Analysis of water price determinants in France: cost recovery, competition for the market and operator’s strategy

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Abstract This paper explores the effects of technical factors, competition and strategies of firms on the water price in France. From data on the procedures of delegation of water utilities, we estimate a price equation, taking into account the unobserved strategies of private operators and geographical effects. We show that the local strategy of the operator has a significant impact on the water price level and that neglecting it would lead to bias the effects of other factors.

Keywords Competition; fixed effects; private operator; strategy; water price determinants

Introduction
In France, local authorities (municipalities or groups of municipalities) are responsible for drinking water and wastewater services. The public authority can be directly in charge of operation and investment but also can entrust the service to a private operator. In this last case, there is a delegation procedure ending up in the choice of the operator by the local authority. The signing of a medium or long-term contract marks the commitment on the content of delegation and on the price. There is no central regulation authority to set the rules in management or price setting for the services. The situation of local natural monopoly and direct negotiation between the local community and a private operator implies a large diversity of local water prices in France. This paper raises the issue of these price variations with a restriction to the private-operated services in analysing the competition for the market through the public tendering process.

In the French context, several hypotheses can be tested to explain the water price variations. From different econometric models, we analyse determinants of price taking into account the principle of costs recovery and the initial competition process (public tendering). The competition for the water market is not uniform through the country and the French water Transnational companies (TNCs) may sometimes be challenged by outsiders (local firms). Moreover, the competition process may be biased by the operators’ strategy. First, one can imagine that there exist different pricing and profit strategies among the different operators. In particular, each operator may take advantage of his private information on the technology and his bargaining power in a different way. Second, the organization of water companies is based on different geographical levels of decision implying numerous indirect costs but also a mutualization of costs among some water services. Managing the allocation of costs among the services may be a strategy for the operator at a local level to win a contract for the operation of a new service in a place where it is already established in order to exploit scale economies. Hence, there could be a non-negligible effect of the private operator on the price during the competition process. Third, the technical (local) conditions in operating the water service may directly influence the choice of the management mode and of the private operator. Several studies (Boyer and Garcia, 2004; Carpentier et al., 2004) show that a more complex operation of
water services leads the local authorities to delegate the service to a private operator and also leads to a higher water price.

The rest of this paper is organised as follows. The next section provides a brief description of the French context of water market. Then, we present the different factors supposed to have the largest impact on the water price. Another section presents the data set, defines the main variables of interest and describes the estimated models. Finally, we present our estimation results and offer some concluding remarks.

**French context and water price for the private operator**

The local public authorities, responsible for the service, own the assets and choose a mode of operation among the two main following forms:

- the service is operated by a public operator which has an independent budget (**régie autonome**), but the local authority keeps the control of the service;
- the operation and sometimes part of the investment are delegated to a private company (leasing or concession contract).

In both cases the local authority is responsible for the quality and performance of the water services. However, whereas in the first case the local authority is directly implied in the management, in the second case, it has mainly a role of control. The local authority chooses the operator by way of a public tendering. After a mutual agreement, the two parties sign a delegation contract describing the tasks of the operator and the negotiated tariff to charge the customer. A typical contract is set for 12 years and provides for a binomial tariff. Indeed, in return for the operation of the service at his own risk, the operator is allowed to charge the customer the tariff set in the contract, classically through a fixed fee per bill and a rate (that may be non-linear) making the bill dependent on the water consumption. He also collects the fees intended for the local authorities and pays them back. It is usual to present the “private operator price” either as the unit revenue of the private firm (water sales divided by billed water volume) or as the bill for a standard consumption of 120 m³ per household and per year. We have chosen to consider the unit revenue as the variable of interest, firstly because it better represents the economic situation of the contract, and secondly because it is a notion internationally used.

