Public-Private Partnerships and Opportunism: New Empirical Evidence in the French Water Industry♣

Preliminary draft, please do not quote

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Abstract: one of the most important pitfalls generally associated with public-private partnerships schemes conducted in natural monopoly industries lies in the difficulty to replace the winning firm once the agreement is signed. The advantages of incumbency may in turn foster firms' opportunistic behaviours. However, the literature also emphasizes that reputation effects may contribute to lower incumbents' bad conducts, even if they are placed in a monopoly situation after winning the contract. Whether these reputation effects are powerful enough to curb opportunism is an empirical question we intend to address here. Using a database of 5000 observations collected in the French water industry in 2004, we show that incumbents may have incentives to take decisions that raise rivals' entry costs at contract's renewal. We find little evidence that reputation effects may weaken this particular kind of opportunism.

JEL codes: D21-D82-L33-L95

Keywords: public-private partnerships, opportunism, reputation, water industry, network information.

INTRODUCTION

Many scholars advocate that competition *for* the market can efficiently substitutes for competition *on* the market in network industries characterized by natural monopoly characteristics (Demsetz [1968], Posner [1972]). However, the literature also emphasizes that a lot of potential pitfalls arise when public authorities implement auctions for the award of public-private partnership (PPP) contracts in monopolistic sectors (Crocker and Masten [1996]). One of the most important problems lies in the fact that the firm winning the very first auction can hardly be replaced during the contract or even at the end of the contract.

The literature provides a lot of arguments that explain why incumbent firms cannot easily be evicted during the contract (Williamson [1976]). First, terminating the contract may involve long and costly judiciary conflicts. Second, concession contracts involve the realization of long term specific investments by the incumbent. Consequently, including termination provisions in the contract makes unsecured the long run agreement signed. Anticipating that he could be evicted before the end of the contract, the incumbent may under invest in specific assets. Third, terminating the relationship is often interpreted by constituents as a mistake of the public authority. Indeed they may consider that politicians were unable to select the best operator at the auction phase. Forth, evicting the incumbent involves important switching costs. The public authority will have to find a successor, which may take time and the transition period may provoke service disruption or interruptions. This is problematic since the services to be provided are often essential to consumers (such as water and sewage services or railway transportation for instance). What's more the public authority cannot be sure that the subsequent firm will behave more fairly than the opportunistic incumbent.

As incumbents cannot easily be terminated, they may take advantage of their monopoly position to behave opportunistically. One example of opportunistic behaviour consists in reneging on the contractual promises (delay in the investment's program, low service quality etc). Obviously, the public authority may want to punish an opportunistic firm by refusing to renew her contract at the subsequent auction. However, it's likely to be a difficult task to the extent that the firm winning the first contract generally dispose of a sizeable advantage on her rivals in the subsequent auctions when relationship specific investments are involved. One of the most acute problems is to assess the residual value to the physical specific assets detained by the losing incumbent and that must be transferred to the new operator or to the public

authority at the end of the contract[1]. The literature suggests that the compensation that should be awarded to the losing incumbent for the assets' transfer may be hard to assess and is often subject to haggling and litigation issues between partners (Williamson [1976], Klein [1998b]). Obviously, the public authority may prefer to renew the incumbent in order to avoid such transaction costs. What's more the incumbent may also develop during the contract a specific know-how that can not be valuable in other contractual relationships. In other words, the value of the specific knowledge accumulated through the years would be lost for the public authority and for the incumbent if his contract is not renewed. To summarize, transaction cost theory emphasizes that when incumbents realize physical or human specific investments, replacing them is costly for public authorities and incumbents dispose of a "first mover" advantage on their rivals at contract's renewal (Williamson [1975]).

Then, a natural prediction of transaction cost theory is that incumbents may have incentives to engage in opportunistic behaviours because they are aware that their monopoly position can hardly be questioned neither during the contractual relationship nor at the end. Several empirical studies tested this proposition but found that incumbents' opportunism is not a serious issue in PPP agreements, principally because reputation effects constrain firms' behaviour (Zupan [1989a], Zupan [1989b], Prager [1990]).

In this paper, we focus on a kind of opportunism that has received little consideration from the empirical literature up to now. More precisely, we study incumbents' incentives to withhold information during the PPP contract. Using a database of 5000 observations collected in the French water industry in 2004, we show that incumbent firms tend to diffuse less information about the network in geographical areas where their contract can be challenged by potential rivals. This result can be interpreted as a strategic behaviour of market protection. Indeed, when the number of alternative bidders increases, dissimulating network information help the incumbent to preserve his informational advantage over potential challengers. As rivals are not properly informed about the state and various characteristics of the network, they may be discouraged to bid so as to avoid the winner's curse problem (Wilson [1967]).

Our data also suggest that incentives to disclose network information tend to decrease at the end of the contract. This result may be explained by the fact that the information transmitted

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[1] For instance, a concessionaire in the water industry who invests in new pipes during the contract should be appropriately compensated for the residual value of these assets if the public authority decides to switch for another concessionaire at the end of the agreement. However assessing a fair compensation is difficult to the extent that pipes are underground and then hardly observable and a lot of factor may affect mains' depreciations: soil acidity, weather conditions, maintenance efforts etc.

at the end of the agreement has more value to enhance bidding parity between suppliers. In such a perspective, incumbents may have more incentives to behave strategically when the end of the contract comes to prevent outsiders from competing on their market.

To sum up, then, our results are consistent with the idea that incumbent firms tend to withhold information in order to maintain their competitive advantage at contract's renewal. What's more, we don't find any evidence of the existence of reputation mechanisms that may help to curb such kind of strategic behaviour. These results then contrast with previous empirical findings emphasizing the role of reputation effects as an efficient way to deter opportunism in PPP contracts.

The remainder of the paper is organized as follows. The first part is devoted to a brief survey of the literature about the link between incumbency advantages and opportunism in PPP agreements. The second part describes the main institutional characteristics of the French water industry that are useful for our empirical study. The third part develops the empirical analysis. Conclusion follows.

1. Related literature

Many scholars underline the existence of incumbency advantages after the first auction when PPP contracts are set up in monopoly markets (Williamson [1976], Crocker and Masten [1996], Klein [1998a, b]). The transaction cost literature suggests that when the incumbent is in charge with the realization of specific investments a bilateral dependency arises between the firm and the public authority. The problem lies in the fact that the value of these assets would be lost if the firm is replaced. The existence of specific assets then creates a "lock in" situation that makes it difficult for the public authority to switch for another firm. As a consequence, the incumbent dispose of a "first mover" advantage over rivals at contract's renewal (Williamson [1975]).

