Public-Private Partnerships and the Life Cycle of Contracts: the Case of Water Industries in France

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Abstract

As the end of the contract approaches, incumbents could have an incentive to decrease prices or to increase the quality of the network in order to get the renewal of the contract. Performance of the service, measured as the quality of the network should thus have a growing negative marginal impact on prices. Distance to the renewal of the contract can be measured by the time to the end in years or by the distance to the end as a percentage of the life-cycle of the contract. It is thus important to control for different contract duration, as their life-cycle differs. The sample consists in 5000 public authorities for the French water services over 1998, 2001 and 2004. Results show two main evidences. Firstly, the marginal impact of quality on prices is increasingly negative when the contract gets closer to the end. Secondly, duration has a positive impact on prices. For a given performance, contracts signed 80 years ago have usually higher prices than contracts signed more recently. These results thus confirm that duration has a positive impact on prices and that prices respond to a reputational effect in the end of the contract.

Classification JEL: D23-L51-L95
Key words: Public-private partnerships, Water industries, Local public services, Contracts.

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1 Introduction

In France, the price of the production of water in public services is a thorny issue. In 2009, the socialist city of Paris went back to direct management "to give back the water services to the Parisians"[1]. More recently, the inter-authority of Toulouse negotiated a 25% decrease in its production price. According to BIPE, a consultancy, prices of water have decreased by 5 to 9% over 2009 and the stock of contracts to be renewed every year for 2009-2015 will be on average 1.5 times higher than the number of contracts renewed between 1998 and 2006. In the French case, lower contract duration and prospects of future renewals can induce the agent to lower prices when the end of the contract approaches.

Empirical evidence suggests that the incentive power of contract renewal leads to lower prices in the end of the contract. Using a panel of 25 franchisees providing passenger services in the UK railway industry in the period 1997-2000, Affuso and Newbery (2002) found for example that non-verifiable investment by the contractors increased as the contract renewal date became nearer. In the water industry, Chong, Huet and Saussier (2006) studied 1102 French local public authorities in 2001 and found that operators reduced customer prices as expiry date approached. Increased performance over contract life, in the form of reduced cost, is also found by Gautier and Yvrande-Billon (2008) in a sample of 124 French urban public transport networks operating between 1995 and 2002. This is intuitively justified. As memory of the principal is limited, performance is expected to improve at the end of the contract.

Observed decreasing prices can be explained by a stronger competition due to the life cycle of the contracts. Even if the number of bidders remains low (Guerin-Shneider and Lorrain, 2003) and the sector geographically concentrated (Huet, Plunkett, Saussier, 2006), competition has increased for two main reasons: first, the contract duration is now limited in time; secondly, it is partly a consequence of the first reason, most of the contracts are at the end of their life cycle. A given effort by the agent should result in lower prices when we get closer to the end of the contract.

In this paper, we empirically investigate the impact on prices of the quality of the network through the life cycle of the contract, and whether shorter duration has a negative impact on prices. To the best of our knowledge, there are no empirical studies that take into account the impact of quality on prices through the life cycle of the contract. we find that a given quality of the network has a significant negative decreasing impact on prices ceteris paribus. Furthermore, the duration of contracts does matter to explain current prices. Especially, contracts signed a long-time ago are characterized by higher prices, revealing thus a fixed-price effect, i.e. longer contracts are characterized by more stable prices. Findings are robust to different econometric methods. Starting from this observation, we consider an econometric model that assesses the impact of duration and contract life on prices. We use a sample of variables of the performance of the water network in 5,000 French municipalities for three years - 1998, 2001 and 2004. Our dependent variable is the price of the water and our interest variables are the quality of the network, a proxy

[1]These are the words of Anne Le Strat, delegated of the water services at the Paris municipality

for the effort, and the life cycle of the contract. We expect quality of the network, measured by the leak ratio, to have a stronger marginal impact on prices at the end of the contract. The prospect of the renewal is an incentive to cut prices for a given level of quality anything else being equal.

The agenda of the paper is the following. A literature review on the subject is done in section 2 while section 3 gives a quick overview of the public-private partnerships (PPP) in the French water services. Section 4 presents empirical strategy and the problems related to estimations and section 5 introduces the data used in the empirical analysis. Section 6 presents the results of the baseline model. A brief conclusion follows.

2 Literature review

Whether operators give different level of effort through the life cycle of the contract and whether it impacts prices is an open question. On the one hand, Baldwin and Cave (1999) consider that long-term contracts mean higher investments in the beginning of the contract, which could justify higher prices, and then decreasing investments as we get closer to the end of the contract. As investments take time to be fruitful, operators would invest early in the contract. This is in line with the career-concern theorists such as Holmstrom (1982) and Lewis (1986) who shows that reputational concerns lead firms to choose higher effort in earlier stage of their procurement contract in order to send favorable signals to the principal regarding their productivity and avoid that project be terminated too soon. Effort decreases over time.

