Are ownership and price related in the water industry? Empirical evidence from Spain

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Abstract:

This paper assesses the impact of provider ownership on the price of water for residential use set by 386 Spanish municipalities. Our main contribution to the previous literature is that we go much further than merely distinguishing between private and public ownership. First, we find that prices are lower when the urban water service is provided in-house. Second, when water services are externalised, the prices set by public utilities are higher than the prices of private utilities due to larger fixed quotas. Finally, water prices are also higher when the provision of the service has been privatised to a private-public partnership compared to entirely private utilities.

Keywords: water industry; ownership; water pricing.

JEL Classification: D43; D44; L11; L95.

Highlights:

- This paper assesses the impact of ownership on the price of water for residential use
- Water prices are lower when the urban water service is provided in-house
- When the urban water service is contracted out, prices are higher in public utilities
- Private-public partnerships set higher prices for water than entirely private utilities

1. Introduction

Water has been traditionally considered one of the most important natural resources that makes economic development possible (Gibbons, 1986). Likewise, water is a scarce resource that has given rise to numerous conflicts worldwide over its allocation to alternative uses

(Lee, 1999). One outstanding feature supporting the relevance of water is that it satisfies a broad group of needs, both as a necessary good upon which public health and life itself depend and also as a basic input in most agricultural and industrial production processes.

Management in the water industry has thus become highly relevant. The urban water service can be managed under different organisational regimes in terms of ownership. The formulas range from in-house provision to several externalisation scenarios in which urban water services are provided by means of different kinds of public-private schemes. In this respect, differences in terms of organisational objectives can lead to diverse price levels and structures. Indeed, several strategies and pricing criteria can be found depending on the kind of ownership.

Only a few studies have investigated the impact of management and/or ownership on residential water tariffs. García et al. (2005) focused on the effects of technical factors, competition and company strategies for water prices in France, showing that local operator strategies have a significant impact on the level of water prices. Accordingly, private operators can set prices either below or above costs depending on their specific objectives in the local market. Hall and Lobina (2004) and Lobina (2005) provided empirical evidence that privatisation occasionally leads to price increases that are difficult to justify. Chong et al. (2006a) showed, also for the French case, that choosing any kind of private-public partnership over direct public management seems to increase the price of urban water services.

Carpentier et al. (2006) compared public and private utilities in France, finding that prices are higher under private management mainly because they face harder operating environments. Furthermore, this paper concluded that local governments are keener to privatise water services if they are more technically difficult to provide. Using a treatment effect methodological approach, Martínez-Espiñeira et al. (2009) also found that privatisation increased water prices in major urban Spanish municipalities. Ruester and Zschille (2010) studied the relationship between the organisational regimes and retail prices of German water suppliers controlling for scale economies and the technical and structural characteristics of the suppliers. The authors distinguish between publicly run companies and several types of water utilities in which private companies can participate, also accounting for the endogeneity of organisational struc-

ture in their model. Furthermore, the main finding is that private sector participation results in higher water prices.

In general, all of the abovementioned studies have analysed the relationship between ownership and the price of water mostly distinguishing between private and public management. However, several other organisational systems are also used to provide the urban water service in most developed countries. In this framework, the objective of this paper is to investigate the impact of different ownership regimes on urban water prices for residential purposes, where water tariffs are heterogeneous (OECD, 2003; 2010). Once we have controlled for several factors mainly related to costs, we assess the effect of different ownership regimes on the price of water for residential use. Our contribution to the existing literature in this field of research is that we go much further than merely distinguishing between private and public management. In the first place, we compare provision in-house *versus* externalisation. Second, when the urban water service has been externalised, public prices are compared to private prices. Finally, in the case of private management, we compare the prices set by fully private companies *versus* public-private partnerships. In doing so, a data base including 386 municipalities in the southern Spanish region of Andalusia is used.

Regarding the methodology, temporal data availability has made it possible to estimate dynamic models using Heckman sample selection techniques (Heckman, 1976; 1979), which account for the possible presence of sample selection bias in both externalisation and privatisation processes. Furthermore, following a recent suggestion by Bel and Fageda (2007), the variables explaining externalisation and privatisation are observed at the time the decision took place, rather than later, as occurs with most of the previous research on this topic.

The paper is organised as follows. Section 2 shows some features related to the institutional framework of urban water services in Andalusia. Section 3 describes the data, variables and methodology. Section 4 presents the main results and policy implications. Section 5 summarises and suggests some future avenues for research.