To the extent that the incumbent may be aware that his monopoly position can hardly be challenged, he may have incentives to behave opportunistically. Several kinds of opportunistic behaviours are analysed by the empirical literature. The firm may renege on her contractual promises after the contract is signed (Zupan [1989b], Prager[1990]). For instance, she may deliberately overestimate demand or underestimate costs to obtain the market and then, ask for a price increase pretending that she did not anticipate the bad market conditions (Zupan [1989b]). Rejecting the incumbent's claims could lead to a decrease in the firm's overall performance (decrease in service quality, investments' delays, service interruptions

etc.) and, in some extreme cases, to bankruptcy risks. Obviously, the public authority may want to avoid such bad outcomes, especially because this would affect consumers' welfare. Another kind of firm's bad behaviour consists in taking advantage of its bidding advantage to negotiate the subsequent contract opportunistically (Zupan [1989a]).

These studies - all realized in the Cable Television sector in the United States - underline that even though incumbents can hardly be replaced at the end of PPP agreements[2], they do not take advantage of their monopoly position to behave opportunistically. The authors explain that the existence of powerful reputation effects is important to curb firms' bad conduct in the cable sector.

Nevertheless, up to now, the empirical literature merely assessed the importance or not of some categories of opportunistic behaviours that may arise because of the difficulty to terminate and replace the incumbent after the initial auction. In this paper we rather focus on strategic actions that may be pursued by incumbents precisely in the perspective to raise rivals' entry costs and then to increase their "first mover" advantage. What's more, whether this particular kind of opportunism can be curbed or not by reputation effects is also an empirical question we intend to address here.

The theoretical literature distinguishes two kind of actions an incumbent could adopt to raise rivals' entry costs. Some authors emphasize that incumbents may have incentives to invest strategically in specific and non-transferable assets at the end of the contract to create a "lock-in" situation (Affuso and Newberry [2002]). Another way to disadvantage challengers consists in dissimulating or distorting information. Indeed, the incumbent generally detains private information about the service he operates (demand characteristics, cost conditions) and he may obviously prefer not to share this information. As challengers are not properly informed, they may decide not to bid aggressively (or not to bid at all) because they may not want to overstate the value of the market and be trapped in a winner's curse problem (Armstrong and Sappington [2004]). Information distortion may also occur in the sense that the incumbent may have a better knowledge of the residual value of the specific assets that would have to be transferred to the public authority or to the new firm in the case he loses the subsequent auction (Williamson [1976]). The incumbent may have incentives to overstate the

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[2] Zupan emphasizes that for an incumbent the probability to be renewed is above 99% in the US cable sector. Other industries located in other countries are also characterized by high rates for incumbents' renewal. For instance, incumbents' renewal rate is around 88% in the French urban public transportation (Yvrande-Billon [2006]) and 90% in the French water industry. Empirical evidence then shows that the incumbent's advantage at contract's renewal is not a myth.

residual value, obliging potential entrants or the public authority to spend huge amounts to buy back these assets. Such kind of behaviour may - once again - contribute to prevent alternative and perhaps more efficient challengers from entering the market.

At the empirical level, we are only aware of two studies trying to emphasize the existence of strategic behaviours conducted by incumbents to make it more difficult for rivals to compete in their market. Focusing on the British railway industry, Affuso and Newberry [2002] find that Train Operating Companies (TOCs) tend to increase their investments when the contract's duration shortens. However, they fail to determine whether the investments realized are really specific and aim to create a "lock-in" or if they merely represent a signal sent by incumbent operators to the regulator in order prove their commitment and then, to enhance their chance to be awarded the subsequent franchise. In our work, we do not focus on incumbents' incentives to undertake strategic investments at the end of the contract. We rather focus their incentives to hide information. In addition, contrary to Affuso and Newberry's paper, our data allow us to determine whether incumbents' behaviour is dictated by strategic considerations or by reputation effects. More recently, Canneva and Garcia [2010] conduct an econometric analysis on the French water industry that considers the link between the incumbents' informational advantage and rivals' winner's curse issue. Their results suggest that municipalities using an outside specialized consultant have a higher probability to switch for another supplier at the end of the franchise. This result is explained by the fact that consultants can foster competition for the water service in two ways. First, they can facilitate the assets' transfer in case of operator's change. Second, they can audit the water service in order to provide challengers with relevant information about network quality, reducing the winner's curse problem. Nevertheless, our work departs from theirs for two reasons. First, in our framework, the level of information obtained by the municipality and by potential competitors depends on the incumbent's behaviour, not on the intervention of on an outside public or private institution. Our econometric estimations highlight that depending on the features of the local environment in which the water service is embedded and depending on the characteristics of the contract, he may decide to hide more or less information to the municipality. Second, contrary to Garcia and Canneva's analysis, we are able to develop a framework that - combined with our empirical analysis - allows us to verify if reputation effects can efficiently contribute to curb incumbents' incentives to dissimulate information.

2. The French water industry

2.1. The case of water supply by private firms

In France, as in most European countries, municipalities must provide local public services that have public good characteristics. However, if the responsibility for service provision is public, its management can be either public or private. In this case, they may choose between alternative contractual arrangements that differ according with regards to the operator's investments in the service and the allocation of risk across the two parties.

There are several types of organizational modes 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 PPP contract[3]. Most contracts involving a private firm are lease contracts. In those agreements, the firm is in charge with the day-by-day service operation (water production and distribution, network maintenance, bills' collection, water pressure supervision etc.). What's more, she is directly remunerated by consumers' bills, exposing her to some operating risks. However, the most important investments, and notably the investments concerning network renewals and extensions are generally realized by municipalities.

The firm managing the water service through a lease contract accumulates over time some strategic information about demand characteristics, the state of the network and more generally about the operating costs. Naturally, she may have incentives to withhold her private information in order to make it more difficult for outsiders to compete on her market at contract's renewal. Facing an opportunistic incumbent, municipalities may face important difficulties to obtain information about the water service. This is especially true if we consider the acquisition of network information to the extent that in the water industry, the pipes are underground and then, not easily observable. Of course, municipalities may engage in auditing procedures by hiring independent consultants to improve their network's knowledge. But these procedures may be costly so that many municipalities may be reluctant to bear such costs.