On the other hand, as first discussed by Kim (1998) in a repeated-game model with moral hazard, effort may be induced by the presence of an implicit agreement between the principal and the agent. The choice of the agent is twofold. He can exert nonverifiable effort when the prospect of a long-term gain from contract renewal is greater than the one-shot saving on the cost of effort. Or, the principal renews the contract with a well-performing agent when the value of future cooperation is greater than the one-shot gain from reneging on the promised rent. However, relational contracting does not explain why contract renewal should make the agent work harder as renewal date approaches. If the principal observes a deviation from the implicit agreement, she should retaliate and not renew the contract regardless of when the deviation was observed. The agent must then exert the same amount of effort in every and each period for the relational contract to be sustained. Relational contracting works only with bounded rationality and short memory of the principal.

But technology could explain why the principal is keen on choosing an operator that performed well in the last periods. Indeed, technology becomes obsolete and recent performance is more informative about the agent's future performance prospects than its performance in the beginning of the contract (Iossa and Rey, 2009).

A second question we address in the paper is how the duration of contracts can impact prices. We then endogenize the duration of contracts to explain its effect on prices. We thus run a generalized method of moments (GMM) regression to check whether the impact of quality on prices remains the same when the duration is instrumented.

A limited number of papers focus on the impact on prices of long-term contracts. On the one hand, long-term contracts can have a negative impact on prices, especially if recontracting costs are high. Moreover, long-term contracts secure parties against a "hold-up" of relationship-specific investments (Williamson, 1975, 1983 and 1985; Grout, 1984) especially if complexity is low and the institutional environment certain. Incentives to invest are positively correlated to the duration of the contract (Laffont and Tirole, 1993).

On the other hand, long-term contracts can be costly. For transaction cost theorists, long-term contracts can cause inflexibility and lead to ex post adaptation failure. Uncertainty and complexity increase the importance of ongoing adaptations and thus raise the risk that contracts motivate undesirable investments: long-term contracts may obstruct "beneficial market forces" (Ellman, 2006). Secondly, long-term contracts are barriers to competition. Goldberg and Erickson (1987) insist on the fact that long-term contracts are highly rewarding winners and penalizing losers. Long-term contracts imply weak ex ante competition as the incumbent has always an advantage at the renewal of the contract (Williamson, 1976).

Joskow (1988) studied empirically the dependency between contract prices and duration of the contract negotiated at the time it is executed. According to the author, contract prices and duration should be independent, i.e. the coefficient of duration nearly equals 0, as both parties are likely to structure price-adjustment provisions to guard against "opportunism", "hold-up", and a breach of the contractual promises and to provide enough flexibility to facilitate adaptations to changing market conditions. The link between prices and duration reveals that the fixed-price effect was higher in contract signed a long-time ago.

This paper adds to the literature that we examine how a given quality impacts prices through the life cycle of the contracts and if duration has a strong fixed-effect on prices.

3 The use of PPP for the distribution of water in France

3.1 The case of water supply by private firms in France: an overview

In France, municipalities must provide local public services that have public good characteristics. As there is no national regulator for these services, local public authorities define the general principles governing the water provision. They monitor prices, control entry and exit of firms into the market, organize competition and ensure uninterrupted service.

There are several types of management for the local public services. *Direct public management* implies that the public authority undertake all operations and investments needed for the provision of the service. Alternatively, the local public authority may choose to involve an outside firm in the operation of the service choosing a *gerance contract* 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.

Between gerance contracts and privatization, *delegated management* contracts means higher risks and investments for the operators. *Lease* contracts are characterized by investments to maintain the network and a financial compensation directly through customer receipts. Finally, under a *concession contract*, the external operator 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 they give operators incentives to reduce costs, and operators share risk in exchange for greater decision rights and claims on revenues. In France, each local public authority may choose a particular contractual form from the differentiated set of alternatives.

3.2 The institutional framework of PPP in water public services in France

In the French case, the local public authority's organizational choice is embedded in an institutional framework that gives it greater powers than its private partners through the *intuitupersonae* principle and the rules of administrative contracts. These rules may mitigate contracting problems both in selecting a partner and enforcing the contract.

Since the "Sapin law" (1993), 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 that is open to all interested operators. Second, there is a phase of negotiation between the public authority and potential entrants that it shortlists. At the end of the negotiation, the public authority chooses its final partner for the duration of the contract.

In France, contracts signed between local authorities and private operators are considered to be administrative contracts. Such contracts give public local authorities asymmetric ability to change the terms of contracts and constrain the ability of private operators to renegotiate prices by more than 5%. Moreover, opportunistic behavior by operators who reduce quality after having signed a contract is constrained by the existence of precise definitions of quality: European water distribution norms specify more than 60 verifiable quality parameters that are monitored by public agencies.