2. The management of urban water services in Andalusia

2.1. Legal framework

The legal framework in Spain, Law 7/1985 on the Regulation of Local Government Terms and Conditions and Law 57/2003 on Local Government Modernisation Measures, establishes that local governments are re-

sponsible for guaranteeing the urban water service, but may choose how it should be managed and the legal regime for provision. The laws mentioned above and Royal Decree 2/2000 establish the legal regimes for the provision of municipal services. The local government may choose between either managing the service itself (in-house) or contracting out. In the latter case, management may be transferred either to a public company or privatised to either a private company (total privatisation) or a private-public partnership (partial privatisation).

Should the local government decide to manage the water service in-house, it must assume all the responsibility for decision making and management, use its own employees and cover production costs with funds from the municipal budget. Creating public companies is one way of decentralising the management of the urban water service while maintaining public ownership. Furthermore, in the case of privatisation, Spanish legislation only contemplates privatising the management of the service, as the infrastructure remains public property.

Concessions are the most widespread form of privatising public services in Spain. They are made official by way of contract whereby the local government entrusts an individual or corporation (legal entity) with the management, but still owns the service. Concessions are awarded following a public tender and for a limited amount of time. In the case of water supply companies, contracts that involve building infrastructures and operating the service must be no longer than fifty years, while those that only imply running the service have a twenty-five-year limit. At the end of the contract, local governments must again decide how they wish the service to be managed for a new period.

One alternative for the private sector to participate in the management of the urban water service is the creation of private-public partnerships (Bel and Warner, 2008; González-Gómez et al., 2009), whereby capital is shared between the private and public sector. In such companies, local government participation is normally sufficiently significant to guarantee that public objectives will be accomplished successfully. This form of management makes it possible to combine public interests such as universal access and quality standards with the industry know-how of private management. In this sense, the private partner is mainly responsible for managing these companies, while the political decisions are made by the public partner.

2.2. Ownership and management of urban water services in Andalusia

After Law 7/1985 was passed and Spanish legislation had adapted the European rules on management and quality of drinking water, plenty of Andalusian municipalities decided to externalise the provision of urban water services. The factors that have led to contracting out have been basically pragmatic (González-Gómez and Guardiola, 2009).

In general, legislative changes that have taken place in Spain since the second half of the 1980s have increased the externalisation of urban water services. The existence of more stringent legal requirements has forced some local governments to professionalise urban water service management by means of externalisation to public or private companies. Additionally, the fragile financial situation of several municipalities has also been a key factor in the decision to externalise urban water services (González-Gómez et al., 2011). On the one hand, privatisations have been a source of significant revenue for local governments. On the other hand, many local governments have opted for the creation of public companies to provide water services as a strategy to elude the legal restrictions on public deficit (Fernández-Llera and García-Valiñas, 2010). Table 1 shows the relative share of different ownership regimes for the provision of urban water services in Andalusia.

In-house management is still preferred by the majority, although this basically occurs in small municipalities. In this sense, town councils provide water services to 48% of Andalusian municipalities, but only to 11% of the population. Furthermore, the most popular format of externalisation is to public companies, which provide urban water services to approximately half the population of the region. It is also worth highlighting that provincial councils have played a key role in promoting inter-municipality associations as a basis for the creation of public enterprises.

Finally, private utilities provide urban water services to 23% of the municipalities and to almost 39% of the population of Andalusia. In this sense, private utilities have established their business in medium-sized and large municipalities, where expected profitability is much higher (Picazo-Tadeo et al., 2012). Furthermore, the private sector of the water industry in Andalusia is not very competitive and displays high market concentration. Indeed, two corporate groups dominate the sector, namely, Aguas de Barcelona (AGBAR) which owns Aquagest and is controlled by the French multinational Suez, and Fomento de Construcciones y Contratas (FCC), which owns Aqualia. Other private utilities with a significant presence in Andalusia include Acciona, Agua y Gestión, Gestagua, Hidrogestión and Urbaser.

2.3. Water pricing in Andalusia

Town councils are responsible for urban water service tariffs in Andalusia and there are currently no regulations that establish what criteria should be used to set them. In the absence of norms of obligatory compliance, prices and tariff systems vary greatly from one municipality to another. The only common element is that all municipalities divide their water tariffs into two parts, namely a fixed quota for the provision of the service and a variable quota that increases in blocks of consumption. This common tariff structure aside, each municipality establishes different prices for the fixed quota, as well as defining a different number of consumption blocks and different water prices for each block.