Nevertheless, when reputation mechanisms do exist, incumbents' incentives to disclose information may be enhanced. For instance, they may decide to behave fairly when they think that such a strategy can be useful in the perspective to obtain new contracts in other regions.

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[3] There are several types of PPP contracts French municipalities can use. These arrangements differ according to the importance of the investments and financial risks beard by the firm. For more precisions about the characteristics of these various arrangements, see Chong *et al* [2006].

This situation can be referred to as "reputation effects external to the existing relationship" because the incumbent behaves fairly so as to increase its chance to extend his market to other municipalities (Zupan [1989b]). Of course, in the situations when the incumbent has incentives to cooperate, the municipality may obviously be able to obtain information about the water service at a lower cost than if auditing procedures had to be used.

2.2. The organization of competition

Since the "Sapin law" (1993), the public authority can select its partner following a two-steps procedure. In a first step, the public authority launches a classical invitation to tender opened to all interested operators. At the end of the tendering procedure, the public authority shortlists the candidates allowed to take part in the second phase of selection. This second step consists in a negotiation process between the public authority and the short-listed candidates. At the end of the negotiation, the public authority chooses its final partner for the duration of the contract.

In inviting tender, the local public authorities are not legally constrained in setting the criteria according to which it short-lists and ultimately chooses an operator. Moreover, it need not publicize its subjective criteria, creating an informational asymmetry between the local public authority and prospective operators and giving the local public authority greater latitude in selecting a partner. This could reduce competition for the field and facilitate collusion among operators or between the local public authority and some operators. But giving municipalities freedom in the choice of their final partner may also induce some desirable outcomes. For instance, when the selection process is flexible, the municipality may be able to threat not to renew the incumbent in the case when he submits the most interesting bid, but by taking some strategic decisions that prevent challengers from competing on a fairly basis. If this threat is perceived as credible, the incumbent may finally prefer to disclose its private information in order to preserve some chance to keep its ongoing market at the rebidding stage. This situation can be referred to as "reputation effects internal to the existing relationship" because the fear to lose the current contract may dissuade firms from behaving opportunistically. In a rigid auction procedure, the municipality would be obliged to simply choose the lowest bid, and then to renew the opportunistic incumbent.

Therefore, in the French institutional context characterized by a flexible selection process, there is some place for internal reputation effects to play a role. But these reputation effects will exist only if municipalities' can credibly commit to terminate opportunistic incumbents,

which imply to bear the political costs of such a decision. Indeed, in the case when the incumbent decides to withhold information, bidding parity is not ensured anymore and the probably increases that the bid proposed by the best challenger is higher than the incumbent's bid. This is due to the fact that challengers' winner's curse problem incites them not to bid aggressively. Nevertheless, selecting a challenger who submits a less interesting bid than the one proposed by the opportunistic incumbent may not be politically sustainable. Therefore, if the incumbent anticipates that the non renewal sanction is not credible, his incentives to withhold information may not be curbed.

3. Empirical Analysis

3.1. Data

The goal of our empirical analysis is to determine if private firms' incentives to disclose information are affected by strategic considerations or reputation mechanisms. For this purpose, we were able to build a dataset on the French water industry by compiling data coming from the French Environment Institute (IFEN), the French Health Ministry (DGS) and the National Statistics Institute (INSEE). The initial database is made up of 5000 municipalities for which several characteristics of the water service are observed in 2004. All size of municipalities is proportionally represented with the exception of large municipalities that are all included in the sample. As our goal is to study firms' incentives to disclose information, we are only interested about the municipalities that chose a PPP contract for water provision. Eliminating all the observations for which the organizational mode is direct public management and the observations with missing or extreme values, our final sample consists in 1198 municipalities for which the organizational mode is a PPP in 2004.

3.2. Dependent variables

In order to investigate our empirical question, we have to find a proxy measuring the importance of the information transmitted by the incumbent firm to the municipality. In a PPP agreement, the incumbent firm is expected to update the network maps to the extent that he is in charge with the operation of the service. Maps' updates can provide structural information (date when the pipe was installed, kind of material used for the pipe, topographic information etc.). But they can also provide information about the interventions realized on the network during the year (localization of mains' repairs for instance). Frequent updates enable the municipality to constantly have new information that may be useful to plan future investments

on the network and to enhance bidding parity at contract's renewal. These arguments certainly explain why the French legislation advises to update the network maps at least once a year.

Our data allowed us to construct a dummy variable equals to 1 when network maps' updates are observed in the municipality in 2004. At the opposite, the value of the proxy is 0 if no update is realized (variable DINFO). Of course, our proxy does not enable us to assess the importance and the nature of the updates when there are any. But we can be confident about the fact that more network information is available to the municipality when DINFO equals to 1 than when DINFO equals to 0.

We also created three other dummy variables that give a better idea of the nature and the importance of the information transmitted. These variables are the following: have the network maps been updated with topographic information (DINFO1); have the network maps been updated with detailed description of the network, namely age and material used for the pipes (DINFO2); have the network maps been updated with a geographic localization of the interventions (water leakages repairs, explorations) on the network (DINFO3).

3.3. Opportunism, Reputation Mechanisms and Information Disclosure

3.3.1. Geographical competition variables

As we already stressed, opportunistic considerations may induce an incumbent firm to conceal her private information about the network whereas reputation effects may induce her to reveal more information. Therefore, maps' updates should be more likely in those situations when reputation effects are important. On the contrary, they may be less likely in those situations when incumbents have incentives to behave strategically.

To account for the impact of reputation effects and strategic behaviours on our dependent variables, the first proxy we consider is a Herfindahl-Hirshman index (HHI) calculated at the department level[4]. We then derived a variable that represents the potential competition between firms in the department:

$$PCOMP_i = 1 - HHI_j$$

where HHI_j is the Herfindahl-Hirshman index for a given department j[5]. This indicator captures the perspective for an incumbent to conquer new markets in the area where he

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[4] France is administratively divided into 100 geographical districts called "department".
[5] The herfindhal index is constructed by considering the market share of each operator in the department. The general formula is the following:

operates. Intuitively, the higher PCOMP$_j$ (or equivalently the lower HHI$_j$) the higher the number of firms operating in the same geographical area than the incumbent and then the higher the perspective for the incumbent to conquer new markets. On the contrary, when PCOMP equals 0 (or equivalently the lower HHI$_j$ equals 1), this means that there is only one firm operating in the department, which means that this firm has presumably few possibilities to conquer new markets. Therefore, in geographical areas where several firms are present, incumbents may have more incentives to provide network information. Behaving fairly may enable them to build a good reputation that may be helpful to extend their market shares at the expense of their rivals. We then expect a positive sign for PCOMP if reputation effects matter.

