Does Intermunicipal Cooperation Increase Prices? An Economic Analysis of the French Drinking Water Sector

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Working Paper
April, 2024

Abstract

The provision of drinking water has become a central concern for public authorities due to climate change, prompting policymakers to reevaluate their approach to this semi-renewable resource. In this paper, we identify factors explaining intermunicipal cooperation and assess the impact of this organizational choice on performance. Using a comprehensive panel dataset comprising all French drinking water providers from 2008 to 2021, we identify the determinants of the price of drinking water as municipalities deliberate between autonomous management and collaborative endeavors within community frameworks. Our empirical findings reveal a selection bias in the estimation of price equations. Prices paid within the framework of intermunicipal cooperation exceed those under municipal management, and this difference in performance can be explained by preexisting strengths and weaknesses of the drinking water provider.

JEL Classification: H11; H77; L11; L95

Keywords: Intermunicipal cooperation, local government, public services, drinking water prices, selection bias

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1 Introduction

Recent decades have been characterized by a growing interest from central governments in enhancing the performance of public services. More specifically, an increasing number of reforms are being embraced with the aim of achieving economies of scale in the provision of certain services such as waste management, drinking water, and gas. Intermunicipal cooperation (IMC) has swiftly emerged as an acknowledged means by developed nations to generate economies of scale and enhance the quality of these services (Bel and Mur, 2009). Moreover, sharing skills within interorganizational structures is expected to reduce production costs (Elston et al., 2018), while better maintaining production control. Nevertheless, it becomes apparent that this organizational approach does not enjoy unanimous support, as a significant portion of local governments reject IMC. Despite the potential for shared competencies to reduce production costs and achieve economies of scale, municipalities affiliated with intermunicipal structures often exhibit diverse political affiliations and harbor disparate ambitions.

The French drinking water sector is a local natural monopoly and municipalities are historically responsible for the provision of this resource. While numerous authors have explored the delegation of public services to private companies (Garcia and Thomas, 2001; Carpentier et al., 2006), IMC has long been sidelined in the analysis of public service performance. However, previous authors have conducted empirical studies on the cost evolution following an IMC, and results are varied. Production costs evolve differently depending on whether one focuses on the drinking water sector, sanitation, waste management, or medical environment. Indeed, while Garcia (2003) showed that water services benefited from economies of scale after being merged into intermunicipal structures, (Aldag et al., 2020) indicated that costs increased for solid waste collection and remained unchanged for ambulances and fire services. IMC has the potential to achieve economies of scale, but this is not a guaranteed outcome, as the reduction in production costs may be offset by the creation of organizational costs.

In this paper, we identify certain factors that explain IMC and assess the impact of this organizational choice on performance. Using a comprehensive panel dataset comprising all French drinking water services from 2008 to 2021, we provide an empirical analysis of the performance of the French drinking water sector. The municipalities' decision to cooperate is endogenous and subject to selection bias. To address this issue, we employ the two-step econometric method proposed by Heckman (1976, 1979) and treat unobserved heterogeneity and serial correlation issues by using a correlated random effects (CRE) framework (Mundlak, 1978; Wooldridge, 2010). The results show that the choice to join an intermunicipal structure is not random and we identify a selection bias in the estimation of our price equations. Prices paid within the framework of intermunicipal management exceed those under municipal management, but this gap in performance is explained by preexisting conditions.

Our work aligns with both the analysis of public service performance and the efficiency of contractual choices on prices paid by consumers. We believe that our paper contributes to the literature on the local governance of public services and natural resource management. The pricing of drinking water has become a central concern for public authorities due to climate change, prompting governments to reconsider their approach to this semi-renewable resource. The performance of the drinking water sector has been extensively analyzed, focusing on the price paid by consumers as well as the operational costs of drinking water and sanitation services. However, to our knowledge, there has been no study on the impact of IMC on prices paid by consumers in this sector.

This paper is organized as follows. Section 2 provides a literature review of the impact of intermunicipal cooperation on the costs and performance of the French drinking water sector. Following this literature review, we present our research hypotheses. This is followed by a presentation of the institutional background of the French drinking water sector in section 3. Section 4 provides a description of our data and variables used in the study. Then, we present our empirical strategy and results regarding the impact of IMC on performance in section 5. To do so, we consider that the decision to join an intermunicipal structure is endogenous. Finally, we conclude in section 6.

2 Related literature

The link between the efficiency of public services and their organizational arrangements has been widely studied in the literature. In addition to theoretical studies, many empirical studies have analyzed the performance of the French drinking water sector. However, to our knowledge, no study has identified a signficicant link between IMC and the performance of the French drinking water sector.

2.1 Intermunicipal cooperation and costs

In their seminal papers, Bish and Ostrom (1973) argue that the effectiveness of public goods provision is associated with service sharing. Their analysis highlighted the critical role of incentives, mutual trust, control mechanisms, and clarity of objectives in promoting effective cooperation in public service management. They show that successful cooperation in public service management hinges on a complex interplay of factors, ranging from incentives to trust. Parks and Oakerson (1993) showed that IMC reduces production costs without losing local identity by analyzing public utilies managed by intermunicipal structures in St. Louis, Missouri and Pittsburgh, Pennsylvania. Ultimately, IMC represents an efficient organizational arrangement for correcting negative externalities and achieving economies of scale.