Most municipalities review their water tariffs on an annual basis. The review procedure begins with a proposal on behalf of the manager of the service, that is, either the town council itself or public or private company. The proposal for new tariffs is then debated and, where applicable, approved by the local government. Despite the current legislation stipulating that water tariff review processes approved by local governments must be supervised by a supra-municipal body designated by the regional government, in practice this is merely a formality to confirm that administrative procedures have been correctly followed. The new tariffs must then be published in the Official Gazette of the province in order to come into force.

Recently, notwithstanding the power of local governments to fix water prices, the Andalusia Water Act 9/2010 has empowered the regional government with the responsibility of regulating the basic criteria for urban water service tariffs. These criteria, which should lead to uniform water bills in Andalusia, should include the number of consumption blocks, billing periods and chargeable, fixed and variable items. However, this regulatory authority over water prices is yet to be used by the government of Andalusia.

3. Data, sample and methodology

3.1. Data and sample

The dataset used in this paper belongs to a sample of 386 municipalities in the southern Spanish region of Andalusia and refers to 2009. They represent almost half of the municipalities in the region and 60% of population. In 353 of these municipalities, urban water services are provided by external public (195) or private (158) companies, while the council provides the service in-house in 33. As regards private suppliers, 83 are private-public partnerships while

75 are entirely private companies. It is worth highlighting the small number of municipalities in the sample that provide water services in-house. The reason is that some of the variables involved in our analysis, mainly regarding water prices, were not available for many of these municipalities. In this sense, they are municipalities in which water tariffs are not renewed on an annual basis and, thus, water prices for 2009 were not available. Furthermore, in some of the smallest municipalities there is not even a tariff for urban water.

As mentioned in Section 2, water tariffs in Andalusia are far from homogeneous, but rather made up of a fixed quota for service connection and a variable quota that rises in consumption blocks which differ hugely across municipalities. Lack of homogeneity in water tariffs in addition to a lack of information about the distribution of consumption makes building a variable representing the price of water for residential use in Andalusian municipalities extremely difficult. Following previous research by Chong et al. (2006b), we overcome this difficulty by calculating the price of a representative bill in each municipality, which includes both the fixed quota and the price of a monthly consumption of 15 m^3 of water, which is the average consumption in Andalusia (INE, 2011). These prices are reported in Table 2.

In 2009, the average representative bill amounted to €10.88 a month, although differences due to the ownership of the water service provider are certainly important. The price is noticeably lower when water is provided in-house (€7.68) than when the service has been externalised (€11.18). Furthermore, once the service has been externalised, public companies charge higher prices for water (€12.23) than private companies (€9.89). Lastly, the average price is higher in public-private partnerships (€10.44) than in entirely private companies (€9.22).

The association between ownership and the price of water for residential use should not necessarily imply a relationship of causality, because water prices might be influenced by many other factors. The aim of this research is to test whether ownership affects the price of water after controlling for these factors. In doing so, we follow the methodological approach described in Section 3.2 to explain the price of water as a function of a series of variables, including ownership. These variables are intended to account for some features of the operational environment that are likely to affect costs and are defined in Appendix 1a. Table 3a presents some descriptive statistics.

Additionally, we also estimate two equations on the determinants of decisions to externalise and privatise the urban water service, respectively, using the variables described in Appendix 1b as explanatory variables. Table 3b provides some descriptive statistics. It is worth highlighting that, following a recommendation by Bel and Fageda (2007), most of these variables are measured at the time the decision to externalise or privatise the urban water service was taken, rather than at a later date, as is the case in most previous studies (Dijkgraaf et al. 2003; Ohlsson 2003; Walls et al. 2005; Zullo 2009; Levin and Tadelis 2010). By considering the time dimension of the variables we expect to enhance the explanatory power of our models (Guardiola et al., 2010). Other recent papers that have considered the time factor include Miralles (2009), González-Gómez and Guardiola (2009), González-Gómez et al. (2011) and Picazo-Tadeo et al. (2012).

3.2. Methodological note

Concerning the methodology, when observations from all the municipalities in the sample are used in the price equations, we employ ordinary least square regression (OLS). However, when only municipalities where the urban water service has been either externalised or privatised are included in the analysis, we use Heckman sample selection models (Heckman, 1976; 1979) to account for the possible presence of sample selection bias. In this sense, externalisation and privatisation decisions do not occur randomly, but rather are influenced by certain variables that might either affect the willingness of local governments to externalise the water service or make managing it more attractive to external companies, either public or private. Moreover, some of these variables might not be observed by the researcher and simultaneously affect both organisational choices and water prices. Under these circumstances, OLS regression yields biased estimates due to sample selection bias (Wooldridge, 2002). Conversely, the Heckman selection model provides consistent and asymptotically efficient estimates.