Finally, the life cycle of the contracts has been modified by recent institutional changes. The "‘Barnier Law"’ (1995) limits the duration of contract to 20 years while a judgement of the Conseil d'Etat (Commune d'Olivet, 2009), the highest administrative court in France, decided that all contracts must be renewed before 2015.

3.3 Quality of the network, distance to the end of the contract and duration

The quality of the network has a negative impact on prices. Indeed, as noticed Martimort and Sand-Zantmann (2004), good quality networks need less investments and less management skills to provide water. When the time to the end of the contract decreases, a reputational effect occurs if, for a given quality, prices decrease. We argue that reputational effects are mainly price effects. Indeed, if quality matters, prices seem to be even more important as they can impact the political agenda. For the customers/voters, prices are the most important signal of the efficiency of the service. For a given level of quality, operators choose to lower the variable part of the price that remunerates their management effort.

In France, the duration of the water contracts with a private entity is a fancy debate. Since the "Barnier law" (1995), water contracts are limited to a maximum duration of 20 years. Recently, the Conseil d'Etat (judgment Commune d'Olivet, April 8th, 2009) decided that all water contracts signed before 1995 should automatically end in 2015, except for contracts implying high stocks of investments (it will be decided case by case). However, whether duration impact prices is an open question.

We can consider duration of contracts as being an indicator for competition. Indeed, contracts signed decades ago were probably signed in a less competitive framework. Even contracts renewed a few decades ago could hide much longer-term cooperation between a municipality and an operator. For all these reasons, we could expect prices to be higher in long-term contracts. To measure this impact, we ran several regressions. First, a linear regression shows that lower duration is associated to lower prices. We then ran locally weighted scatterplot smoothing (Lowess) and local polynomial regressions to have a smoother representation of the link between duration and prices. The latter fittings show also a strong impact of the length of the contracts on prices. However, there is a sample effect due to the fact that longer contracts are all signed before 1995. This is taken into account in our empirical model.

4 Empirical strategy

4.1 Econometric issues

Our empirical approach follows the literature on PPP and contracts which emphasizes the importance of several variables to explain prices. We first run OLS models and then run GMM models to endogenize the duration of contracts. Our OLS regressions focus on the impact of quality, the distance to the end of the contract and duration on prices. Our main OLS model can be approached by the following model:

$$Price_{ij} = \beta_1 Duration_{ij} + \gamma_1 Distance_{ij} + \gamma_2 Quality_{ij} + \gamma_3 Distance_{ij} * Quality_{ij} + \gamma_4 Z_{ij} + \mu_{ij} \quad (1)$$

Where i indexes the municipality, j the year and $Distance_{ij}$ is the distance to the end of the contract for a municipality i at the time j and Z_{ij} is a vector of variables. The duration of contracts should have a positive impact on prices. On the one hand, long-term contracts may be the result of a high market power of the operators. On the other hand, duration itself strongly depends on the institutional environment in which the contract is signed. In the latter case, a strong fixed-price effect could explain a significant positive coefficient for the duration of contracts.

Moreover, we want to show that the quality of the service has a negative increasing marginal impact on prices when distance to the end of the contract decreases. We focus on quality as it is a moving variable on the contrary of other structural variables such as the population, the area or the origin of the water. We thus consider quality, distance to the end of the contract and their interaction in our model. We expect the coefficient of quality to negative and the coefficient of the distance to the end of the contract to be positive. The coefficient of their interaction should be positive as we expect the life cycle to have an important impact on prices, i.e. the farer we are from the end of the contract, the higher are prices. Our tables of regression will be followed for all regressions on prices of a computed marginal effect of quality on prices and its significance at the mean values of quality and at different point of the life cycle of the contract.

Our second issue is to properly assess the impact of the duration of the contracts on the prices. We test the empirical validity that longer contracts lead to higher price, i.e. longer contracts means higher market power, or longer contracts have a higher fixed-price effect. The following empirical model thus takes the form of a two-stage instrumental variables specification, where we are interested in the estimated relationship in both stages.

The two equations given in (2), describe the general relationship between the extent of duration and prices of water:

$$Duration_{ij} = f(X_{ij}) \tag{2}$$

$$Price_{ij} = g(Duration_{ij}, Z_{ij}) \tag{3}$$

where X_{ij} and Z_{ij} are vectors of factors influencing these relationships. We begin by examining the relationship between duration of contracts and the institutional environment in which they are signed given by:

$$Duration_{ij} = \alpha_1 Institution_{ij} + \alpha_2 Sanitation_{ij} + \epsilon_{ij} \tag{4}$$

where the duration of contracts depends on the institutional environment at the signature and the sanitation type of contract (private or public). The parameters of interest are the coefficients on the institutional environment of the signature of the contract. The inclusion of the management type in the sanitation of water in (2) helps us control for the link between the two contracts - water production and water sanitation - as they are often held by the same operator.