These conclusions have been partially challenged by the transaction cost theory. Indeed, the latter has come into conflict with the Public Choice school by making a clear distinction between production costs and organizational ones. Under transaction cost theory, Williamson (1968, 1976) argue that larger organizations can more effectively absorb the fixed costs associated with transaction execution, resulting in overall cost reduction. Similarly, within the context of intermunicipal cooperation, the consolidation of services among multiple municipalities can lead to economies of scale by reducing fixed costs through resource and infrastructure sharing, thus potentially lowering costs for each involved municipality. However, IMC can yield more varied outcomes regarding organizational costs, which may increase following the cooperation process, stemming from new negotiations among the partners of the intermunicipal structure (Williamson, 1996). This theoretical framework is therefore particularly useful for analyzing IMC and its effect on the performance of a particular sector. Lowery (2000) and Feiock (2007) highlighted that joining an intermunicipal structure was costly because of the coordination and negotiation among the members of such a collaborative relationship. Alongside these new transaction costs, Rodrigues et al. (2012) defined "political transaction costs" as a consequence of the collaboration of various political parties in an intermunicipal organization, which incurred expenses due to ideological divergences. Moreover, elements such as surveillance and oversight play a central role.

There is no consensus regarding the impact of IMC on costs and performance. More precisely, Bel and Warner (2015) reported that findings on intermunicipal cooperation and production costs yield diverse outcomes, depending on the country and the area studied. Bel and Costas (2006) found that privatization had no significant effects on costs, while IMC was associated with lower costs in Spain. Clear evidence of cost reductions was also found by Dijkgraaf and Gradus (2013) in Netherlands, Soukopová et al. (2018) in Czechia and Aldag et al. (2019) in the United States. Alongside these empirical findings in the solid waste sector, Sørensen (2007) and Garrone et al. (2013) identified an increase in costs after local governments decided to join forces through IMC in Norway and Italy. In France, Garcia and Thomas (2001) showed that water providers benefit from significant economies of scale when merging, while Frère et al. (2014) found that IMC had no significant impact on the level of municipal public spending. Finally, by conducting a difference-in-differences empirical strategy, Tricaud (2021) shows that new costs could be generated by IMC, proving that organizational costs could offset reductions in production costs.

Although the literature presents conflicting perspectives on the impact of IMC on costs, a consensus seems to emerge across scholars. Recent studies have emphasized that size is a crucial factor in analyzing the impact of IMC on a sector (Gori et al., 2023; Blåka et al., 2021). These empirical findings align with the results identified by Garcia (2003), who pinpointed an effective size of IMC beyond which achieving economies of scale becomes impractical.

2.2 Performance of the French drinking water sector

For decades, economists have been interested in the French drinking water sector because of its market structure and governance modes. Structured as a local monopoly, this sector exhibits high fixed costs, which could be reduced through IMC. Local governments play a central role since they are responsible for organizing this market at the local level. However, most studies on the performance of the sector have analyzed the impact of public service delegation on costs or prices. Thus, Ménard and Saussier (2003) demonstrated that for the contractual relationship to function, water provider must be credible in its threat of sanctions and must enforce them when necessary. These theoretical conclusions have been empirically tested by Chong et al. (2015), who identified the vulnerability of small drinking water providers to private companies. Indeed, their low credibility leads the delegated entities to impose higher prices than larger service providers would, all else being equal. Therefore, the sector's performance can be partially explained by the size of the water service.

The prices paid by consumers in the French drinking water sector closely represent the costs supported by local governments. This can be explained by the "water pays water" principle, which compels local governments to establish a price that generates revenue equal to expenditure. The link between contractual choices and performance has been established in numerous empirical studies showing that the performance of the French drinking water sector can be influenced by the management mode chosen by water services (Ménard and Saussier, 2003; Le Lannier and Porcher, 2014). However, the difference in performance can also be explained by observed and unobserved factors (Carpentier et al., 2006). The difference in performance can, therefore, be elucidated by external factors and is not invariably accounted for by the organizational mode selected by the municipality or intermunicipal structure. The authors reached this conclusion by identifying a selection bias during the estimation of price equations using the method introduced by Heckman (1976). In our case, a potential selection bias may also have arisen. As a result, our empirical analysis will similarly be grounded in this method, which has demonstrated its efficacy in assessing the performance of the French drinking water sector. These findings have significantly propelled the literature on the performance of the drinking water sector forward.

The quality of the resource has emerged as a fundamental variable in the analysis of the performance of the drinking water sector. For an extended period, the pricing of drinking water was estimated without considering parameters measuring water quality. Using structural or reduced-form models, Garcia et al. (2005) and Carpentier et al. (2006) reported that the price is not only explained by geographical effects or the size of the water service, but is also highly determined by the quality of the resource and losses in the network. The study conducted by Destandau and Garcia (2014) also investigated variations in management modes concerning cost and service quality within a sample of U.S. water services. They concluded that the marginal costs of drinking water production are greater for private operators. These findings were confirmed by Le Lannier and Porcher (2014), who emphasized that public management is more efficient. Indeed, due to the presence of information asymmetry and third-party opportunism, water service providers that delegate resource management must compensate for the transaction costs associated with monitoring the private company throughout the contract duration (Moszoro and Spiller, 2011; Beuve et al., 2019). These challenges are similarly present in the decision-making process regarding cooperation, as members of an intermunicipal structure may be motivated by divergent political aspirations. More precisely, intermunicipal cooperation may be perceived opportunistically as a means to enhance public financing during electoral cycles (Bischoff and Wolfschütz, 2021).

2.3 Research hypotheses

The previous literature review revealed the absence of a consensus regarding the impact of IMC on costs and performance. Nonetheless, transaction cost theory allows for the identification that this governance mode may lead to varied outcomes. Mayol and Saussier (2023) describes communities as political intermunicipal structures composed of members from different political backgrounds. Feiock (2007) highlighted that political cooperation among local governments may result in additional organizational costs, particularly due to diverging interests and political objectives among community members. Furthermore, according to Chong et al. (2006), coordination and negotiation costs can be significant factors in the provision of drinking water, potentially leading to an overall increase in the price paid by consumers. Therefore, intermunicipal cooperation may result in higher costs for drinking water, leading to an increase in the price of water for consumers.

