20} Neighbor\_Remu\_50 + \beta_{21} Neighbor\_Remu\_50 \\ &+\beta_{22} Pol\_Party + \beta_{23} Election\_Year \\ &+\beta_{24} Pol\_Party * Election\_Year + u \end{aligned} \tag{7}$$

where *Remu* is a dummy variable equal to one if the city decides to remunicipalize at the end of the contract. We perform this regression over the sample of private management and remunicipalization the year the contract terminates.

4.4.1 Privatization

We performed the same methodology over privatization cases (i.e. cases where the municipality switches from in-house to private management). We restricted our sample to services either provided in-house or that switches to private management. We estimated the following equation:

$$\begin{aligned} Privatization &= \xi_0 + \xi_1 Overprice + \xi_2 Overleak + \xi_3 Overprice * Pop \\ &+\xi_4 Overleak * Pop + \xi_5 Surface + \xi_6 Touristic \\ &+\xi_7 DENSITY + \xi_8 Unemployment + \xi_9 Debt \\ &+\xi_{10} Personel + \xi_{11} Inter\_Authority \\ &+\xi_{12} Treatment + \xi_{13} Neighbor\_Private\_25 \\ &+\xi_{14} Neighbor\_Inhouse\_25 + \xi_{15} Neighbor\_Inhouse\_25 * Pop \\ &+\xi_{16} Neighbor\_Inhouse\_50 + \xi_{17} Neighbor\_Inhouse\_50 * Pop \\ &+\xi_{18} Neighbor\_Remu\_25 + \xi_{19} Neighbor\_Remu\_25 * pop \\ &+\xi_{20} Neighbor\_Remu\_50 + \xi_{21} Neighbor\_Remu\_50 * pop \\ &+\xi_{22} Pol\_Party + \xi_{23} Election\_Year \\ &+\xi_{24} Pol\_Party * Election\_Year + u \end{aligned} \tag{8}$$

Where Variables *Overprice* and *Overleak* are obtained as follow:

$$Overprice = Price_{t-1}^{Inhouse} - Price_{t-1}^{Private} \tag{9}$$

$$Overleak = Leak_{t-1}^{Inhouse} - Leak_{t-1}^{Private} \tag{10}$$

5 Results

Results from the endogenous switching model solved for equations (5) and (6) are displayed in Table 5 [1]. Several important conclusions can be drawn from a comparison of both column (2) and (3), and columns (5) and (6). First, the results indicate that the larger the city, the higher the price and leak reduction. However, the effect over price is bigger for cities with private provision whereas the effect over the leak ratio is higher for cities with in-house management. Second, treatments positively and significantly impact price and leaks almost exclusively for publicly managed water services. On the contrary, $Surface$, another usual measure of complexity, impacts positively the price and negatively the leak ratio, except for the case of leak under in-house management. This connection is less strong when services are privatized because 1/ the price is partly the result of competition and 2/ private firm might subsidize some services in their contract portfolio. Columns (1) and (4) give results from the selection equation, namely determinants of private provision given by equations (6) and (7). The larger the city, the more likely privatization is. The same is true when the provision of sanitation services is privately made and the city is a tourist attraction. Also, complexity plays a positive role through the type of treatment since the more complex, the more likely private management is. Those results are consistent with past studies showing that price differences between public and private management of water services is greatly driven by the fact that privatizations occur when services are complex to provide (See Chong et al. (2015)).

The core results of this paper are given in table 6. Column (7) displays the determinants of remunicipalization. First, the positive and significant value for $Overprice$ shows that cities paying more under private regime that what they would have had under a public one are more likely to remunicipalize. In addition, this effect is greater with the size of the city. Interestingly, there is no effect from the variable $Overleak$ or any other interaction of it with the population variable. This means that reducing leak is not an objective of remunicipalization. These results make sense when looking at table 4, where we observe that cities with in-house provision of water services tend to be less efficient in terms of leak ratio. Therefore, we can conclude that municipalities opt for remunicipalization when prices are too high, but do not consider the leak ratio as an important aspect since this ratio is usually more important under public management. Second, complexity appears as a determinant only through the origin of water, since surface water is associated with a negative and significant likelihood, whereas the treatment has no significant effect. Third, the likelihood of remunicipalization decreases with $Share\_Firm$, the share of the price transferred to the firm. The higher this share, the more investments are delegated to the private, the more competencies are lost by the city increasing the difficulty to revert back in public management. We note also that private management of sanitation services reduces the likelihood

[1] Endogenous switching models can be estimated one equation at a time either by maximum likelihood (ML) or two-step least square (2SLS). However, as Lokshin and Sajaia [2004] note, both of these estimation methods are inefficient and require adjustments to get consistency of the standard errors. To face this problem , we use the full information maximum likelihood method (FIML) implemented by the Stata command, movestay. Therefore, we simultaneously estimate binary and continuous parts of the model in order to yield consistent standard errors. For that we have to assume joint normality of the error terms in the binary and continuous equations. More information available at http://www.stata-journal.com/sjpdf.html?articlenum=st0071.