A striking characteristic of the French water market is the impressive number of local authorities responsible for a service and, at the same time, the no less impressive concentration of private operators. Only three main companies (Veolia — formerly Générale des Eaux, Suez — formerly Lyonnaise des Eaux and SAUR) and a limited number of smaller local firms are facing more than 30,000 local authorities. This oligopolistic situation creates some difficulties to organise the competition. In this context, the lawmakers have set up a legal system designed to regulate public service delegation. In particular, the so-called Sapin law (January 29th, 1993) is one of the most important in this regulatory framework. The aim of the Sapin law is to prevent corruption and to achieve transparency of public procedures. The law defines a specific procedure consisting of following up the fulfilment of delegation contracts so that no agreement may be accomplished without preliminary notice and competitive procedure. Because of the characteristics of the water market in France, it is often the case that bidders include the incumbent operator. It has long been observed that the auctions do not seem to create much competition: in up to 27% of such auctions, there is a unique bidder; only 13% of auctions result in a change of the operating firm (**GEA-ENGREF, 2005**). This gives a strong argument for the inefficiency, on the marginal cost basis, of the price setting process. Given this situation, one central and recurrent question is the following: what can explain the price charged by the operator? Some determinants can be assumed a priori. In this paper, we try to identify them and to test their relevance with a statistical approach.
Determinants of the operator water price

We try to identify what could be potential determinants of the price. It is possible to anticipate at least three categories of factors:

- the determinants linked to the level of cost;
- the determinants linked to the competition for the market;
- the determinants linked to the operator strategy.

Determinants linked to the level of cost

The implicit assumption behind the costs determinism is that the level of revenue (i.e. the water volume sold at a fixed price) has to cover the costs borne by the operator. However, the problem of asymmetric information on costs is predominant in water contracts (Garcia and Thomas, 2003). The pertinence of financial documents provided by the private operators to the local authority is subject to discussion regarding their relation to the true costs (Guérin-Schneider and Nakhla, 2000). Nevertheless, to overcome this obstacle, it is usual to assume that the costs are directly dependent on the technical complexity of the service and on the main tasks delegated to the operator. The more complex the service and the larger the list of tasks (correlated with the duration of contract) are, the higher the costs. We try to capture the complexity of the service in a limited number of technical indicators. Table 1 illustrates the link between indicators and technical complexity.

Determinants linked to the competition for the market

It is trivial to assume that the level of price is decreasing with the level of competition. To test this assumption in the water industry, we can consider information such as number of bidders during the public tender or presence of an outsider. In practice, these two factors are closely linked (the number of bidders is usually higher when one or more outsiders take part in it). That is why in the next sections we consider only one of them (presence of an outsider).

Limits of the previous determinants

Our experience in the water field leads to strongly discuss the real impact of the determinant linked to the technical complexity and to the competition. First, the allocation of cost for the management of utilities for one particular local authority is not so easy to follow up. Indeed French companies have a geographic organization that is largely independent of the scale of the local authorities and their infrastructures. They have a pyramidal organization with different geographic levels: head office, regional direction, operational

Table 1 Technical indicators supposed to influence the level of private operator water price

<table>
<thead>
<tr>
<th>Activity</th>
<th>Technical indicators</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water production</td>
<td>Authorised consumption per connection</td>
<td>Scale effects</td>
</tr>
<tr>
<td></td>
<td>Percentage of water imported in the supplied water</td>
<td>Origin of water (self production or importation)</td>
</tr>
<tr>
<td>Treatment</td>
<td>Type of treatment (three categories according to a French standard classification)</td>
<td>Complexity of the treatment is more directly connected to costs than the origin of water (e.g. surface, ground waters)</td>
</tr>
<tr>
<td>Water distribution</td>
<td>Length of the network</td>
<td>Size of the service</td>
</tr>
<tr>
<td></td>
<td>Service connection density</td>
<td>Rural or urban area</td>
</tr>
<tr>
<td>Customer service, billing</td>
<td>Apparent losses per km of network</td>
<td>Network quality, maintenance effort</td>
</tr>
<tr>
<td></td>
<td>Number of connections</td>
<td>Size of the service</td>
</tr>
</tbody>
</table>
centre, and local agency. As a consequence, at the local level, the percentage of indirect
costs inherited from the upper level is very high. It means that the cost applied one ser-
vice is dependent on all the other services operated by the same company. The mutualiza-
tion of costs can be considered as positive because it may contribute to limit the financial
risk on one particular service. However, it makes the cost analysis less transparent from
the point of view of the local authority. Second, there are important limitations on com-
petition for the market (Williamson, 1976). The situation of natural monopoly gives a
strong advantage to the incumbent operator (in France, 90% of delegation procedures end
up with the operator previously in place). The oligopoly restricts the potential compe-
tition. Finally, because the delegation procedure is based on a direct negotiation between
the mayor and the operator, the choice of the “better price” is not the only criterion. The
confidence in the operator and the criteria of the “best offer” (price and quality) also
interfere (Brunet et al., 2003).