Hypothesis 1: *Intermunicipal cooperation leads to an increase in the price paid by consumers.*

As illustrated by Carpentier et al. (2006) and Boyer and Garcia (2008), failing to account for potential selection bias in estimating the price of drinking water leads to biased estimates. Water services opting for IMC may exhibit specific characteristics that influence both their decision to cooperate and the price of drinking water. More precisely, drinking water providers facing financial or geographical difficulties may be more inclined to cooperate to share resources and costs with other providers. However, this cooperation could lead to nonrandom selection of drinking water providers, where those facing more severe problems are more likely to cooperate. Consequently, the price of drinking water may be influenced by these selection factors.

Hypothesis 2: *Drinking water providers' choice to engage in intermunicipal cooperation is influenced by selection bias.*

3 Institutional framework

France has a unique territorial framework with more than 35,000 municipalities and 13,000 water services[1]. Each service serves an average of 5,800 inhabitants, municipalities have an average of 1,800 inhabitants and 32,000 municipalities have fewer than 2,000 inhabitants. A similar result is found for water services, with more than 80% serving fewer than 10,000 inhabitants. Municipalities are ruled by a municipal council, renewed through elections every six years, which is responsible for the municipal budget, urban planning, environmental protection, sports, educational, and social facilities, cultural activities, and economic development.

Municipalities have historically been entrusted with the management of drinking water for several reasons. Firstly, the municipality represents the administrative unit clos-

[1] A drinking water service is defined by article L. 2224-7 of the General Code of Local Authorities as "any service providing all or part of the production by capture or pumping, protection of the abstraction point, treatment, transport, storage, and distribution of water intended for human consumption."

est to residents, facilitating the transportation of drinking water over shorter distances, thereby preserving its quality. Second, the local population typically exhibits greater trust in local governments than in national governments (Bischoff and Wolfschütz, 2021). However, the municipality may opt for a collective management of drinking water by joining an intermunicipal community.

Communities were created by the "Chevènement law" in 1999 and primarily aimed to develop the economic and social activities of the territory in which they are located (drinking water, waste treatment or urban planning). When a municipality decides to merge into a community, the responsibility for providing drinking water to users is transferred from the service to the community. Therefore, decision-making regarding the management of drinking water is undertaken by the community council. Mayol and Saussier (2023) argued that communities are political forms of IMC and are at the core of a territorial project with the aim of maximizing the general interest. This is enabled by their fiscal resources, which are directly generated through a taxation system voted on by members of the community. As a result, the community is not dependent on contributions from its members or the national government.

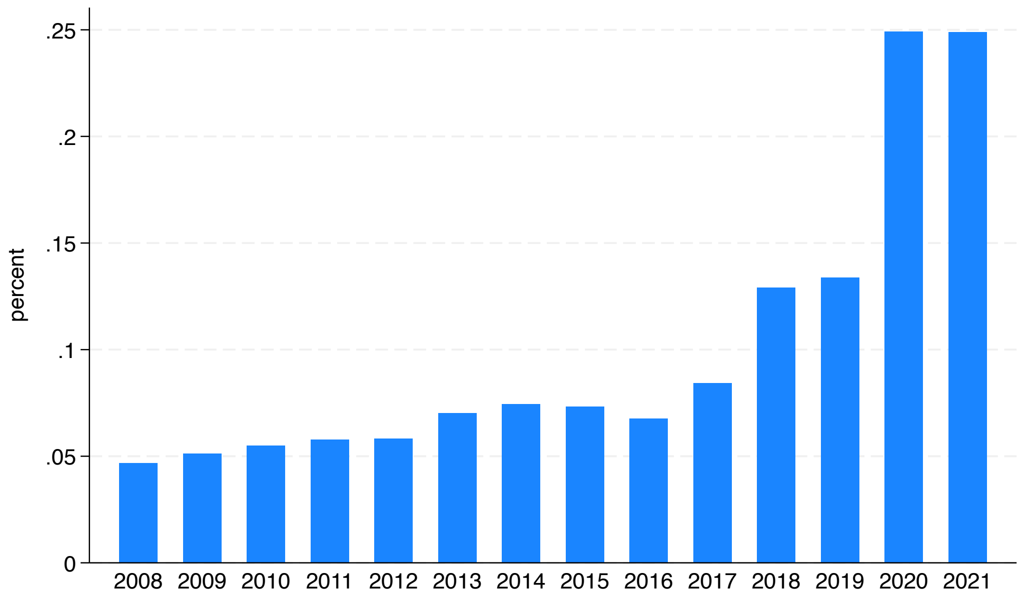
To join a community, a water service must meet geographical criteria, but the decision must primarily be approved by its governing council of the service. Once the decision is adopted, the transfer of responsibilities occurs. The representation of a water service in the intermunicipal council is proportionate to the population it serves. The president of the intermunicipal structure is then elected, and decision-making is collective and is subjected to a vote. A member no longer in agreement with the decisions made is free to leave the intermunicipal structure but, when joining the structure, it must meet certain criteria. Indeed, the decision must be approved by the council governing the intermunicipal entity, and tangible reasons must be presented in an impact study that assesses the effects of the departure on the expenditures and revenues of the community[2].