Table 5: Endogenous switching regression for private provision

	PRICE			LEAK		
	(1)	(2)	(3)	(4)	(5)	(6)
	Selection	**Equation (6)** ***PRIVATE =0***	**Equation (6)** ***PRIVATE =1***	**Selection**	**Equation (7)** ***PRIVATE =0***	**Equation (7)** ***PRIVATE =1***
Pop 5K-10K	0.132***	-0.138***	-0.224***	0.0693*	-0.0101*	-0.00681**
Pop>10K	0.175***	-0.198***	-0.330***	0.0382	-0.0341***	-0.0295***
Surface	-0.0314	0.113***	0.218***	-0.0631	0.00590	-0.0223***
Density	6.26e-05	0.000215***	0.000211***	-0.000118	-4.87e-05**	2.79e-05*
Share Firm	7.332***	2.678***	0.103***	6.673***	0.00859	-0.000762
Sanitation	1.368***			1.534***		
Touristic	0.262***	-0.00614	-0.0380***	0.245***	0.0173***	0.00318
Treatment 1	1.169***	0.217***	-0.0378	1.185***	0.0515***	0.0485**
Treatment 2	1.590***	0.333***	0.0374	1.641***	0.0231**	0.0404*
Treatment 3	1.735***	0.313***	-0.0116	1.778***	-0.00542	0.0132
Treatment 4	1.642***	0.408***	0.0474	1.697***	0.00665	0.0156
Treatment 5	1.395***	0.220***	-0.00932	1.436***	0.0332***	0.0306
Unemployment	-0.110***			-0.112***		
Debt	6.82e-06			6.71e-06		
Personnel	-5.99e-05			0.000284***		
Taxes	-0.000320***			-0.000226***		
Left Wing	-0.147***			-0.171***		
Election Year	0.436***			0.362***		
Constant	-1.537***	1.432***	1.790***	-1.650***	0.222***	0.179***
Sigma 0		-0.669***			-1.893***	
		(0.00859)			(0.00756)	
Rho 0		0.711***			0.00855	
		(0.0234)			(0.0301)	
Sigma 1			-0.695***			-2.163***
			(0.00725)			(0.00716)
Rho 1			-0.528***			0.256***
			(0.0206)			(0.0237)
Observations	18,771	18,771	18,771	18,771	18,771	18,771

to remunicipalize suggesting the existence of synergies between services and/or a natural propension of the city to privatize. When looking at the influence of the variables capturing possible mimicking behaviors of the municipalities, we found that there is a positive and significant impact of the number of neighbors with in-house provision of water distribution services as well as the number of remunicipalizations, both of them within a radius of 25km for municipalities with less than 5,000 inhabitants. However, this effect does no longer hold when looking at medium and large municipalities. When focusing at a 50km radius, there is no significant influence from the number of neighbors with in-house provision. This result hold for the impact of remunicipalization, except for large municipalities where the number of neighbors who remunicipalized significantly decrease the likelihood of remunicipalization. Our variables measuring the political dimension of the remunicipalization decision show that cities with a left-wing tendency are more likely to remunicipalize. However, this effect is significantly weaker during an election year. Finally, there is no effect from the macroeconomic variables namely, the unemployment rate, the debt, taxes, and personnel expenses.