Determinants linked to the private operator
Because of particular context and objectives, the private operator negotiating with the
local authority can propose a price deviating from what should result from technical and
competition constraints seen above. For instance, if the operator wants to enter the mar-
ket, he will propose a lower price. Setting a low price is possible for big companies
because of high level of costs mutualization. Indeed, it makes possible the adjustment of
weights of indirect costs allocated to one particular contract. In this case, the marginal
cost of one service is taken into account to set the price rather than the marginal cost of
production in the service. Another type of operators, the outsider (local) firms, has very
few overhead costs compared with those of big companies (no national direction, no
research centre). They can also propose lower prices. To check these assumptions, we
deide to consider two additional factors: the operator (the parent company) awarded by
the concession and the department (that is one of the 95 main administrative divisions of
France). We consider that the variable “parent company” can convey the strategy of the
water company depending on its organization (national, medium size or local company). On
the other hand, the department conveys local conditions (i.e. environmental variables)
omitted in taking into account a restricted set of technical factors. Moreover, some mar-
ket conditions can influence the strategy of the operator. For instance, the implantation
on the local market can attract the company to exploit scale economies. The personal
strategy and the experience of the person in charge of negotiating with the local auth-
orities in the department can also have a significant impact on the water price.

Materials and methods
Data
Our study is based on a data set of procedures of delegation of water utilities to a private
operator made by the local authorities. Since 1998, the laboratory GEA compiles every
year the majority of calls for tender publicised either by the French consulting services
for water and sanitation or directly by the local authorities. They are then asked to answer
a questionnaire in order to get information about the (economic and technical) state of
service before and after the tendering. Our sample contains 371 drinking water services
delegated (by way of lease contract) to private operators between 1998 and 2003, spread
over 71 departments.

The endogenous variable PRICE is computed as the revenue perceived by the private
operator divided by the consumed water volume the first year of the contract. One limit
of our database is that we have only two variables (CONS and CONNECT) to capture
the great complexity of the drinking water technology and to proxy the level of cost.
Before selecting these two variables, we tried different models to obtain the best explanation of price variation from another more complete data set (but unfortunately, this data set does not contain information on competition and contract matters). A larger range of exogenous variables (the two ones used here, but also the length of network, the linear losses index, imported water volumes, and the type of treatment used to produce drinking water, as mentioned in the previous section) was available. We showed that the two variables CONS and CONNECT are the most significant and finally essential cost determinants. We have used them in the actual empirical analysis. We also consider the duration of the current contract (DURATION) to take into account some additional cost effects (as mentioned above the duration is positively correlated with the private investment). Moreover, a longer contract may be synonym of a lower competitive pressure. In order to proxy the competition facts, we also include a dummy variable denoted by OUTSIDER equal to one if a small local firm takes part in the competitive bidding. Finally, we construct dummy variables to measure the impact of different operators. D1 is equal to one when an outsider firm is awarded the water contract. The other dummies from D2 to D7 represent other water companies. Table 2 presents descriptive statistics for the different variables used in the regression models. Concerning the dummy variables from D1 to D7, the proportions are respectively 6.47%, 28.57%, 6.47%, 7.55%, 15.63%, 21.56%, and 13.75%.