Equation (3) is used as the first-stage reduced-form in an instrumental variables estimation of the second-stage equation which characterizes the relationship between prices of water, the life cycle of the contract and duration. We then run alternative models including other controls, such as the share of the price that goes to the firm and the management type retained in the contract, to assess the robustness of our model.

4.2 Tests for consistency, relevance and heteroskedasticity

I run GMM regressions to correct for heteroskedasticity. This procedure is consistent and efficient estimates if the model is overidentified and the sample size is large enough (Ferson and Foerster, 1994).

For all our estimations, we reported Hansen's J-Statistic (Hansen, 1982) for overidentifying restrictions to check that the instruments are not correlated with mu_{ij}, the error term of the structural equation. We also verified that all instruments were exogenous by running for each of them the difference-in-Sargan statistic (Hayashi, 2000), i.e. the difference between two Hansen J-Statistics to test the exogeneity of one or more instruments by relying on one other or several other instruments assumed to be exogenous (Baum, Schaffer and Stillman, 2003). Our model is consistent. We also assess the relevance of the model. The First-stage F-statistic (Staiger and Stock, 1997; Stock and al., 2002; Stock and Yogo, 2004) is reported for all IV regressions. The threshold of 10% maximal relative bias provided by Stock and Yogo (2004) is always exceeded by the First-stage F-statistic and thus satisfies the relevance condition.

To conclude on the robustness of the GMM method, we finally run Moreira's conditional likelihood ratio (Moreira, 2003). Moreira's CLR gives critical value functions for the Wald and likelihood ratio tests, which leads to correct rejection probabilities independent of how weak the instruments are. These Wald and likelihood ratio tests give confidence regions that are reliable regardless of the strength of the instruments (Andrews and al., 2006, 2007, 2008). Confidence regions and their p-values are reported in the tables.

5 Data

There are several studies which try to explain the price of water distribution in France. Some are descriptive studies (Cour des Comptes, 1997, 2003), other test the impact of organizational choices (Chong, Huet, Saussier, 2006) or the impact of ex ante and ex post competition (Chong, Huet, Saussier, Steiner, 2007) on prices. To the best of our knowledge, there are no studies that attempt to assess the impact of duration on prices using IV methods and focusing on the impact of quality during the life of the contract.

We developed a unique dataset by combining data from the French Environment Institute (IFEN), the French Health Ministry (DGS) and the National Statistics Institute (INSEE) on 5000 local public authorities in 1998, 2001 and 2004. 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 the larger local authorities - with more than 5000 inhabitants - are all represented. As we take into account the duration of contracts as a variable of interest, we can only consider local public authorities with private management. Because of missing data, the sample goes down to 6120 observations and to 4446 and 4432 observations when we use alternative models. The unit of observation is a municipality.

5.1 Prices of water

The dependent variable is the Price of water in a local public authority for a yearly consumption of 120 cubic meters. The price measure is the amount that consumers pay, including national subscription fee but net of local and national taxes. As the IFEN database just gives us prices, we deflated prices between 1998, 2001 and 2004 to smooth the evolutions of nominal prices.

5.2 The duration and the life cycle of contracts

The IFEN database provides us with the *Duration* of contracts. In the GMM regression, we used several variables to instrument the duration of contracts. The main variable to explain the duration is the *institutional environment* in which contracts are signed. 3 periods are considered: before 1993, between 1993 and 1995 and after 1995. For all contracts, a dummy is equal to 1 if the signature of the contract occurs in the period, 0 otherwise. As noticed Crocker and Masten (1985), lower prices during the contract and the expectation of deregulation by the time the current contract expires favor shorter term agreements: the institutional environment at the signature of the contract has a direct impact on its duration.

For example, most contracts signed after 1995 do not exceed 12 years while the average duration of the contracts in the panel is higher than 20 years. As noticed Guriev and Kvasov (2006) time is an integral part of the institutional environment, i.e. parties contract in time. But time is also one of the most important variables in a contract either as the duration of contractual obligations, i.e. parties contract on time.

We also consider a dummy for the management type of the *sanitation* that equals 1 if it is a private management and 0 otherwise. Indeed, water sanitation is often ensured by the same operator than the water production through bundled contracts. Duration is thus closely linked to the management type of the sanitation.

The life cycle of the contract is taken into account by two different variables. The first one is the *Time to the end* of the contract in years, and the second one is the *Distance to the end* of the contract as a percentage. Time to the end of the contract is simply the difference between the year at which contract ends and the year we consider. It helps us understand whether prices are more sensitive to a given level of quality in the last years.

The distance to the end of the contract is, for a given municipality, the ratio between the time to the end in years and the duration of the contract. Distance to the end of the contract helps us check whether prices tend to decrease or to increase through the life cycle of the contract.

5.3 Quality

Our proxy for quality is derived from the *Leak ratio* given by the IFEN Database. The leak ratio can be considered as an indicator of the quality of the network. A high leak ratio means that investments need to be done and thus refers to a low quality. We thus build a variable quality equal to $quality_{ij} = (1 - leak_{ij})$. Quality is interacted with the life cycle of the contract.