In 2015, the French Parliament passed the NOTRe law, which represented an additional incentive for IMC. Through this legislation, the central French government initiated a new decentralization process by granting more powers to municipalities and

[2] Article L. 5211-19 of the General Code of Local Authorities.

communities. To encourage cooperation, the minimum population threshold for a community was set at 15,000 inhabitants, and the management of drinking water and sanitation had to be transferred to communities by January 1, 2020. However, this obligation was postponed to January 1, 2026, by the French Parliament. The NOTRe law aimed to reduce the number of water providers from 13,000 to 2,000 and increase their average population served from 5,800 to 46,500 (Pezon, 2019). However, as shown in Figure 1, these objectives seem far from being achieved, as in 2021, only 25% of services were managed by communities.

Figure 1: Share of communities responsible for drinking water provision in France



4 Data and sample

4.1 Data

The database we used in our empirical strategy is an official database provided by the French Biodiversity Observatory. This institution is directly affiliated with the Ministry of Ecological Transition, and data are collected annually from drinking water services[3]. In France, it is mandatory for all drinking water and sanitation services to provide financial and organizational information (especially water and network quality).

[3]Data are publicly accessible at this link: https://www.services.eaufrance.fr/pro/telechargement

Sanitation constitutes a significant portion of the water price but is an independent service from drinking water supply. Therefore, it is not included in the scope of our study. From these data, we constructed a comprehensive panel encompassing all French drinking water services from 2008 to 2021. However, services lacking crucial information (such as pricing or management modes) are excluded from our analysis. This allows us to work with more than 3,700 services annually. Table 1 is a summary of the variables used in this study.

Table 1: Summary of variables

Variables	**Description**
Price_{it} (constant 2015 euros)	Prices paid by consumers for 120 cubic metres of drinking water in year t
Community_{it}	Dummy variable that takes a value of 1 if a community is responsible for water provision and 0 if the provision is under a municipal management
Public_{it}	Dummy variable that takes a value of 1 if water provision is under public management and 0 otherwise
Return_{it} (%)	Ratio between the volume of water consumed by users and the volume of treated water introduced into the distribution network
Nondomestic share_{it}	Share of total water consumption by nondomestic users of service i in year t: $\frac{\text{Nondomestic Volume}}{\text{Consumed Volume}}$
Import share_{it}	Share of produced water that was imported: $\frac{\text{Imported Volume}}{\text{Produced Volume}}$
Export share_{it}	Share of produced water that was exported: $\frac{\text{Exported Volume}}{\text{Produced Volume}}$
Microbiological Conformity_{it} (%)	Compliance rate of water regarding microbiological parameters
Physicochemical Conformity_{it} (%)	Compliance rate of water regarding physicochemical parameters such as pesticides, nitrates, chromium, and bromate
Population_{it}	Number of inhabitants served by water service i in year t
Water Factories_{it}	Number of stations needed to distribute water in year t
Revenues_{it} (Euros)	Annual revenue generated by service i in year t.

4.2 Dependent variable

The performance of the French drinking water sector can be gauged through the annual price paid by consumers for 120 cubic metres of water because this variable is indicative of the costs borne by the entity responsible for providing drinking water. Prices are set by the municipality or the community responsible for water provision and depend on multiple factors, such as the required investments in the network and geographical constraints. However, French legislation requires prices to perfectly represent costs incurred by the local authority following the "water pays water" principle. Finally, this variable is adjusted for inflation.

The responsible government (municipality or community) has the ability to delegate water provision to a private company. In this case, public authorities face information asymmetry framework, and the private company may engage in opportunistic behaviours. To limit this, the French legislation implemented rules so that delegation contracts specify a price structure and private companies are allowed to renegotiate it only under exceptional conditions. Therefore, even in the case of private management, prices are set to perfectly represent the costs incurred by the needed investments. Carpentier et al. (2006) and Chong et al. (2006) show that there is no significant influence of the management mode on the performance of the French drinking water sector. The gap in performance comes from unobserved factors. Figure 2 shows the evolution of prices paid by consumers between 2008 and 2021. The blue line represents the price under municipal management and the red line represents the prices under a community management. All prices are expressed in constant 2015 euros. The gap between IMC and municipal management remained almost the same after 2011.

Figure 2: Price evolution under IMC and municipal management

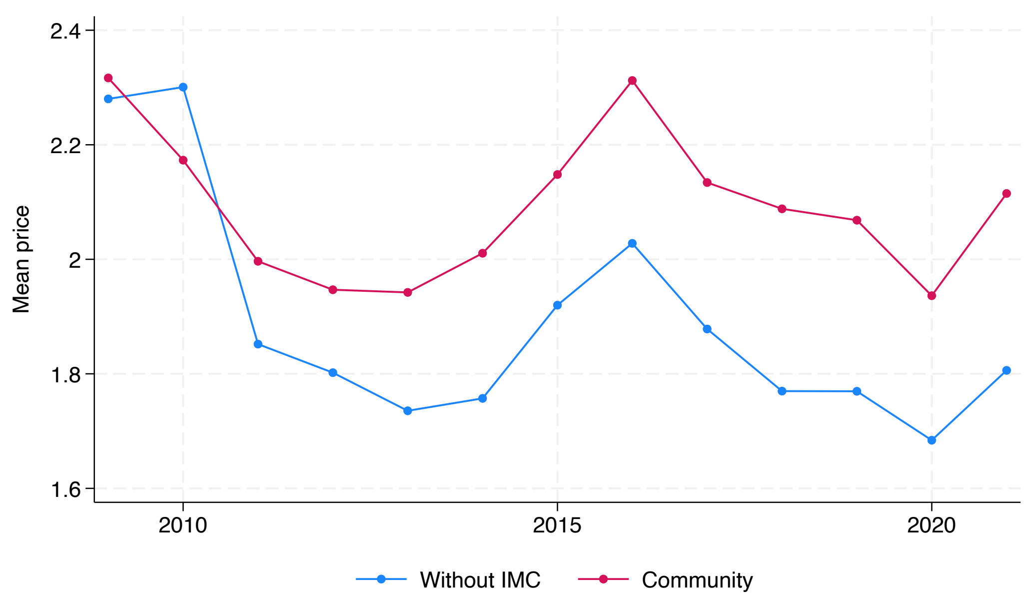


Table 2 shows more detailed information on the price paid by consumers. Standalone municipalities appear to exhibit better performance, as evidenced by lower prices. However, it seems that the governance mode (public or private) chosen by municipalities and communities has an impact on the gap in performance. While the price discrepancy stands at 8.23% for communities and municipalities overseeing public water management, it decreases to a mere 0.92% when service provision is delegated to a private company.