Heckman selection models estimate two equations simultaneously. On the one hand, the outcome equation, which in our case would model the price of water for residential use as a function of a series of exogenous variables X_{Price}; and, on the other hand, the selection equation, which in our research could model either the externalisation or privatisation process as a function of a series of variables $Z_{Externalisation}$ or $Z_{Privatisation}$. Formally, the price equation is:

$$\text{Water price} = \beta X_{Price} + \vartheta_{Price}, \quad (1)$$

while the selection equation might be either an externalisation equation:

$$Externalisation = \delta Z_{Externalisation} + \eta_{Externalisation} \quad (2)$$

or a privatisation equation:

$$Privatisation = \gamma Z_{Privatisation} + \eta_{Privatisation} \quad (3)$$

β, δ and γ being three vectors of unknown parameters to be estimated, $\vartheta_{Price} \sim N(0,\sigma)$, $\eta_{Privatisation} \sim N(0,1)$ and $\eta_{Externalisation} \sim N(0,1)$.

Finally, we assume that the error terms in the outcome and selection (either externalisation or privatisation) equations are jointly normally distributed with a correlation *rho*. In this way, the Heckman two-equation model controls for the part of the organisational choice that is correlated with the error term in the price equation. When the correlation *rho* is found to be statistically significant, OLS techniques applied to the price equation yield biased estimates while, as already noted, the Heckman selection model provides consistent and asymptotically efficient estimates for all the parameters in both equations.

4. Results and policy implications

4.1. Water prices: In-house provision versus externalisation

The first question we raise in this research is whether the provision of the urban water service either in-house or by means of an externalised company affects the price of water for residential use. In order to attain an answer, we have estimated a price equation by OLS using all the Andalusian municipalities in the sample. In this equation, the price of water is explained as a function of the variables *population*, *housing stock* and *water treatment* (remember that these variables are defined in Appendix 1a), in addition to *externalised*, which is a dummy variable that takes a value of 1 if water services are supplied by an external company and 0 if they are provided in-house. The second column of Table 4 displays the results.

These results show, in the first place, that the price of water is higher in more populated municipalities, i.e., the sign of the variable *population* is positive and statistically significant. The reason could be that in more populated municipalities, providing the urban water service is more complex, which implies higher costs and, consequently, higher prices. In the second place, a negative and statistically significant relationship between water prices and the variable *housing stock* is observed. This variable represents the

percentage of dwellings on the fourth and top floors over total dwellings and is intended to account for the concentration of the population and the presence of customer density economies. Accordingly, our results seem to point to the existence of customer density economies in the Andalusian water industry. In the third place, the variable *water treatment* is a dummy that identifies municipalities where strong chemical treatment is required in order to make poor quality raw water suitable for human consumption. The parameter associated to this variable is positive and significant, indicating that the need to treat raw water with strong chemical procedures increases costs and therefore the price of water for residential use.

The variable *externalised* has a positive and statistically significant relationship with the price of water, indicating that prices are higher in municipalities that have opted for the externalisation of the urban water service. A reasonable hypothesis that could explain this result is that councils and external companies record costs in their accounts and incorporate them into prices differently. When water services are provided in-house, especially in small municipalities, costs might not be reported properly and are therefore not passed on in full to prices. Certain management and administrative tasks involved in the provision of the water service, such as issuing and charging bills, can be carried out by public employees at the town council itself as part of their everyday job, which generally speaking would have a broader scope. Consequently, the wages such employees receive would not be recorded as a specific cost of the urban water service. Other variable costs, such as electricity and other supplies, could also be recorded as general town council expenses. In contrast, when the water service is externalised, service provider accounts must detail all the costs incurred to provide the service. These accounts must allow managers to design a tariff structure aimed at recovering said costs. In other words, externalising the urban water service reduces the possibility of subsidising the price of water, a situation that might occur when the service is managed by the town council.

4.2. Water prices: public *versus* private companies

The second relevant question we pose in this paper is, once the urban water service has been externalised, whether there is a difference in the price of water due to the nature of the provider, a public company or a company with partial or total private participation. In this case, only the 353 municipalities in the sample in which urban water services have been externalised are included in

the analysis. In order to account for the possible presence of sample selection bias, we have estimated a two-equation Heckman model consisting of a price equation and an externalisation equation, the latter including *population*, *population-squared*, *financial burden*, *income per capita*, *public employment*, *consortium*, *water capture system* and *ideology*, as explanatory variables (these variables are defined in Appendix 1b). However, the correlation *rho* between the error terms in the price and externalisation equations is not significantly different from zero at standard confidence levels, so the hypothesis that they are independent cannot be rejected. Accordingly, the price equation has been estimated independently by OLS. Results are in the third column of Table 4.