5.4 Controls

We also include a set of variables that might shift the costs, and therefore the price, of water distribution. A first set of controls accounts for the complexity of the water treatment performed by the operator before the water is distributed. *Treatment type* and *Origin of the water* are proxies not only for the complexity of service provision, but also the level of specific investments needed to operate the service, an important variable from a transaction cost perspective (Williamson, 1999). Origin of the water should determine the type of treatment as the quality of underground water is generally more stable over time, reducing uncertainty about the evolution of the kind of treatment over the life of the contracts.

Secondly, we include a set of variables to control for the structure of the network. Log-value of the size of the *Area* and log-value of the *Population* are included to control for the size of the market. Indeed, most French municipalities are characterized by a small density of the network, i.e. large areas and small population. Large areas needs longer networks of water and can be costly to maintain compared to the size of the population. A large population itself can impact the price of water as it often means economies of scale and a stronger negotiating ability of the local public authority regarding the private operators. Small towns have fewer internal resources either to produce water themselves or to pay external experts and to monitor and control private operators. At the same time, private operators have little incentive to set up shop in small towns. This may explain the tendency of small towns to create pools, which then either provide water directly through a joint bureau of outsource. Conversely, when the population is large, local authorities have greater resources to hire technical experts and simultaneously their market is more attractive to private operators.

A dummy variable *Touristic area* takes the value 1 if the municipality is subject to a high volatility of demand due to seasonal variation in the population that might necessitate overcapacity in order to satisfy peak-load demand. As there are some geographical asymmetries in the sanitation of water in France, mainly depending on the characteristics and the climate of the territories, we include dummies for the 26 French *Rï¿œgions*. To take into account the ability of a set of municipalities to provide water and to negotiate with operators, we included a dummy *Inter-authority* equal to 1 and 0 otherwise if the municipality provides water jointly with other local authorities.

We also control for shocks by including *Year dummies* for 1998, 2001 and 2004 to take into account the fixed-year effects. In our robustness checks, we also include *Management dummies* as different type of management may lead to different prices. Indeed, according to the type of organizational choice chosen by the municipality, the repartition of investments between the municipality and the operator is different. As the terms of the contract foresee that the price is shared between the municipality and the firm, we include the *share of the price* that goes to the private operator. The higher the quality of the network, the easier the management of the service. The share of the price that goes to the private operator is thus expected to have a negative coefficient.

6 Empirical results

We now turn to our empirical results. We first discuss the impact of duration and distance to the end of the contract on prices including the marginal impact of quality on prices through the life cycle of the contract in the OLS and GMM regressions. Then, in sub-section 6.3., we discuss the robustness of our model.

6.1 OLS regressions

Tables [1] and [2] report our results for OLS regressions for our four models. Model (1) is our basic set-up while model (2) includes the share of the prices that goes to the firm, model (3) includes only the management dummies and model (4) includes both. We thus check the robustness of our model. For each regression, we reported in a sub-table the marginal effect of quality on prices for different periods of the life cycle of the contracts. The first line of the sub-table presents the marginal effect of quality at the end of the contract. The second line and the fourth line report the marginal effect respectively for the first quartile and the third quartile value of the distance to the end of the contract or the time to expiry. The third line shows the marginal effect at the median value of the distance to the end of the contract or the time to the end of the contract. In table [1], the last line gives the marginal effect of quality on prices at the maximum time to the end of the contract in our sample while in table [2] it gives the marginal effect at the beginning of the contract. One can thus read how marginal effects of quality evolve when we get closer to the end of the contract.

Considering our models, we find that the coefficient on the duration of contracts is always positive whatever the variable for the life cycle of the contract considered. However, whether the impact of duration on prices is due to a lack of competitiveness or to a fixed-price effect remains unclear. Due to our unbalanced panel, we argue that there is a strong fixed-price effect. Contracts signed decades ago have probably higher prices because they imply less volatility in the price due to a smoothing of provisions and investments. We cannot conclude that lowering the duration of a contract could lead to lower prices but we can notice that long-term contracts are structurally more expensive.

Quality has a significant negative impact on prices. As the coefficient of quality does not change between (1) and (2), (1) and (3), (2) and (4) and (3) and (4), whatever the variable of the life cycle considered, we can conclude to the robustness of this variable. Time to the end of the contract measured in years or in percentage has always a negative coefficient but is only significant in the model (4). This is surprising as we should expect that the closer we are from the end, the lower prices should be. However, as the interaction term has always a positive coefficient, we can expect the time to the end of the contract to have overall a positive impact on prices. This is the case when the quality is good.