Table 2: Average price paid by consumers for 120 cubic metres of water (2008-2021)

Water Services	**Average Price**	**Std. Dev.**	**Obs.**
All services	2.025	0.002	64,080
Cooperation			
Without IMC	1.897	0.003	35,330
Community	2.073	0.006	6,748
Community/Without IMC Gap	*+9.23%*		
Public Management			
Without IMC	1.776	0.003	25,064
Community	1.921	0.008	2,677
Community/Without IMC Gap	*+8.23%*		
Private Management			
Without IMC	2.192	0.006	10,266
Community	2.172	0.008	4,071
Community/Without IMC Gap	*+0.92%*		

Note: Calculations from the authors. "Std. Dev." stands for the standard deviation.
Prices are corrected for inflation and expressed in constant 2015 euros.
"Community/Without IMC Gap" represents the percentage difference between services under a community management and independent services.

4.3 Explanatory variables

To estimate how organizational choices influence performance, we built a $Community_{it}$ dummy variable, to indicate whether drinking water service is managed by a community or by a standalone municipality. When the provision of drinking water is the responsibility of a community, the variable equals 1. If the service is managed by a standalone municipality, it equals 0.

As noted above, the drinking water provision can be delegated by a municipality or a community to a private company through a delegation contract. Therefore, we add the $Public_{it}$ variable, which equals 1 if the water service is under public management and 0 if the service is under private management.

We also used quality variables to measure the conformity to Physicochemical and microbiological standards (variables *Physicochemical* $Conformity_{it}$ and *Microbiological* $Conformity_{it}$). These quality indicators are important outcomes because municipalities usually justify their decision to join communities with the aim of addressing quality issues.

Another quality indicator is the ratio between the volume of water consumed by users and the volume introduced in the network (variable $Return_{it}$). Studies consider water network losses to be both a good indicator of technical quality and an environmental indicator (Le Lannier and Porcher, 2014). It is also an important indicator because water conservation is at the centre of European considerations and water quality is highly regulated by the French legislation.

We added variables related to volumes and how they are used by water services. The *Import (Export)* $share_{it}$ variable reflects the share of produced volume that is dedicated to imports (exports). We expect that importing water would lead to higher prices because the municipality (or the community) depends on other municipalities and water must pass through a longer distribution network. We add the *Nondomestic* $share_{it}$ variable which refers to the share of produced water used for purposes other than domestic use. Nondomestic uses typically include water utilization in industry and agriculture. Local authorities and regulatory bodies monitor this outcome to implement effective water management policies.

Finally, we add control variables such as $Population_{it}$, which refers to the population served by the drinking water service. We add this variable to control for the size of the provider. Prior research posits that $Price_{it}$ and $Population_{it}$ should be negatively correlated (Chong et al., 2015). We also added the *Water* $Factories_{it}$ variable which refers to the number of stations needed to distribute the water.

The descriptive statistics of the variables for our samples are presented in Table 3. As discussed above, the price paid by consumers is greater when drinking water is provided by communities. Moreover, communities appear to be more inclined towards private management rather than public management. This is surprising, considering that within an intermunicipal structure, reaching a consensus on a delegation contract may seem challenging. This phenomenon could be explained by the fact that a community represents a form of formal political IMC that helps the members reach an agreement more easily. Both samples exhibit similar microbiological qualities and network returns.

Table 3: Descriptive statistics of the samples

Variables	**Communities**			**Standalone municipalities**		
	Mean	**Std. Dev.**	**Obs**	**Mean**	**Std. Dev.**	**Obs**
Price	2.07	0.52	7,830	1.90	0.56	36,623
Public	0.40	0.49	7,830	0.71	0.45	36,623
Return	76.44	13.06	7,797	76.19	15.43	36,317
Physico conformity	98.94	4.61	7,569	96.69	9.23	35,869
Microbio conformity	96.49	12.73	7,502	95.78	14.82	35,756
Export share	0.05	0.12	6,752	0.03	0.10	35,332
Import share	0.36	0.44	6,889	0.28	0.42	35,408
Nondomestic share	0.04	0.10	4,758	0.07	0,15	28,792
Water factories	4.56	10.72	7,830	2.34	3.82	36,623
Population	14,662.97	32,385.21	7,797	3,360.64	43,096.31	36,356
Revenues	2,160,825	4,582,071	3,393	425,833.3	9,606,194	25,113

Note: Calculations from the authors. "Std. Dev." stands for the standard deviation.
Prices are corrected for inflation and expressed in constant 2015 euros.

5 Empirical strategy

The objective of this article is to identify the impact of intermunicipal management on the price of drinking water. The model to be estimated is thus composed of two regime equations and a selection equation. The estimation procedures employed are specific to panel data, allowing the consideration of unobserved heterogeneity and correlated individual effects. By addressing selection bias, we also consider that the decision to join a community is endogenous.

5.1 Estimation procedure

Previous scholars have shown that estimations of the impact of organizational choices on subjective performance will be biased if selection bias issues are not addressed. Therefore, simply comparing average prices for different organizational modes or regressing prices on organizational choices cannot be considered a satisfactory methodology (Chong et al., 2006).