However, if the presence of other firms in a department may enhance the perspective to conquer new markets for an operator, these firms may also represent a threat for a him. Indeed, when disclosing network information, an incumbent may encourage these firms to come and compete in the markets he operates at contract's renewal. As the incumbent may prefer to give priority to the protection of its current market, we cannot exclude the possibility that the presence of other operators in the neighborhood fosters its strategic behaviours instead of lowering them. In other words, a negative sign for PCOMP may be consistent with the idea that incumbents disclose less network information in areas where the number of other suppliers is high so as to protect their market from competition.

The degree of potential competition between firms at the local level appears to have an ambiguous effect on incumbents' incentives to update the network maps. The same reasoning is true if we consider competition among organizational modes instead of inter-firm competition. More precisely, a second proxy measuring for each department the market shares of in-house provision is introduced (SHAREDM)[6]. The higher this variable, the more the department is dominated by direct public management services. In particular, a high value for SHAREDM means that the municipalities involved in a PPP contract in these regions are likely to be located near other municipalities providing water in-house. However when a municipality involved in a PPP agreement is located in the neighbourhood of municipalities that opted for direct management, she can easily associate with them at the end of the PPP and

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HHI$_j$ = $\sum_{i=1}^{n} P_i^2$, where P$_i$ indicates the market share of firm **i** in the department **j**. (namely the size of the population of the department that is delivered water by the firm **j** divided by the size of the population of the department concerned by water provision through PPP contracts).

[6] SHAREDM is calculated the following way: size of the population of the department that is delivered water by a municipality that chose in-house provision / size of the population of the department.

benefit from their experience in the case when they are not satisfied with the performance of their incumbent. In other words, the proximity of municipalities providing water in-house makes the transition to direct management easier for municipalities in PPP at the end of the contract.

The variable SHAREDM then proxies the degree of potential competition between PPP and in-house provision, and in the same way as PCOMP, we expect this variable to have an ambiguous impact on incumbents' incentives to disclose network information. On the one hand, the proximity of other municipalities that operate their water service in-house may induce the incumbent to behave less strategically in order to send a good signal to these municipalities and convince them to switch for a PPP contract. On the other hand, the dominance of in-house provision in the region may also represent a threat for the current markets detained by the incumbent to the extent that the municipalities they contract with may switch more easily from a PPP to direct management at the end of the contract. As a consequence, when SHAREDM is high, the incumbent may have incentives to disclose less network information in order to make the transition to in-house provision more costly for the municipality.

To summarize, a positive sign for the two geographical competition variables described above may reflect incumbents' incentives to behave fairly in order to conquer new markets. This situation can be referred to as "reputation effects external to the existing relationship" because the incumbent behaves fairly so as to increase its chance to extend his market to other municipalities (Zupan [1989b]). However, a negative sign may reflect a strategic behaviour of market protection (opportunism).

3.3.2. Contractual characteristics

In our database, we also dispose of variables reflecting the contractual characteristics of the service. In particular, we account for the influence of the contract's expiring date on the incumbent's incentives to disclose information. For this purpose, we created a variable called EXPIRY. It represents the difference between the year when the contract expires and 2004 which is our year of observation. Hence, the smaller EXPIRY, the closer the PPP contract to its expiring date.

Contractual characteristics and strategic behaviours

We suspect that under some circumstances, the incumbent's incentives to provide network information may decrease when the end of the contract comes. In such a situation, EXPIRY would have a positive sign (since lower values for EXPIRY would be associated on average with lower probability that DINFO, DINFO1, DINFO2 and DINFO3 takes the value 1). Our contention is that this will be true if two assumptions are verified. First, the information disclosed toward the end of the contract is more valuable to increase competition at the next bidding process than the information disclosed a couple number of years before[7] (H1). Second, concealing information at the end of the contract increases the incumbent's probability to be renewed (H2a)[8]. H2a will be verified if the public authority cannot commit to sanction the opportunistic incumbent by choosing a rival in the case when a challenger proposes a higher bid or by bearing the costs to switch from PPP to direct management. Several reasons may explain why the public authority cannot commit to terminate an opportunistic incumbent at the end of the PPP agreement. For instance, if the auction procedure is rigid, the public authority may always be obliged to choose the firm submitting the lowest bid. However, we mentioned earlier that in the French water context, the selection process is quite flexible. But even if the public authority has some discretion in the choice of her supplier, she may not necessarily be willing to switch for in-house provision or for a firm submitting a higher bid when the incumbent behaves opportunistically. Threatening the incumbent to choose another supplier or to switch for public direct management implies that the public authority is willing to bear the political and economic costs of this decision (price increases, transition costs to the new organizational mode). Obviously such a threat may be perceived as not credible by the incumbent.

Let's explain in more details why the incumbent's incentives to disclose network information may be lower at the end of the contract than at the beginning. First, an important institutional feature of the French water services is that municipalities are in charge with the network's renewal in the wide majority of the PPP agreements[9]. Obviously the more reliable the information they have about the network, the more efficient the investments realized.

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[7] This seems to be a sensible assumption. For instance, in a complex or uncertain environment, we can suspect that a report submitted by the incumbent to the municipality about the state of the network or about demand conditions say 1 year before the contract's end will be much more instructive for outside challengers that are willing to submit a bid than the same report submitted 20 years before the contract's end.

[8] Indeed, we make a distinction here between the incumbent's strategic behaviour and the probability that he is renewed. We'll show below that even if the incumbent can take actions that decrease the degree of competition at the subsequent auction, the probability that he is renewed does not necessarily increase if the public authority can credibly commit not to renew him.

[9] Some concession contracts in which pipes' renewal and extensions are conferred to the private firms exist but these contractual arrangements are rare.

However, efficient investments reduce water leakages and then affect the incumbent's operating costs. Therefore at the beginning of the PPP contract, the incumbent may find an interest in disclosing its private information. Of course, behaving fairly may reduce its informational rents but this reduction may be more than compensated by a decrease in its operating costs enabled by municipalities' more efficient investments.