As our interaction term is not always significant, we can focus on the marginal impact of quality on prices through the life cycle of the contract. An average level of quality tends to have a higher significant decreasing impact on prices at the end of the contract. This is a reputation effect. Anything else being equal, prices should decrease by the end of the contract. When we are far from the end of the contract or at the beginning of the contract, good quality has a positive effect on prices in table [1]. However, the coefficients are not significant in table [1] and negative and non significant for all the models but (2) in table [2] so we cannot conclude to an opportunistic behavior in the beginning of the contract.

6.2 GMM regressions

Tables [3] and [4] report our results for GMM regressions for our four models. We find that the coefficients on the duration of contracts differ between the OLS and the GMM estimators, being greater for the latter model, but are always positive whatever the variable for the life cycle of the contract considered. When we endogenize the institutional environment in which the contract has been signed, the coefficients on duration are bigger. This is probably due to a competition effect. Contracts signed before 1995 are structurally associated to higher prices.

As in the OLS regressions, quality has always a significant and robust negative impact on prices. The time to the end of the contract in years and the distance to the end in percentage have negative but not always significant coefficients. For the former, coefficients are significant in (2) and (4) while for the latter it is significant in (1) and (2). As with the OLS regressor, the interaction term has a coefficient with a higher absolute value than the time to the end of the contract. This means that for low quality, we might have an opportunistic effect; i.e. anything being equal, prices could increase in the end of the contract. If we look at the marginal impact of quality on prices, we can see that quality tends to have a significant decreasing impact on prices at the end of the contract. This is a reputational effect that is consistent with the OLS regressions and with our theoretical framework.

6.3 Robustness checks

The quality of our model remains relatively unchanged especially when comparing the signs and the coefficients of our variables in the columns (1) and (2) on the one hand and (3) and (4) on the other hand for OLS and GMM. Coefficients are robust when we switch the proxy for the life cycle of the contract. Differences between both types of regression are limited in terms of values while the signs of the coefficient remain the same.

Specific robustness tests are reported in the GMM regression tables. We can consider our IV model to be relevant. First, the First-stage F-statistic satisfies the relevance condition at the threshold of 10% maximal relative bias provided by Stock and Yogo (2004). Secondly, the p-value of the Hansen J-statistic for (2) and (3) does not reject the overidentifying restrictions. Third, the orthogonality condition is satisfied for each instrumented variables. Finally, Moreira's CLR gives reliable confidence regions with strong p-values.

Nevertheless, one should be careful when interpreting the results of our regressions for two main reasons. To begin with, our life cycle proxy measured by the distance to the end of the contract in percent can be deceiving. For example, two contracts, one signed in 1995 and another signed in 1937 could be both in the end of their life cycle in 2004. The main drawback is that we do not observe contracts during their whole life cycle. We thus cannot conclude to the generality of our results.

7 Conclusion

In this paper, we presented evidence that the life cycle of the contracts do matter to explain prices evolution. Firstly, the marginal effect of quality on prices is negatively increasing when the contract gets closer to the end. As operators do care about their reputation, a given level of quality has a higher impact on prices when they get closer to the renewal of the contract. Secondly, contract duration has a positive impact on prices. For a given level of quality, contracts signed decades ago are expected to have higher prices than contracts signed more recently. This is in line with economic theory.

Our results have a bearing on the expected effects of possible future negotiations on the water contracts. Shorter duration and being closer to the end of the contract can partly explain the decrease in prices for the consumer in the coming years. We should notice, however, that we do not have data for costs and investments in the network that greatly influence duration of the contracts and reputational behaviors. Further research will have to focus on these points.

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8 Appendix

8.1 Summary statistics

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
Price	6120	162.364	47.861	10.343	373.301
Quality	6120	0.774	0.122	0.056	0.989
Duration	6120	22.134	17.586	1	89
Distance to the end	6120	0.469	0.281	0	1
Time to expiry	6120	8.333	5.109	0	25
Area	6120	3,963.189	51,128.31	51	1,836,000
Population	6120	7,407.422	17,975.31	29	403,298
Inter-authority	6120	0.811	0.391	0	1
Touristic area	6120	0.135	0.342	0	1
Share of the price going to the firm	4446	0.631	0.253	0	0.948
Sanitation type	6120	0.953	0.212	0	1