Methodology

We observe water services operated by private companies in different French departments. Consequently, the more general regression model can be written as follows:

\[ y_{ijk} = \alpha + \beta X_{ijk} + u_{ijk} \]  

with:

\[ u_{ijk} = \mu_i + \gamma_j + \lambda_k + \varepsilon_{ijk} \]  

where,

- \( i \): indices water services,
- \( j \): indices French departments and
- \( k \): indices private operators.

So, \( y_{ijk} \) is the price of water service \( i \) operated by the private firm \( k \) and located in the department \( j \). \( X_{ijk} \) is a vector of service characteristics that also includes competition and contract variables. \( \mu_i \) are service specific effects, \( \gamma_j \) are department effects, \( \lambda_k \) are operator effects and \( \varepsilon_{ijk} \) is a classical error term. \( \alpha \) and \( \beta \) are the parameters to estimate.

Each water service is observed one time since we have only cross-sections data. However, the heterogeneity in data is captured by the way we take into account that different operators manage the communal services at the department level. In order to simplify the computation methods, we only consider the effects specific to departments (\( \gamma_j \)) but we include operator dummies (\( D \)) to control for factors specific to private operators. Indeed,

<table>
<thead>
<tr>
<th>Variables</th>
<th>Units</th>
<th>Mean</th>
<th>Std dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRICE</td>
<td>€</td>
<td>0.82</td>
<td>0.35</td>
<td>0.19</td>
<td>2.91</td>
</tr>
<tr>
<td>CONS</td>
<td>m³</td>
<td>142.72</td>
<td>60.11</td>
<td>41.14</td>
<td>614.20</td>
</tr>
<tr>
<td>CONNECT</td>
<td></td>
<td>2,310</td>
<td>4,063</td>
<td>53</td>
<td>37,500</td>
</tr>
<tr>
<td>OUTSIDER</td>
<td></td>
<td>0.3235</td>
<td>0.4684</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>DURATION</td>
<td>yr</td>
<td>11.43</td>
<td>2.53</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>
it is common to treat the larger set of observations as fixed effects and the smaller set as an ordinary set of dummy variables. Hence, we employ a one-way fixed effects model to control for unobserved department-specific effects and operator-specific effects. In short, we estimate the following price regression:

\[ y_{ij} = \alpha + \beta x_{ij} + \delta D + \gamma + \epsilon_{ij} \]  

(3)

There is an important point worth stressing about the estimation method applied on the equation (3). Equation (3) includes department fixed effects. The method used is not driven by average differences across individuals over time as usual in panel data models (Baltagi, 1995). Instead, our estimation consists of identifying within-department variation over different observed services. In this case, \( \gamma \) are assumed to be fixed parameters to be estimated and the remainder disturbances stochastic with \( \epsilon_{ij} \) IID(0, \( \sigma^2_{1} \)). The right-hand side variables are assumed independent of the \( \epsilon_{ij} \) for all \( i \) and \( j \). However, some regressors (such as CONS) may be correlated with the fixed term. This problem disappears as the fixed term vanishes after the within transformation.

We compare three models to evaluate the impact of different factors. First, the regression equation is simply estimated using the OLS method excluding department and operator specific effects (Model 1). The objective here is to isolate the effects of technical factors and other variables specific to the service from the possible strategies of private operators at a department level. Second, the same model is estimated but we add the operator dummies as explanatory variables (Model 2). And third, we run a fixed-effects model from the equation (3) to fully take into account the strategies of water companies but also the unobserved heterogeneity related to the local area (Model 3). The difference in estimation between the last two regressions allows to test the presence of department specific effects.