Nevertheless, at the end of the contract, the information disclosed by the incumbent may decrease for two reasons. First, the information revealed at the end of the agreement may decrease the operating costs of the water service in the future, but the incumbent is not sure anymore that he will be the next supplier. In other words, he may be reluctant to reveal information that may benefit to the subsequent firm. Second, the more the contract approaches to its end, the more the information disclosed by the incumbent can be used by rivals to compete for the market at the subsequent auction or by the municipality to switch for in-house provision (H1). As the incumbent wants the degree of competition to be as low as possible, he may decide to conceal more and more information as the contract's expiring date arrives. Such a behaviour may disadvantage rivals' firms because as they lack information, they may decide not to bid at contract's renewal or they may include a risk premium in their bid to take into account the winner's curse problem. What's more, information concealment may increase the transition costs incurred by the municipality to switch for in-house provision[10].

To summarize then, the more the incumbent conceals information at the end of the contract, the lower the probability that a challenger proposes a more interesting bid than the one submitted by the incumbent and the more costly it is for the municipality to switch for in-house provision. This increases the probability that the incumbent is renewed to the extent that the public authority cannot commit to sanction his strategic behaviour by choosing a supplier proposing a higher price. What's more, the public authority cannot commit to bear the transition costs from PPP to direct management (H2a).

Disclosing less and less information as the end of the contract comes can therefore be interpreted as a strategy of market protection. We can also make a similar reasoning by focusing on the contract's duration (variable DURATION) rather the contract's expiring date. Indeed, as short-term contracts are frequently re-auctioned, the information transmitted by the incumbent in those agreements may always contribute to enhance bidding parity at the

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[10] In particular, the more the municipality lacks network information, the more she will have to invest in order to improve her network's knowledge after switching to in-house provision. This may result in a price increase for consumers, making the transition to direct management less interesting and politically more difficult.

subsequent auction. Conversely the information disclosed at the beginning of long-term agreements is likely to be less informative for challengers at contract's renewal. Consequently if H1 and H2a hold, we can suspect incumbents to be – on average - more reluctant to disclose information in shorter contracts than in longer ones.

Contractual characteristics and reputation effects

However the argument that opportunistic behaviours should increase when the contract's end comes can be contested. Theoretical and empirical studies in contract theory also point out a possible increase in the performance of franchise bidding agreements before contract's renewal, suggesting that opportunism may decrease over time (Rey and Iossa [2010], Chong *et. al* [2006], Affuso and Newberry [2002], Yvrande-Billon and Gautier [2008]). A first reason advanced by the literature to explain this result is that because of bounded rationality problems (limited memory, myopia), public authorities may forget or forgive bad past behaviours and then, they may rather focus on recent performances to decide to renew the incumbent or not. Therefore, an incumbent that wants to preserve its chance to be renewed may be more tempted to behave opportunistically at the beginning of the contract than at the end[11]. A second argument lies in the fact that when the contract's expiring date gets closer, the incumbent becomes more concerned about its contract's renewal than at the beginning of the agreement, which may induce a more fairly conduct. This point is clearly explained in Chong *et. al* [2006]: *"the present value of the renewed transaction depends on both the private operator's discount factor and the time left until this transaction takes place: holding the operator's discount factor constant, if the transaction is going to be realised in some near future, its present value to the operator will be higher than if it's going to take place in some far away future. Therefore, one may think that gains from behaving opportunistically are less likely to outweigh gains from an enhanced probability of contract renewal the closer the private operator is to the term of his contract"*.

The two arguments presented above lead to the same conclusion: an incumbent that wants to enhance the chance to see its contract renewed should be less opportunistic, and then disclose more information when the contract's expiring date becomes closer. In such a situation, EXPIRY would have a negative sign (since lower values for EXPIRY would be associated on average with a higher probability that DINFO, DINFO1, DINFO2 and DINFO3 takes the value 1). Nevertheless, adapting contract theory's proposition to our framework also implies

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[11] The literature evokes different kinds of opportunistic behaviours that may be used by incumbent, including investments' delays, renegotiation claims and of course information concealment and distortion.

that concealing information at the end of the contract decreases the incumbent's probability to be renewed (H2b). In other words, the public authority must commit to sanction the opportunistic incumbent by refusing to renew his contract and to bear the costs of such a decision. This means that she must commit either to switch for in-house provision, even if the lack of network information makes the transition costs to this new organizational mode high, or to opt for an alternative supplier, even if this supplier submits a higher bid than the one proposed by the incumbent[12].

Let's explain in more details why the incumbent's incentives to disclose network information may be lower at beginning of the PPP agreement than at the end. After winning the contract, the incumbent may prefer to withhold his private information for three reasons.

First, at the beginning of the relationship with the municipality, the rents to be perceived on the current contract are high. Hence, even if disclosing information may enable the municipality to invest more efficiently (which would decrease the network's operating costs), the incumbent may obtain higher profits if he decides to behave opportunistically. For instance, after signing the agreement, the incumbent may be able to obtain a price increase by pretending that because of new problems on the network, his costs are higher than expected. In other words, concealing information may enable the incumbent to increase his rents through opportunistic renegotiations. But concealing information may also help the incumbent to protect his rents. Indeed, if the public authority finds out that the incumbent's costs are much lower than expected, she may be tempted to force him to revise his tariffs downward after the contract's signature.

Second, behaving opportunistically at the beginning of the contract may have no consequence with regards to the incumbent's chance to be renewed if the public authority has a bounded rationality.

Finally and anyway, at the beginning of the contract, the incumbent pays more attention to the rents he could get on the current contract than to the present value of a contract that will be signed in some far away future.

However, as the contract approaches to its end, the rents that remain to be perceived on the current contract decrease but the incumbent is more and more concerned about the perspective

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[12] Once again, let's remind that a necessary condition for such a commitment to be credible is that the public authority must have some discretion in the choice of her partner at the auction stage, which is the case in the French water sector.

to see its contract renewed. What's more, the closer the contract's expiring date, the less likely a strategic behaviour will be forgotten by the municipality. Therefore, if H2b holds, the incumbent knows that if he behaves opportunistically toward the end of the contract, he is sanctioned by a non renewal with a probability 1. Anticipating this, his incentives to disclose information should increase as the contract's expiring date comes. Of course, behaving fairly may enhance competition intensity at contract's renewal but also allows the incumbent to preserve some chance to obtain the future contract.

Paradoxically, in the environment described above, the incumbent should give more and more network information as the end of the contract approaches in order to send a good signal to the municipality and then maximize the chance to preserve its market. A lack of cooperation just before the agreement expires would certainly be synonymous with contract termination. This situation can be referred to as "reputation effects internal to the existing relationship" because the fear to lose the current contract may dissuade firms from behaving opportunistically (Zupan [1989b]).