Estimating a structural model of the price of drinking water is outside the purview of this study. Instead, we build a two-step econometric strategy inspired by Heckman (1976, 1979). We estimate a probit model of the decision to join a community versus remaining independent as a function of time-varying variables X_{it} and time-invariant variables Z_i to treat the selection bias. We subsequently regress prices on the determinants of the decision to cooperate or not and on the inverse Mills ratios (IMRs), calculated after estimating the probit model in the first stage. Using these estimations, we calculate the average effect of IMC on prices paid by consumers.

Wooldridge (2010) showed that the correlated random effects (CRE) approach is effective in generating reliable estimates when confronted with many individuals and a limited number of time periods. This methodology addresses issues related to heteroscedasticity, serial correlation, and correlation between time-varying variables and individual effects by incorporating the individual mean of time-varying variables ($\overline{X}_i$) and the individual mean of year dummies in the probit model. Initially, applied to linear models by Mundlak (1978), the CRE approach has been extended to nonlinear models and unbalanced panel data, as discussed by Wooldridge (2019). Like Carpentier et al. (2006), we employ the revenues of water providers ($Revenues_{it}$) as an instrument in the first-stage probit model. This amount corresponds to all annual revenues from the service. This decision stems from the fact that revenues influence the binary selection variable in the first stage but do not affect consumer prices. The probit models employed in our analysis are as follows:

$$P(\text{Community}_{it} = 1 | X_{it}, \text{Revenues}_{it}, Z_i, \overline{X}_i, \overline{\text{Revenues}}_i) = \Phi(\Psi) \tag{1}$$

with

$$\Psi = \psi_1 + \beta_1 X_{it} + \delta_1 \text{Revenues}_{it} + \theta_1 \overline{X}_i + \kappa_1 \overline{\text{Revenues}}_i + \gamma_1 Z_i \tag{2}$$

and

$$P(\text{Community}_{it} = 0 | X_{it}, \text{Revenues}_{it}, Z_i, \overline{X}_i, \overline{\text{Revenues}}_i) = 1 - \Phi(\Psi) \tag{3}$$

where Φ is the standard normal cumulative distribution function and X_{it} contains time dummies.

The second step involves estimating price equations conditional on the organizational choice of the municipality (cooperation or remaining alone). To address the selection bias, the inverse Mills ratios $\frac{-\phi(\Psi)}{\Phi(\Psi)}$ and $\frac{\phi(\Psi)}{1-\Phi(\Psi)}$ are incorporated into the following regime equations ('0' : standalone municipality management, '1' : community management):

$$Price_{it}^0 = \beta_2^0 X_{it}^0 + \gamma_2^0 Z_i^0 + \rho^0 \left(\frac{\phi(\Psi)}{1 - \Phi(\Psi)} \right) + \mu_i^0 + e_{it}^0 \tag{4}$$

$$Price_{it}^1 = \beta_2^1 X_{it}^1 + \gamma_2^1 Z_i^1 - \rho^1 \left(\frac{\phi(\Psi)}{\Phi(\Psi)} \right) + \mu_i^1 + e_{it}^1 \tag{5}$$

where ϕ denotes the standard normal density function. μ_i^0 and μ_i^1 are the unobserved individual heterogeneity for standalone municipality management and community management. If either of the coefficients ρ^0 or ρ^1 is significantly different from zero, this implies a statistically significant difference between the price under municipal (community) management and what it would have been under community (municipal) management.

We computed a panel bootstrap estimation with 10,000 replications to correct standard errors for heteroscedasticity and serial correlation. Combining the two-step Heckman method with the CRE framework allows us to address endogeneity due to the correlation of the explanatory variables with individual effects and selection bias.

5.2 Results

Table 7 displays estimates for the probit model 4, which represents the selection equation. Using these estimated parameters, we can compute inverse Mills ratios, to treat selection bias in the estimation of price equations. We contend that the decision to cooperate or not can be explained by considerations of economic performance, specifically a desire for higher returns. Moreover, we assume that the quality of the resource and network can account for the inclination to cooperate within communities. Consequently, we regress the choice of community cooperation on variables related to economic performance and quality.

Table 4: Probit estimates of IMC

	Correlated Random Effects
Variables	Community
Public	0.850**
	(0.370)
Return	-0.005**
	(0.002)
Microbio conformity	-0.004***
	(0.001)
Physico conformity	0.0009
	(0.003)
Export share	0.194
	(0.392)
Import share	0.162
	(0.251)
Nondomestic share	-0.628**
	(0.266)
Water factories	-0.011
	(0.030)
Pop < 5k	*ref*
Pop 5-10k	2.099*
	(1.264)
Pop 10k-15k	2.377*
	(1.261)
Pop > 15k	1.221
	(1.306)
Revenues	0.00002***
	(0.00006)
Constant	-2.391***
	(0.855)
Year Dummies	Yes
Water Agency Dummies	Yes
Observations	22,808
McFadden's pseudo R^2	0.356
Log pseudolikelihood	-3656.55
Wald χ^2	1122.49
Prob > χ^2	0.00

Note: Significance levels: $***: p < 0.01, **: p < 0.05, *: p < 0.10$. All regressions include time averages and time averages of year indicators. The estimations include indicators for each number of time-observations. Heteroscedasticity-robust standard errors are in parentheses. Standard errors are clustered at the drinking water provider level.

The pseudo R^2 associated with our estimation is 36%, which is deemed satisfactory given the panel specification of our database. Not all explanatory variables contribute to explaining the choice of IMC through communities, but noteworthy results are observed. Initially, public management tends to enhance the likelihood of choosing cooperation within a community. Delegated management incurs negotiation and coordination costs, which tend to discourage water services from engaging in cooperation.