8.2 Year of signature of the contract

8.3 Management types of the production of water

Table 1 - Price depending on the time to expiry; Method: OLS

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VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS
Duration	0.474***	0.506***	0.507***	0.537***
	(0.030)	(0.034)	(0.045)	(0.052)
Time to the end	-0.681	-1.300	-0.883	-1.456*
	(0.708)	(0.806)	(0.709)	(0.804)
Quality	-23.699***	-27.712***	-24.684***	-28.191***
	(9.066)	(9.998)	(9.044)	(9.986)
Quality*Time to the end	1.220	2.236**	1.204	2.094**
	(0.895)	(1.030)	(0.892)	(1.025)
Area	5.615***	5.690***	4.946***	5.301***
	(0.709)	(0.825)	(0.712)	(0.819)
Population	-10.275***	-10.265***	-10.340***	-10.566***
	(0.421)	(0.501)	(0.422)	(0.498)
Interauthority	21.391***	19.867***	20.332***	19.295***
	(1.515)	(1.768)	(1.511)	(1.752)
Touristic	4.451**	3.826*	4.177**	3.589*
	(1.795)	(2.082)	(1.777)	(2.073)
Regional dummies	Yes	Yes	Yes	Yes
Origin dummies	Yes	Yes	Yes	Yes
Treatment dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Management type dummies	No	No	Yes	Yes
Share of the price to the operator		-7.488**		-3.592
		(3.007)		(3.565)
Constant	154.087***	210.906***	161.776***	216.083***
	(20.869)	(11.414)	(21.233)	(11.444)
Observations	6,120	4,446	6,105	4,432
Adjusted R-squared	0.351	0.359	0.362	0.370
Marginal impact of quality on prices				
End of the contract	-23.699***	-27.712***	-24.684***	-28.191***
	(9.066)	(9.998)	(9.044)	(9.986)
1st quartile (4-5 years)	-18.821***	-18.768***	-18.666***	-19.817***
	(6.411)	(6.899)	(5.881)	(6.886)
Median (7-8 years)	-13.943***	-12.060**	-15.056***	-13.536**
	(5.062)	(5.532)	(5.037)	(5.503)
3rd quartile (11 years)	-10.284*	-3.117	-11.445**	-5.162
	(5.552)	(6.134)	(5.522)	(6.072)
Maximum (20-23 years)	4.351	17.006	2.997	13.681
	(13.988)	(13.323)	(13.940)	(13.217)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 2 - Price depending on the distance to the end in %; Method: OLS

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VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS
Duration	0.482***	0.535***	0.488***	0.543***
	(0.035)	(0.039)	(0.051)	(0.057)
Distance to the end	-11.473	-18.310	-12.539	-18.781
	(12.126)	(12.653)	(12.214)	(12.684)
Quality	-20.461**	-23.050**	-21.335**	-23.708**
	(9.357)	(10.049)	(9.366)	(10.051)
Quality*Distance to the end	13.735	25.285	12.944	23.293
	(15.610)	(16.281)	(15.649)	(16.256)
Area	5.560***	5.681***	4.906***	5.258***
	(0.710)	(0.827)	(0.712)	(0.821)
Population	-10.092***	-10.085***	-10.275***	-10.478***
	(0.415)	(0.498)	(0.418)	(0.494)
Interauthority	21.515***	20.110***	20.418***	19.437***
	(1.511)	(1.764)	(1.507)	(1.747)
Touristic	4.327**	3.719*	4.124**	3.520*
	(1.797)	(2.088)	(1.778)	(2.077)
Regional dummies	Yes	Yes	Yes	Yes
Origin dummies	Yes	Yes	Yes	Yes
Treatment dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Management type dummies	No	No	Yes	Yes
Share of the price to the operator		-6.602**		-3.459
		(2.966)		(3.534)
Constant	153.112***	207.862***	160.849***	213.742***
	(21.143)	(11.736)	(21.390)	(11.624)
Observations	6,120	4,446	6,105	4,432
Adjusted R-squared	0.350	0.357	0.362	0.370
Marginal impact of quality on prices				
End of the contract	-20.461***	-23.050**	-21.335**	-23.708**
	(9.357)	(10.049)	(9.366)	(10.052)
1st quartile (10-15% remains)	-17.350***	-18.309**	-18.423***	-19.399**
	(6.659)	(7.651)	(6.666)	(7.674)
Median (40-45 remains)	-14.052***	-12.093**	-15.295***	-13.615**
	(5.083)	(5.578)	(5.056)	(5.547)
3rd quartile (66,67 remains)	-11.304**	-6.192	-12.706**	-8.179
	(5.647)	(5.892)	(5.619)	(5.834)
Beginning of the contract	-6.726	2.236	-8.392	-0.415
	(9.234)	(9.484)	(9.227)	(9.414)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 3: Price depending on the time to expiry; Method: GMM