A similar reasoning can be made with the contract's duration (DURATION) rather than the contract's expiring date. Obviously, as short-run agreements are frequently re-auctioned, the incumbent may – on average – feel more concerned about his renewal if the contract is short than if it's long. In an environment characterized by bounded rationality but in which municipalities can commit to sanction strategic behaviours, the incentives to disclose network information should be higher on average when the contract's duration is short.

3.3.3. A summary

In summary, we highlighted above that a negative impact of the geographical competition variables (PCOM, SHAREDM) on our dependent variables (DINFO, DINFO1, DINFO2, DINFO3) may be consistent with the assumption that private firms behave strategically in order to protect their market whereas a positive impact may be consistent with the existence of external reputation effects.

Concerning the influence of the contractual characteristics, a positive sign for ECHEANCE may be consistent with the idea that incumbents conceal information at the end of the contract in order to protect their market from the competition of outsiders. On the contrary, a negative sign may suggest that there exists some internal reputation effects at the end of the PPP contract that induce incumbents to deliver more network information. Finally, the contract's duration represents a complementary proxy for the assessment of incumbents' incentives to

disclose information when the end of the agreement approaches. A negative sign for DURATION may be consistent with the existence of internal reputation effects, since contract that are renewed frequently (short duration) are associated on average with higher level for our dependent variables. On the contrary, a positive sign may reflect strategic behaviours of market protection since short duration contracts are associated on average with lower levels for our dependent variables.

All theses considerations are summarized in the following table:

Table 1. Market protection considerations versus reputation considerations: a summary

	Market protection considerations	Reputation considerations
PCOMP	-[13]	+
SHAREDM	-	+
EXPIRY	+	-
DURATION	+	-

3.4.Control variables

We also included in the model a set of control variables that might impact on the firm's incentives to disclose information.

First of all, in France, incumbents may have some incentives to provide information because in lease contracts, investments with regards to network renewals are realized by municipalities in the majority of the situations. Giving the municipalities relevant and updated information about the network enables more efficient network performances (fewer leakages can be reached thanks to more efficient municipal investments programs). However, when leakages increase on the network, an incumbent can continue to meet a given level of water demand using two strategies: either by producing more water to compensate water losses, either by undertaking actions that reduce these losses, including the disclosure of network information to the municipality to induce efficient renewals. Then, we can think that when producing water is cheap, incumbents may choose to compensate leakages by producing more water. In

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[13] The sign "minus" in the second row and second column can be interpreted as follows: a negative impact of PCOMP on our dependent variables (DINFO, DINFO1, DINFO2, DINFO3) is consistent with the idea that incumbents' behaviours are characterized by strategies of market protection for this variable.

such a case, withholding network information enables the incumbent to keep his informational rents and even if water losses increase, he can continue to meet the water demand by producing more water at a sensible cost. But when producing water becomes more and more costly, the incumbent may be more and more worried about the performance of the network and his incentives to disclose information may increase. Of course, revealing network information may induce a loss of informational rents, but these losses may be lower than the high costs he would incur if he gives priority to water production rather than to network performance and then, efficient renewals.

We include some proxies in the model to account for the cost of water treatment. A first set of controls accounts for the complexity of the water treatment performed by the operator before the distribution of the water. We included dummies for the different types of treatment with the basic treatment as the reference variable (TREATA2, TREATA3, TREATMIX, TREATMIXA3). The more complex the treatment, the more costly water production and then the higher the incumbents' incentives to disclose information.

As an operator can always choose to minimize its treatment costs, we also included dummies for the origins of water. Water can come from an underground source, a source on the surface or a mix of different types of sources. Underground water is the reference. Dummies for the origin of water (SURFACE, MIX) are included in the model, with underground water as the reference variable. On *a priori* grounds, underground water is more expensive to extract than surface water, raising water production costs. We thus expect a negative relationship between the origins of the water and the probability to update.

Controls for the ability of the operator to give the information are also included. We took into account a set of dummies that control if there exists some water losses detecting systems. These systems can be manual or computer-based. When they are computer-based, they can be with a geo-referring system (SIG) or not (NO DETECTION, MANUAL, SI, SIG). All municipalities that combine two or several systems are the reference variable. We assume that the better the detecting system, the higher the capacity of the firm to update the network maps every year and then, the higher our four dependent variables.

Controls for the different operators are also integrated. Dummies for Suez, Veolia, Saur, and independent operators are used as controls. We account for the possibility that some operators can be more reluctant to provide information than others.

We also consider a variable that can be a good proxy for the capacity of the municipality to force the incumbent to produce information. The POPULATION of the municipality can impact on the level of information disclosed by the firm. Indeed, municipalities with a large population probably have a higher capacity to get detailed network maps from the operators because they have more skilled staff and deeper financial resources to hire technical experts that can control the nature of the information disclosed by the firm. POPULATION should thus have a positive impact on our information variables.

The DENSITY of the network is measured as the ratio between the length of the network and the population. We expect that the higher DENSITY, the higher the number of kilometers of network per inhabitant and then the more difficult it may be to regularly update the network maps.

Per capita consumption of water is described through the variable CONSHAB. The higher the consumption per capita and the lower the average production costs because fixed costs can be spread on a higher level of production. CONSHAB is thus a proxy for the economies of consumption densities realized. Networks where CONSHAB is high may be those with the highest level INFORMATION because they may be able to afford to allocate resources to the production of network information. On the contrary, networks where the water consumption per inhabitants is low probably have higher average production costs. They may have more difficulties to allocate resources for constant network maps updates. Then, we expect that the higher CONSHAB, the higher the probability to observe a network update.

SCARCITY is a ratio that measures the degree of independence of a municipality concerning the provision of water to its population. The lower SCARCITY, the more the municipality is obliged to import water from other municipalities to meet users' demand. If SCARCITY is close to 0, the firm running the water service totally depends on the imports of another municipality for her users' water provision. Water scarcity may incite incumbents to improve network performance in order to economize on water losses. This may result in higher incentives to disclose information to the municipality so as to induce efficient investments that may contribute to reduce leaks.

We also consider whether a municipality that is part of a grouping of municipalities to provide water has a bigger market power. A dummy INTER-AUTHORITY equals to 1 if the municipality provides water jointly with others and 0 otherwise. This is due to the fact that grouping of municipalities may have higher experience and financial power than

municipalities alone. We expect a positive impact of this dummy on the level of information disclosed by the firm to the public authorities.