**Results and discussion**

We take logs of the explained variable PRICE as well as the technical variables (CONS and CONNECT). By doing this, we reduce the possible scale and multicollinearity problems. Moreover, it is possible to directly interpret coefficients as elasticities. Competition issues are often raised in the public utility regulation. The outsider firms are often supposed to be cheaper. They could lead to a stronger competition through aggressive territorial strategy, breaking the usual oligopoly for the water market. Their presence in the public tendering is strongly correlated to the “competition feeling” of the local authorities. We focus our attention on these competitors to check whether this new deal leads to significant price decreases in new water contracts. Results for different models are given in Table 3.

A first step consists of identifying the effects of determinants linked to the level of cost (CONS and CONNECT) on the price of water services. The first column shows estimated parameters and standard errors for the model 1 without operator dummies or department effects. We observe significant density and scale effects from estimates respectively associated to the variables CONS and CONNECT. For example, a one percent rise in the unit consumption decreases the price by about 0.46%, and a one percent increase in the number of connections implies a decrease of 0.06% in prices. Moreover, an outsider firm among the bidders (whatever the final choice of the operator by the local authority) seems to increase the competition since the estimate is significantly negative. A longer contract implies a water service more expensive because the cost of concessive works that are sometimes entrusted to the operator are allocated over time.

Model 2 includes the operator dummies and the associated results are shown in the second pair of columns. As said above, we dropped the dummy D1 (“outsider awarded”)

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to avoid dummy trap. Hence, the sign of coefficients associated to other dummies can be interpreted as an increase or decrease with respect to the outsiders. It is interesting to notice that all the estimates are positive and the ones associated to dummies D5, D6 and D7 are significant, indicating that operators propose higher prices than outsiders. Moreover, our estimates are similar but the coefficient associated to OUTSIDER is not significant anymore. This result means that the participation of an outsider firm in the bidding does not automatically imply an increasing competition resulting in a decreasing price. The local firm may propose the lowest bid but the local community may not consider this firm as credible to bear high commercial and technical risks. Another reason often given by the municipalities is that these small firms could not provide a sufficient quality of service in regard to their low price. Moreover, the credibility of the outsider will be more important if it is well established locally.

The results for Model 3 with fixed department effects are shown in the last columns. First, the goodness of fit (adjusted $R^2 = 0.455$) is increasing by taking into account operator effects and fixed department effects. Moreover, we check that the model with fixed effects is accurate in testing the joint significance of these effects by performing an $F$-test. This is a simple Chow test comparing the residual sum of squares of OLS regression and fixed-effects regression. The Fisher statistic is equal to 3.14 whereas the critical value is $F_{71,289} = 1.31$. We can reject the hypothesis of nullity of fixed effects and conclude that the model 3 is the best specification among the three. The estimation results tend to show that omitting the fixed effects led to bias the estimates of explanatory variables because the department effects can capture unobserved relevant local area variables including technical local factors but also operator strategies. Indeed, the coefficient associated to CONS is higher (in absolute value) by 10%. The impact of the number of connections on the water price is divided by two. The presence of an outsider among the bidders now makes the price higher but this effect is not significant. Finally, the impact of private operators is lower (except for D3) and significant only for one firm (D7) even if the coefficients associated to D5 and D6 are well estimated.

Taking into account the department-specific effects allows to capture different local factors and so to soften the positive impact of the nature of operators on the water price. First, these effects can be related to local technical constraints, for instance the quality