The signs and statistical significance of the parameters for the variables *population*, *housing stock* and *water treatment* are the same as those commented in Section 4.1. In addition, here we have introduced a new dummy variable, namely *consortium*, which is only defined when the water service has been externalised and is intended to account for economies of scale; it takes a value of 1 if the external company provides water services to several neighbouring municipalities and 0 if not. However, the parameter associated to this variable is not statistically significant. It is true that expanding their area of activity by supplying neighbouring municipalities can allow companies to take advantage of the economies of scale in the water industry and, in turn, reduce costs and prices. However, publicly-run companies do not always expand their area of service management for financial reasons. In the case of Andalusia, the public sector has encouraged certain public companies to supply several small municipalities, not for reasons of economic efficiency, but to improve the provision of the service and occasionally to guarantee the principle of universal access to a basic commodity such as water.

Additionally, we have introduced several dummies in the price equation to account for the possible existence of different business strategies in the policy of water pricing in Andalusia. These variables represent the three public companies and five private companies with the largest share of the sample in terms of the number of municipalities supplied. The public companies are Emproacsa, Giahsa and Aguas del Huesna, while the private companies are Aqualia, Aquagest, Acciona, Agua y Gestión and Gestagua. The estimated parameters for these variables and their statistical significance suggest that two public companies have a different water pricing strategy.

Regarding the most important variable in terms of the purpose of our research, the sign of the parameter associated to *public*, a dummy variable that takes a value of 1 when the water service has been externalised to a public company and 0 to a private company (including both private utilities and private-public partnerships), is positive and statistically significant, suggesting that the price of water is higher in public companies than in companies with private participation. There might be several reasons for this. In the first place, it could be due to public utilities not being managed as efficiently as private ones. In this sense, Picazo-Tadeo et al. (2009a, b) showed that public water companies in Andalusia are less efficient than private companies, particularly regarding the management of labour. Another possible explanation for public companies charging higher prices could be that they provide a higher quality service in the interests of society. However, the information available does not allow us to test this hypothesis empirically.

In the third place, higher public prices could be due to the existence of cross-subsidisation in the tariff structure. It is possible that public companies are more sensitive, for social equality reasons, to offering discounts to, for example, large or low-income families. The decrease in revenues could be offset by higher tariffs for standard families. In this sense, it is worth recalling that the price calculated in this study refers to a standard family. However, bearing in mind the information available for the water industry in Andalusia, empirically testing for this circumstance is tremendously difficult, for which reason we have left it as an avenue for future research.

The fourth and final reasonable explanation for the difference in the price of water charged by public and private companies would also be related to their tariff structures. As mentioned previously, the water bill in Andalusia is made up of a fixed quota and a variable quota that depends on consumption. Most private concessionaires of the urban water service are only obliged to pay for the maintenance of existing infrastructure, as the public sector remains responsible for investing in new infrastructure. In contrast, many public companies that report to, for example, provincial governments, do invest in infrastructure. It would therefore be reasonable for public companies to include a larger fixed quota in the water bill to recover, albeit partially, the cost of their investment. Consequently, the price of water would be higher. In this case, the information available does allow us to perform an indirect empirical test on this hypothesis.

Table 5 includes the water tariff structure in Andalusian municipalities, distinguishing between the fixed and variable quotas corresponding to a standard consumption of 15 m^3. The fixed quota set by public companies is €2.77 a month, while the fixed quota in private companies is €2.18 a month. The result of a simple Kruskal-Wallis test shows that the difference is statistically significant at standard confidence levels. Furthermore, we have estimated the price equation using only the variable part of the tariff as the dependent variable, thereby excluding the possibility of the differences in water prices being due to differences in the fixed quota. The results are presented in Appendix 2, which also displays the results from estimating all the price equations in this study using only the variable price as the dependent variable. Once again, we began by estimating a Heckman model to control for the possible presence of sample selection bias. On this occasion there is a statistically significant correlation between the errors of the price and externalisation equations (*rho* is 0.736, and the p-value for the LR test 0.015).