As there are some geographical asymmetries in the degree of competition in the different geographical areas, we included dummies for the 26 French regions[14]. This allows us to take into account some geographical shocks. A detailed description of all the variables used is given in annex 1 and some descriptive statistics are reported in annex 2.

3.5. Estimation methodology

The general models we intend to test take the following form:

$$DINFO_i = \alpha_1 PCOMP_i + \alpha_2 SHAREDM_i + \alpha_3 EXPIRY_i + \alpha_4 DURATION_i + \alpha_5 X_i + e_i$$

$$DINFO1_i = \alpha_6 PCOMP_i + \alpha_7 SHAREDM_i + \alpha_8 EXPIRY_i + \alpha_9 DURATION_i + \alpha_{10} X_i + u_i$$

$$DINFO2_i = \alpha_{11} PCOMP_i + \alpha_{12} SHAREDM_i + \alpha_{13} EXPIRY_i + \alpha_{14} DURATION_i + \alpha_{15} X_i + v_i$$

$$DINFO3_i = \alpha_{16} PCOMP_i + \alpha_{17} SHAREDM_i + \alpha_{18} EXPIRY_i + \alpha_{19} DURATION_i + \alpha_{20} X_i + w_i$$

where $EXPIRY_i$ and $DURATION_i$ proxy the influence of the proximity of the contract's renewal date on incumbents' incentives to provide information, $PCOMP_i$ and $SHAREDM_i$ proxy the influence of geographical competition (between firms and between organizational modes) on incumbents' incentives to provide information, and X_i is a set of controls for a given municipality i. These four equations are estimated using a standard probit procedure.

3.6. Results

The following table shows our estimates of the impact of PCOMP, SHAREDM, EXPIRY and DURATION on our four dependent variables (DINFO, DINFO1, DINFO2, DINFO3).

Dep. Var	(1) Probit **DINFO**	(2) Probit **DINFO1**	(4) Probit **DINFO2**	(5) Probit **DINFO3**
PCOMP	-0.546**	0.0266	-0.155	-0.786***
	(0.232)	(0.194)	(0.195)	(0.191)
SHAREDM	0.493***	0.400***	0.299**	0.177
	(0.176)	(0.151)	(0.150)	(0.146)
EXPIRY	0.0187**	0.0229***	0.00834	0.00190
	(0.00797)	(0.00685)	(0.00664)	(0.00640)
DURATION	0.00461	0.00557**	0.00655***	0.00704***

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[14] France is divided in 26 regions, including overseas territories.

	(0.00308)	(0.00248)	(0.00235)	(0.00218)
TreatA2	-0.106	-0.0757	-0.217**	-0.0427
	(0.113)	(0.0971)	(0.0948)	(0.0938)
TreatA3	-0.164	-0.140	-0.139	0.123
	(0.112)	(0.0981)	(0.0977)	(0.0953)
TreatmixA2	-0.152	-0.0288	-0.127	0.102
	(0.159)	(0.143)	(0.138)	(0.134)
TreatmixA3	-0.345**	-0.212*	-0.324***	-0.0220
	(0.141)	(0.129)	(0.126)	(0.123)
Surface	0.321***	0.0719	0.165	-0.0719
	(0.122)	(0.103)	(0.103)	(0.101)
Mix	-0.0352	0.0696	0.157*	-0.198**
	(0.102)	(0.0919)	(0.0905)	(0.0889)
SIG	0.161	0.274***	0.123	-0.0330
	(0.124)	(0.0993)	(0.0980)	(0.0906)
SI	-0.183	-0.398***	-0.350***	-0.428***
	(0.138)	(0.112)	(0.112)	(0.107)
Manual	-0.546***	-0.467***	-0.656***	-0.628***
	(0.123)	(0.102)	(0.102)	(0.0980)
No Detection	-0.741***	-0.546***	-1.013***	-0.974***
	(0.128)	(0.111)	(0.111)	(0.111)
Inter-authority	0.277***	0.396***	0.172**	0.107
	(0.0812)	(0.0713)	(0.0707)	(0.0696)
Scarcity	0.541***	0.740***	0.185	0.0252
	(0.131)	(0.117)	(0.117)	(0.115)
Density	0.000714	0.000793	-0.00119	-0.00167
	(0.00127)	(0.00111)	(0.00103)	(0.00103)
Conshab	1.086	0.198	-1.055	1.453*
	(1.032)	(0.814)	(0.783)	(0.794)
Population	6.70e-06*	1.11e-05***	-3.60e-07	-2.39e-07
	(3.47e-06)	(3.14e-06)	(5.86e-07)	(6.06e-07)
Op1	-0.118	-0.188*	-0.0345	0.418***
	(0.109)	(0.0961)	(0.0948)	(0.0925)
Op2	0.116	-0.0288	0.171*	0.676***
	(0.123)	(0.105)	(0.104)	(0.0984)
Op3	0.0922	-0.179*	0.0465	0.377***
	(0.117)	(0.101)	(0.100)	(0.0979)
Constant	0.406	-0.735***	0.323	-0.0281
	(0.255)	(0.218)	(0.216)	(0.211)
Regional Dummies	YES	YES	YES	YES
Observations	2,330	2,330	2,330	2,330

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

EXPIRY has a positive sign in all the specifications, and it is significant in two of them. What's more, the influence of DURATION is also positive and significant in three out four specifications. Therefore, the lower the contract's duration or the lower the number of years remaining before contract's renewal, the lower the probability that an update is observed. This result is consistent with the assumption of information retention with the proximity of the contract's renewal. Concealing information may help the incumbent to protect his market by raising the costs for the municipality to switch for a new supplier or a new organizational mode.

The presence of other firms in the neighbourhood (high values of PCOMP) decreases the probability to update in a given municipality, which is also consistent with the idea that incumbents may consider the presence of other operators in the region as a threat for their market, which may induce them to disclose less information.

However, the presence of municipalities in public direct management (high values of SHAREDM) increases the probability that municipalities in PPP update their network maps. This result may be consistent with the idea that municipalities in PPP behave fairly so as to send a good signal to the neighbour municipalities in direct management and convince them to switch for a PPP contract.

To sum up then, our preliminary results suggest that reputation effects play a weak role to induce incumbents to behave fairly with regards to information disclosure, except for those located in regions where in-house provision is dominant. The results on these two variables are also consistent with the findings of Chong et. al [2006] suggesting that potential competition between organizational modes is more effective to induce private firms to behave fairly than competition between firms.