### Table 3: Estimation results

<table>
<thead>
<tr>
<th></th>
<th>Model 1 OLS estimation</th>
<th>Model 2 OLS estimation (with operators' effects)</th>
<th>Model 3 Fixed effects estimation (revealing operators' strategy)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Std error</td>
<td>Estimate</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>2.1453***</td>
<td>0.2832</td>
<td>2.1009***</td>
</tr>
<tr>
<td>CONS</td>
<td>-0.4572***</td>
<td>0.0561</td>
<td>-0.4654***</td>
</tr>
<tr>
<td>CONNECT</td>
<td>-0.0588***</td>
<td>0.0147</td>
<td>-0.0614***</td>
</tr>
<tr>
<td>OUTSIDER</td>
<td>-0.0815**</td>
<td>0.0383</td>
<td>-0.0484</td>
</tr>
<tr>
<td>DURATION</td>
<td>0.0222***</td>
<td>0.0070</td>
<td>0.0195***</td>
</tr>
<tr>
<td></td>
<td>0.1071</td>
<td>0.0795</td>
<td>0.0177**</td>
</tr>
<tr>
<td></td>
<td>0.0263</td>
<td>0.0987</td>
<td>0.0838</td>
</tr>
<tr>
<td></td>
<td>0.1200</td>
<td>0.0954</td>
<td>0.0818</td>
</tr>
<tr>
<td></td>
<td>0.1416*</td>
<td>0.0838</td>
<td>0.1061</td>
</tr>
<tr>
<td></td>
<td>0.1561*</td>
<td>0.0819</td>
<td>0.0893</td>
</tr>
<tr>
<td></td>
<td>0.1848**</td>
<td>0.0860</td>
<td>0.1568**</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.226</td>
<td>0.228</td>
<td>0.455</td>
</tr>
</tbody>
</table>

Total number of observations = 371, number of departments = 71, number of operators = 7

***: significant at 1%, **: significant at 5%, *: significant at 10%
of water resources (e.g. farming pollution in Western area in France greatly affects groundwater), higher costs of water pressurization in hilly regions, or cost differences depending on the density of users (rural versus urban areas). Second, this geographical effect may measure response of operators to local environment that acts as a benchmarking process. In particular, the existence of an outsider potentially threatening for the TNCs, the concentration effects of the nearby régies or, instead, the concentration of delegated contracts may locally influence the bid strategies of TNCs. Indeed, it has been shown that if the régie is the organisational arrangement most widespread in a French department, a delegated management in the same department will be cheaper, everything else remaining the same (Carpentier et al., 2004). Third, it is now well recognised that the advice of public or private consultants organised at the department level allows to diminish the imbalance between the local community and the operator during the negotiation of contract acting upon the level of price.

Conclusions
The model of delegation of water services is spreading in numerous countries but is particularly developed in France. When the service is delegated, the price is negotiated between the local authority and the private operator. In this paper, we show that if the importance of the technical complexity and the list of the delegated tasks cannot be denied, it is rather less important that it is usually argued. Even if in most cases the negotiation between the local authority and the operators explicitly mention to justify the price on the basis of cost consideration, the implication of asymmetric information (and price strategies of private operators) is clearly highlighted. We also stress that the notion of “operation cost of a local service” is not so easy to define, considering the French market concentration and the existence of TNCs with offices shared out in different geographical levels. Under these conditions, the allocation of the overhead costs makes the local price estimation biased with respect to the cost of service. Moreover, the effect of competition factors such as the presence of an outsider in the bid process (correlated with the number of bidders) on the price is not clear. It confirms that the competition process is not easy to analyse. In numerous cases the competition process and the sole criteria of best price do not work. It can occur when there are few bidders (in France, for one third of the procedures there is only one bidder). It can also occur when the criterion of the best bid (on the basis of quality and price) is retained by the local authority rather than better price. Moreover, the problems of capture of local authority or collusion between operators cannot be rejected in the context of asymmetric information. Finally, we tried to evaluate the importance of the unobserved local factors by considering a department-specific effect. In particular, this effect can reflect some omitted technical local factors. Moreover, measuring the combined effects of the nature of the private (small, medium or national size) company and the department-specific effect gives us some indications on the local strategy of the private operator. The estimation results seem to indicate that this strategy may influence the price level in addition to technical and competition factors taken into account in our model. In some cases, the operator will propose a bid above the cost of service, for instance if the neighbouring services are expensive or if the delegated contracts are the majority. If in a given department the régie is the dominant organisational arrangement of water services, the prices fixed by the operators will be lower.

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