Results from column (8) indicates the determinants of privatization. $Overprice$ is associated with a positive probability of privatization, and this effect gets larger with the size of the municipality. The variable $Overleak$ has significant and negative impact for small municipalities. This result probably reflects the lack of knowledge and capabilities that small municipalities may suffer from. However, it $Overleak$ becomes positive and significant when there is more than 5,000 inhabitants. This means that when the leak ratio that would have prevailed under private regime is lower than under an in-house one, cities with more than 5,000 medium and large cities are more likely to switch. $Overleak$ is clearly an important determinant of privatization, even more influential than the extent of $Overprice$, except for small cities. Also, privatization is associated with a positive probability when the sanitation services in privately managed. Complexity plays almost no role in this switching decision since $Surface$ and $Treatment$ have no significant effect. The unemployment rate has a negative and positive coefficient. This result makes sense since privatization is usually associated with downsizing. The amount of local taxes is also negative and significant, pointing out that municipalities with high level of debt are reluctant to provide the service in-house. There is no significant effect from the number of neighbor that privatized their water services in both radius. However, when focusing on privatization, there is a significant and positive effect for small (<5k) municipalities in a radius of 25km only. Finally, a left-wing tendency has no effect over the likelihood of privatization, whereas the timing is relevant since $Election_Year$ is associated with a positive and significant coefficient. Finally, the political color has no significant effect, but being in an election year increases the likelihood of switching to private management.

When comparing the results from column (7) and (8), we observe two major results. First, $Overprice$ has globally more effect for the decision to remunicipalize than to privatize. Second, whereas $Overleak$ is a determinant for privatization in medium and large municipalities, it is not the case for remunicipalization. As said earlier, public management is associated with a greater average leak ratio than private one Other interesting contrasts between determinants of remunicipalization and privatization appear. The origin of water is significant only for remunicipalization, but the treatment does not seem to be an important factor for both types of switch. Macroeconomic variables such as taxes and unemployment are only relevant for privatization. Management of water distribution services in the neighborhood

Table 6: Determinants of remunicipalization and privatization

	Counterfactual Probit	
	(7) Equation 1 Remunicipalization	(8) Equation 8 Privatization
Overprice	1.403***	1.458***
Overprice x Pop 5K-10K	0.975**	0.821**
Overprice x Pop>10K	2.364***	1.723***
Overleak	-0.107	-1.135**
Overleak x Pop 5K-10K	-0.269	3.580***
Overleak x Pop>10K	2.473	7.342***
Pop 5K-10K	-0.279	-0.108
Pop>10K	0.475	-0.352
Surface	-0.455**	0.0996
Density	-0.00180	0.000907
Share Firm	-2.024***	5.980***
Sanitation	-0.527***	1.026***
Touristic	0.275	-0.000622
Treatment 1	0.405	0.0947
Treatement 2	0.748	0.429
Treatment 3	0.309	0.0787
Treatment 4	0.433	0.543
Treatment 5	0.695	0.0551
Unemployment	0.0526	-0.218***
Debt	-0.000148	3.49e-05
Personnel	0.000613	0.000695
Taxes	0.000280	-0.00172***
Neighbor Inhouse 25	0.0327**	
Neighbor Inhouse 25 x Pop 5k-10K	0.0142	
Neighbor Inhouse 25 x Pop >10K	-0.0321	
Neighbor Inhouse 50	0.00593	
Neighbor Inhouse 50 x Pop 5k-10K	0.0189	
Neighbor Inhouse 50 x Pop >10K	0.0326	
Neighbor Remu 25	0.332***	
Neighbor Remu 25 x Pop 5k-10K	-0.0158	
Neighbor Remu 25 x Pop >10K	-0.0680	
Neighbor Remu 50	0.0131	
Neighbor Remu 50 x Pop 5k-10K	-0.0637	
Neighbor Remu 50 x Pop >10K	-0.368*	
Neighbor Private 25		0.00418
Neighbor Private 25 x Pop 5k-10K		0.0213
Neighbor Private 25 x Pop >10K		0.0207
Neighbor Private 50		0.00546
Neighbor Private 50 x Pop 5k-10K		-0.00725
Neighbor Private 50 x Pop >10K		0.0207
Neighbor Privatization 25		0.0755***
Neighbor Privatization 25 x Pop 5k-10K		0.0652
Neighbor Privatization 25 x Pop >10K		0.0692
Neighbor Privatization 50		0.0290
Neighbor Privatization 50 x Pop 5k-10K		-0.0606
Neighbor Privatization 50 x Pop >10K		-0.0849
Left Wing	0.928***	-0.116
Election Year	-0.205	1.142***
Left Wing x Election Year	-0.730**	0.000391
Constant	-2.571***	-1.698***
	1,404	8,687

has an impact over remunicipalization and privatization only for small cities for the former, and both for small and medium for the latest in radius of 25km. Finally, the political wing has a significant impact for remunicipalization only. The impact of an election year works in opposite directions for the two types of switching.

6 Conclusions

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