The parameter associated with the variable $Return_{it}$ is positive and statistically significant, indicating that a service with a lower-quality distribution network has a greater likelihood of cooperation. The decision to cooperate is negatively correlated with microbiological quality, indicating that water services see IMC as a way to improve the quality of drinking water.

We use these results to compute inverse Mills ratios to correct for potential selection bias present in our price regressions. The results are presented in Table 8. First, we estimate a naive regression of the price paid by consumers on the IMC decision. Community-managed water provision is positively correlated with the price paid by consumers. However, this naive regression does not yield robust estimates, as it fails to address potential selection bias. The estimation of equations 4 and 5 reveals that the outcomes exhibit the anticipated signs. In all scenarios, public management is associated with a lower resource price. This could be explained by the decision to delegate resource management being driven by a challenging environment, leading to an increase in prices for services under private management (see Carpentier et al. (2006)).

Regarding the provision of drinking water by municipalities, the coefficient associated with the IMRs significantly deviates from 0 (at the 1% significance level). This indicates the presence of selection bias, with the negative sign implying that prices are lower than they would be if the service provision were managed by a community. The sign associated with the inverse Mills ratio in the price equation for communities is also significantly different from 0 (at the 5% threshold). This significance, coupled with the positive sign, implies that the price paid by consumers is greater than it would be if the service provision was managed by a community.

Surprisingly, the microbiological and physicochemical quality of drinking water does not impact its price. Drinking water quality standards are often regulated by government agencies, and water providers are required to meet these standards regardless of variations in water quality[4]. Therefore, variations in physicochemical and microbio-

[4] In France, drinking water is one of the most regulated items. It is subject to continuous health monitoring by both the government and the operator. At the European level, quality standards concerning access to and the quality of water intended for human consumption are also high and regulated by the decree of December 22, 2022.

Table 5: Prices regressions

Variables	Robust OLS regressions		
	Full sample	Standalone municipality	Community
Community	0.109***	-	-
	(0.157)		
Public	-0.310***	-0.234***	-0.190***
	(0.015)	(0.012)	(0.021)
Return	-0.001***	-0.0002	-0.003***
	(0.0003)	(0.0002)	(0.001)
Microbio conformity	-0.0004	0.00005	0.001
	(0.0003)	(0.0002)	(0.0007)
Physico conformity	0.001***	-0.0008	-0.003
	(0.0005)	(0.0004)	(0.002)
Nondomestic share	-0.217***	-0.065	-0.007
	(0.036)	(0.025)	(0.088)
Import share	0.238***	0.217***	0.195***
	(0.015)	(0.009)	(0.023)
Export share	-0.031	-0.209***	-0.216**
	(0.061)	(0.037)	(0.092)
Water factories	0.003***	0.002***	0.005***
	(0.001)	(0.0008)	(0.001)
Pop $<$ 5k	*ref*	*ref*	*ref*
Pop 5-10k	0.146***	0.469***	0.134***
	(0.026)	(0.030)	(0.036)
Pop 10k-15k	0.047	0.225***	0.012
	(0.032)	(0.026)	(0.036)
Pop $>$ 15k	-0.031	0.089***	0.012
	(0.044)	(0.033)	(0.041)
IMRs	-	-0.155***	0.025**
		(0.011)	(0.010)
Constant	1.750***	1.820***	2.978***
	(0.180)	(0.178)	(0.291)
Year Dummies	Yes	Yes	Yes
Water Agency Dummies	Yes	Yes	Yes
Observations	33,515	22,163	2,212
R^2	0.233	0.205	0.207
Wald χ^2		5296.00	821.20
Prob $> \chi^2$		0.00	0.00

Note: Significance levels: $***\ p < 0.01, **\ p < 0.05, *\ p < 0.10$. The estimations include indicators for each number of time observations. Standard errors in parentheses are from 10,000 cluster-bootstrap repetitions.

logical parameters within acceptable regulatory limits may not directly affect pricing decisions. However, network efficiency has a negative effect on the price of distributed water for communities, indicating that the leakage rate is an important factor in the cost of water distribution for communities. We also observe that population is positively correlated with the price of drinking water only for individual municipalities, and communities with fewer than 10,000 consumers. Population is not significantly correlated with price for communities with more than 10,000 consumers. This may be explained by the fact that large distribution networks serving larger populations can benefit from economies of scale in the production, treatment, and distribution of drinking water. These economies of scale reduce costs per unit of water distributed.

Importing water often incurs significant transportation costs to convey water from an external source to the region or municipality. These transportation expenses may be transferred to consumers in the form of elevated prices for the imported water. Furthermore, by relying on external sources for their water supply, regions or municipalities may face risks associated with the availability and reliability of these sources, particularly due to climate change. Water providers may find themselves compelled to pay higher prices to ensure their supply, a cost that could be reflected in the prices levied on consumers. Conversely, water exporters possess a relative surplus production capacity. This engenders a scenario where the water supply surpasses local demand, fostering competition among suppliers and exerting downwards pressure on prices. Exporting water enables water providers to diversify their revenue streams by selling excess water to other regions or municipalities. This diversification can assist in offsetting fixed costs and mitigating price pressure on local consumers.

From these results, we can compute the average effect of IMC on the price paid by consumers. The findings are outlined in Table 6.

Table 6: Estimated average price by organizational form

	Municipal management	Community management
Mean	1.864	2.046
Median	1.827	2.036
Std. Dev.	0.242	0.232
Min	1.119	1.418
Max	2.882	2.904

Several intriguing outcomes can emerge from these estimations. Initially, it appears that the management of drinking water by a community is linked to higher prices. Providers who have chosen intermunicipal management appear to be providers with challenging operating conditions from both a technical and financial standpoint. Those operating independently may have more favourable operating conditions.