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VARIABLES	(1) IV	(2) IV	(3) IV	(4) IV
Duration	0.717***	0.718***	0.679***	0.684***
	(0.077)	(0.081)	(0.081)	(0.088)
Time to the end	-0.773	-1.441*	-0.913	-1.469*
	(0.708)	(0.807)	(0.707)	(0.800)
Quality	-25.089***	-29.514***	-24.660***	-27.997***
	(9.026)	(9.949)	(9.017)	(9.930)
Quality*Time to the end	1.238	2.352**	1.140	2.035**
	(0.896)	(1.030)	(0.892)	(1.021)
Area	6.129***	6.149***	5.001***	5.342***
	(0.724)	(0.834)	(0.710)	(0.816)
Population	-10.888***	-10.827***	-10.562***	-10.749***
	(0.456)	(0.536)	(0.428)	(0.502)
Interauthority	21.013***	19.528***	20.192***	19.102***
	(1.511)	(1.757)	(1.504)	(1.739)
Touristic	4.420**	3.720*	3.964**	3.340
	(1.786)	(2.068)	(1.772)	(2.062)
Regional dummies	Yes	Yes	Yes	Yes
Origin dummies	Yes	Yes	Yes	Yes
Treatment dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Management type dummies	No	No	Yes	Yes
Share of the price to the operator		-7.637**		-4.738
		(2.979)		(3.571)
Constant	146.025***	205.206***	158.211***	214.210***
	(21.188)	(11.570)	(21.368)	(11.488)
Observations	6,120	4,446	6,105	4,432
Adjusted R-squared	0.346	0.355	0.360	0.369
Difference in Sargan-stat.	Yes	Yes	Yes	Yes
First-stage F-Stat	1010.67	911.41	1303.02	1091.87
p-value of Hansen J-test	0.778	0.564	0.663	0.519
p-value of DWH	0.003	0.002	0.008	0.029
Moreira CLR (p-value)	[0.565, 0.865]	[0.555, 0.871]	[0.519, 0.835]	[0.508, 0.849]
	(0.000)	(0.000)	(0.000)	(0.000)
Marginal impact of quality on prices				
End of the contract	-25.089***	-29.514***	-24.660***	-27.997***
	(9.026)	(9.949)	(9.017)	(9.930)
1st quartile (4-5 years)	-20.138***	-20.106***	-18.962***	-19.856***
	(6.373)	(6.853)	(5.851)	(6.843)
Median (7-8 years)	-15.187***	-13.051***	-15.543***	-13.751**
	(5.042)	(5.450)	(5.009)	(5.468)
3^{rd} quartile (11 years)	-11.474**	-3.644	-12.124**	-5.610
	(5.557)	(6.137)	(5.502)	(6.046)
Maximum (20-23 years)	3.379	17.523	1.551	12.708
	(14.039)	(13.363)	(13.938)	(13.276)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4: Price depending on the distance to the end in %; Method: GMM

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VARIABLES	(1) IV	(2) IV	(3) IV	(4) IV
Duration	0.951***	0.879***	0.722***	0.721***
	(0.158)	(0.134)	(0.132)	(0.128)
Distance to the end	-26.602**	-26.637**	-13.075	-18.596
	(12.671)	(12.793)	(12.129)	(12.586)
Quality	-38.571***	-33.565***	-24.682***	-25.344**
	(10.671)	(10.501)	(9.363)	(9.994)
Quality*Distance to the end	46.167**	44.382**	18.488	26.252
	(18.120)	(17.389)	(15.655)	(16.232)
Area	6.467***	6.342***	5.009***	5.311***
	(0.769)	(0.852)	(0.711)	(0.817)
Population	-11.252***	-10.929***	-10.615***	-10.714***
	(0.561)	(0.587)	(0.450)	(0.511)
Interauthority	20.902***	19.605***	20.245***	19.192***
	(1.522)	(1.762)	(1.502)	(1.737)
Touristic	4.631***	3.801*	3.982**	3.340
	(1.797)	(2.077)	(1.773)	(2.064)
Regional dummies	Yes	Yes	Yes	Yes
Origin dummies	Yes	Yes	Yes	Yes
Treatment dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Management type dummies	No	No	Yes	Yes
Share of the price to the operator		-7.018**		-4.841
		(2.952)		(3.587)
Constant	146.523***	201.657***	156.505***	211.222***
	(20.904)	(11.802)	(21.321)	(11.662)
Observations	6,120	4,446	6,105	4,432
Adjusted R-squared	0.336	0.349	0.360	0.369
Difference in Sargan-stat.	Yes	Yes	Yes	Yes
First-stage F-Stat	241.248	367.99	584.776	693.36
p-value of Hansen J-test	0.555	0.455	0.667	0.509
p-value of DWH	0.002	0.005	0.054	0.110
Moreira CLR (p-value)	[0.565, 0.865]	[0.616, 1.126]	[0.519, 0.835]	[0.472, 0.952]
	(0.000)	(0.000)	(0.000)	(0.000)
Marginal impact of quality on prices				
End of the contract	-38.571***	-33.565***	-24.682***	-25.344**
	(10.671)	(10.501)	(9.363)	(9.994)
1st quartile (10-15% remains)	-28.091***	-25.244***	-20.522***	-20.487***
	(7.311)	(7.876)	(6.653)	(7.621)
Median (40-45 remains)	-17.024***	-14.335***	-16.054***	-13.969**
	(5.137)	(5.565)	(5.030)	(5.505)
3rd quartile (66,67 remains)	-7.791	-3.976	-12.356**	-7.842
	(5.716)	(5.941)	(5.591)	(5.815)
Beginning of the contract	7.596	10.817	-6.194	0.908
	(10.076)	(9.929)	(9.207)	(9.413)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1