3.7. Control variables

Contrary to what we expected, the treatment type has a negative impact on the probability to update the maps. The origin of water also have a non expected sign, has it is positive and significant in one specification whereas we rather expected a negative sign. Then, the more costly it is to produce water (the more costly the water treatment and/or the more costly its extraction), the lower his incentives to update the network maps. SCARCITY admits a significant sign in 2 out of 4 specifications, but contrary to our expectations, it is positive. In other words, the more abundant the resource in a municipality, the higher the probability to update the network maps. Concerning the other variables, they are either non significant

(RESHAB, CONSHAB), or their sign is consistent with what we expected *a priori* (SIG, SI, MANUAL, NO SYSTEM, INTERAUTHORITY, POPULATION).

and the origin of water do not have a significant impact on INFORMATION, which suggests that water production costs do not impact on firm's incentives to disclose information.

CONCLUSION

In this paper, we highlighted that a firm signing a PPP contract with a municipality can theoretically have incentives to disclose some elements of its private information when internal and external reputation matter. But one can also argue that she may also withhold information in order to protect her market from competition, creating a winner's curse problem for her rivals. Leading an econometric study on the French water industry in 2004, we showed that dissimulation incentives dominate disclosure incentives.

Our results then suggest that some strategic actions, particularly those that enable the incumbent to protect his current contracts, may not be easily curbed by reputation effects. This conclusion depart from other empirical studies on the field that focused on other dimensions of opportunism and showed that both internal and external reputation effects can be powerful institutional features to mitigate opportunism.

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ANNEX 1: VARIABLES (DEFINITION AND BASIC DESCRIPTIVE STATISTICS

Variables	Definition	Observations	Mean	Std. Dev.	Min	Max
DINFO	Takes the value 1 if a network map update is observed in 2004	2330	0,829	0,376	0	1
DINFO1	Takes the value 1 if a network map update is observed in 2004 with topographic information	2330	0,643	0,479	0	1
DINFO2	Takes the value 1 if a network map update is observed in 2004 with detailed description of the section(s) (age of mains, material used)	2330	0,648	0,477	0	1
DINFO3	Takes the value 1 if a network map update is observed in 2004 with a localization and historic of the intervention realized (pipes repairs)	2330	0,494	0,5	0	1
PCOMP	Proxy for the potential competition intensity at the department level	2330	0,509	0,158	0	0,759
SHAREDM	Percentage of the municipalities in the department that chose in-house provision	2330	0,283	0,199	0	0,95
EXPIRY	Time to the end of the contract measured in years (year of contract termination – 2004)	2330	6,749	4,48	0	21
DURATION	Contract's duration (in years)	2330	19,91	15,84	1	89
TREAT A2	Takes value 1 when raw water needs an intermediate disinfection treatment	2330	0,141	0,348	0	1
TREAT A3	Takes value 1 when raw water needs a heavy disinfection treatment	2330	0,219	0,414	0	1

TREATMIXA2	Takes value 1 when raw water needs mix kind of treatment (A1 & A2 because water comes from different sites)	2330	0,054	0,226	0	1
TREATMIX A3	Takes value 1 when raw water needs mix kind of treatment (A1, A2 and A3 because water comes from different sites)	2330	0,071	0,257	0	1
SURFACE	Takes value 1 when the water origin is surface	2330	0,149	0,356	0	1
MIX	Takes value 1 when water origin is mixed	2330	0,216	0,412	0	1
SIG	Takes value 1 if the local authority has geo-referring information system to localize leaks	2330	0,388	0,487	0	1
SI	Takes value 1 if the local authority has an information system to localize leaks	2330	0,133	0,339	0	1
MANUAL	Takes value 1 if the local authority uses manual operations to localize leaks	2330	0,222	0,416	0	1
NO DETECTION	Takes value 1 if the local authority has no detection system to localize leaks	2330	0,132	0,338	0	1
INTERAUTHORITY	Takes value 1 if the local authority is organizing water distribution in cooperation with other local authorities	2330	0,763	0,424	0	1
SCARCITY	Produced volume/(produced volume + imported volume)	2330	0,862	0,253	0	1
DENSITY	Number of kilometers of network/Population	2330	23,11	27,68	0	710,52
CONSHAB	Volume of consumed water/Population	2330	0,068	0,033	0,006	0,441
POPULATION	Number of inhabitants concerned by the contract	2330	9472,58	48392,92	31	2125246

OP1	Takes 1 if the local authority has a PPP contract with this operator	2330	0,414	0,492	0	1
OP2	Takes 1 if the local authority has a PPP contract with this operator	2330	0,221	0,415	0	1
OP3	Takes 1 if the local authority has a PPP contract with this operator	2330	0,245	0,43	0	1

Table 1: Average value of the probability *P** of updating network maps (DINFO) depending on the Herfindahl Index in 2004

Herfindahl Index (H)	Observations	Mean	Standard deviation
H < 0.5	980	0.811	0.391
0.5 ≤ H < 0.7	994	0.826	0.379
0.7 ≤ H ≤ 1	798	0.803	0.398

Table 2: Average value of the probability *P** of updating network maps (DINFO) depending on the share of direct public managed services at the local level in 2004

Sharedm (S)	Observations	Mean	Standard deviation
S < 0.1	949	0.781	0.414
0.1 ≤ S < 0.2	699	0.817	0.387
0.2 ≤ S < 0.5	583	0.849	0.358
0.5 ≤ S < 1	541	0.832	0.374

Table 3: Average value of the probability *P** of updating network maps (DINFO) depending on the time to the end of the contract in 2004

Time to expiry (T)	Observations	Mean *P**	Standard deviation
T < 2	269	0.732	0.444
1 ≤ T < 4	380	0.782	0.414
4 ≤ T < 6	351	0.838	0.369
6 ≤ T < 8	451	0.858	0.349
8 ≤ T < 10	312	0.856	0.352
T ≥ 10	647	0.859	0.347

Table 4: Average value of the probability *P** of updating network maps depending on the duration of contracts in 2004 (DINFO)

Duration (D)	Observations	Mean *P**	Standard deviation
D < 10	338	0.796	0.403
10 ≤ D < 12	797	0.816	0.388
12 ≤ D < 15	339	0.838	0.369
15 ≤ D < 20	294	0.867	0.334
D ≥ 20	760	0.842	0.365