6 Conclusion

Ensuring access to drinking water and determining its pricing constitute critical concerns that are garnering increasing attention from public authorities. The imperative to address climate change has prompted policymakers to reevaluate the management of potable water resources. Many perceive collaborative efforts across communities as a potential avenue to curtail production costs and enhance the economic efficiency of the water sector. In our study, we investigate the impact of joint community management on the consumer price of drinking water. Additionally, we discern the determinants of pricing as municipalities deliberate between autonomous management and collaborative endeavours within community frameworks.

To compare the prices associated with municipal and community management, we use a methodology developed by Heckman (1976, 1979), which was designed to mitigate potential selection biases. We address panel data issues such as unobserved heterogeneity, serial correlation, and the correlation between individual effects and explanatory variables, using an approach outlined by Wooldridge (2010, 2019).

Our empirical results reveal selection bias in the estimation of pricing equations. The price of drinking water is explained by economic factors, such as the efficiency of the distribution network, in addition to organizational considerations. Notably, we observe that consumers pay higher prices when drinking water provided by communities. A plausible rationale suggests that the adoption of intermunicipal cooperation likely stems from municipalities' preference to avoid managing challenging water production and distribution conditions themselves, irrespective of any considerations regarding price disparities. This selection bias elucidates why municipalities consistently exhibit a propensity to opt for intermunicipal management, even when it results in higher prices than independent management. Our estimates also indicate that consumers in communities with fewer than 10,000 inhabitants pay higher prices than do consumers in communities with more than 10,000 inhabitants. This price differential may be attributed to the potential for IMC to achieve economies of scale. The fixed costs associated with water treatment and distribution infrastructure can be spread across a larger number of consumers in larger communities, leading to lower fixed costs per unit of water distributed. Additionally, larger communities that delegate water management to private companies have increased bargaining power with water suppliers, equipment providers, and service providers, which can result in savings on procurement and maintenance costs.

Our findings have several policy implications. First, we show that the determinants of drinking water prices are not only technical but also organizational in nature. In the context of climate change, it is increasingly important for water services to maintain the quality of the drinking water network and water resources. IMC within communities is associated with higher prices, partially validating the first hypothesis developed in Section 2. Indeed, these higher prices are not necessarily the result of organizational costs generated during cooperation, but rather the outcome of a challenging environment. Drinking water providers thus view the community as a means of managing these difficult geographic or financial conditions.

A promising avenue for further research could involve expanding this framework to examine how ideology and political colour affect other dimensions of performance such as the quality of the network. For instance, examining whether municipal elections also have an impact on the performance of the drinking water sector could provide valuable insights. Finally, our estimates here concern the impact of intermunicipal cooperation on price, rather than production costs due to a lack of data. It would be interesting to analyze the impact of these organizational choices on production costs by estimating a cost function and incorporating the profits of private companies into the analysis.

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Appendix 1 : Marginal effects of the selection equation

Table 7: Probit estimates of IMC

	Marginal Effects
Variables	Community
Public	0.074**
	(0.032)
Return	-0.0004**
	(0.0001)
Microbio conformity	-0.0003***
	(0.0001)
Physico conformity	0.0001
	(0.0002)
Export share	0.014
	(0.358)
Import share	0.017
	(0.160)
Nondomestic share	-0.054**
	(0.023)
Water factories	-0.001
	(0.002)
Pop < 5k	*ref*
Pop 5-10k	0.182*
	(0.383)
Pop 10k-15k	0.206*
	(0.311)
Pop > 15k	0.106
	(0.018)
Revenues	0.00004***
	(0.00008)
Constant	-2.391***
	(0.174)
Year Dummies	Yes
Water Agency Dummies	Yes
Observations	22,808

Note: Significance levels: $***: p < 0.01, **: p < 0.05, *: p < 0.10$. All regressions include time averages and time averages of year indicators. The estimations include indicators for each number of time-observations. Heteroscedasticity-robust standard errors are in parentheses. Standard errors are clustered at the drinking water provider level.

Appendix 2 : CRE estimates of the price equations

Table 8: CRE Prices regressions

	Correlated Random Effects	
Variables	Standalone municipality	Community
Public	-0.264***	-0.104
	(0.092)	(0.125)
Return	0.001***	0.0003
	(0.0003)	(0.001)
Microbio conformity	0.0007***	-0.0003
	(0.0002)	(0.001)
Physico conformity	-0.0001	-0.001
	(0.0003)	(0.002)
Non domestic share	0.160***	-0.309
	(0.046)	(0.271)
Importation share	0.057	-0.026
	(0.037)	(0.076)
Exportation share	0.076	-0.0241
	(0.078)	(0.227)
Water factories	0.001	0.003
	(0.001)	(0.003)
Pop < 5k	*ref*	*ref*
Pop 5-10k	-0.295	-0.107
	(0.411)	(0.124)
Pop 10k-15k	-0.284	-0.165
	(0.406)	(0.112)
Pop > 15k	-0.299	-0.127
	(0.391)	(0.099)
IMRs	-0.185***	0.031
	(0.032)	(0.019)
Constant	4.826***	2.424*
	(1.250)	(0.291)
Year Dummies	Yes	Yes
Water Agency Dummies	Yes	Yes
Observations	22,163	2,212
R^2	0.214	0.253

Note: Significance levels: $***\ p < 0.01, **\ p < 0.05, *\ p < 0.10$. Estimations include indicators for each number of time-observations. Standard errors in parentheses are from 10,000 cluster-bootstrap repetitions.