Regarding the externalisation equation, only the variables *income per capita* and *consortium* are statistically significant and display the expected sign. The reason for these poor results is probably the small number of observations corresponding to municipalities in which the urban water service is provided in-house, which greatly reduces the variability of the dependent variable. Concerning the price equation, all the results remain unchanged with the exception of the parameter estimated for the variable *public*, which is no longer significant at the 10% level. In other words, after controlling for other factors, public or private ownership of the company that provides the urban water service does not significantly affect the variable quota of the price of water for residential use. This result would support the hypothesis that the higher water prices charged by public companies are due to a higher fixed quota, possibly to recover investments in infrastructure.

4.3. Water prices: private companies versus public-private partnerships

The last question this research addresses is whether, once the urban water service has been privatised, the participation of the public sector in the management of the company providing the service affects the price of water for residential use. Once again, we have started by estimating a two-equation Heckman model, the selection equation being a privatisation equation with the same explanatory

variables as in the previous externalisation equation. In this case, the correlation between the privatisation and price equations is found to be statistically significant. The fourth and last column of Table 4 presents the estimates from the two-equation Heckman model. Concerning the privatisation equation, the results are in line with the previous literature, *population* (albeit with a decreasing effect), *income per capita*, and *consortium* all fostering privatisation, and the weight of *public employment* and a system of *water capture* based on mechanical means reducing the likelihood of urban water services being privatised (see Picazo-Tadeo et al., 2012 for a detailed explanation of the economic interpretation of these relationships).

Regarding the results for the price equation, the signs and statistical significance of the variables *population*, *housing stock* and *water treatment* coincide with those already commented on in previous Sections. However, now the parameter for the variable *consortium* is negative and statistically significant. This relationship might be due to the fact that, unlike public companies, companies with private participation decide to expand their activity for strictly economic rather than political reasons. Therefore, the decision to manage the urban water service in several neighbouring municipalities would only be justified if it reduces costs due, for example, to economies of scale. Likewise, we have included a variable in the price equation that represents the degree of market concentration at the time the urban water service was privatised, namely *market concentration*. This variable, only defined when the urban water service has been privatised through a public tender, is intended to account for the effect of competition on water prices. The sign and statistical significance of the parameter associated to this variable indicates that higher market concentration leads to higher prices of water for residential use. A sensible explanation for this result might be that in areas with higher market concentration, bidding companies foresee lower competition in public tenders and, consequently, propose a higher price for water (Bel et al., 2011).

The variable that includes the type of company ownership, namely, *private mixed,* reveals that when the public sector participates in the management of the company providing the urban water service, the price is higher in relation to the case when the company is entirely private. One possibility that would explain this result would be that companies with public participation provide a higher quality service, which entails higher costs and, in turn, higher prices. In this sense, as mentioned previously, it is possible that the public sector representatives on the company's board of directors exert

pressure in favour of social interests in order to fulfil certain quality standards that, due to not being required by law, would not be met if the company were entirely private.

Finally, it is worth indicating that we have also estimated the two-equation model comprising both price and privatisation equations using the variable part of the price of water as the dependent variable for a standard monthly consumption of 15 m^3 of water. The results figure in the last column of the table in Appendix 2 and show how in this case the parameter of the variable that distinguishes total private companies from private-public partnerships remains positive and is also statistically significant.

4.4. Some policy implications

The findings of this research could lead, in our opinion, to some interesting policy implications. In this sense, observed differences in water prices reveal clear differences in terms of performance and investment strategies and also in terms of water tariff structures. Obviously all these issues are largely correlated.

On the one hand, we find that water prices set by entirely private companies for a representative residential water consumption of 15 m^3 per month are lower than the prices established by other externalised formulas of providing the service. As already mentioned, this finding could indicate the superiority of private management in terms of efficiency. However, and at the same time, the greater ability of private utilities to adjust production costs could also lead to lower quality water services. Previous literature has signalled the relationship between reductions in the quality of water and privatisation in the case of the United Kingdom and Argentina (Shaoul, 1997; Lobina and Hall, 2000). Nonetheless, testing for this relationship in our case study is not easy, mainly due to the lack of statistical information on water quality. Consequently, it would be strongly recommendable for public authorities in Spain to elaborate and publish indicators of the quality of water services. In addition to other interesting purposes, such as providing managers and policymakers with sound information as a basis to make strategic choices, these indicators would serve to compare different ownership regimes for the provision of the urban water service more robustly.

On the other hand, our results reveal large differences according to ownership, not only in the price of water for residential use, but also in the structure of water tariffs. In this sense, water utility managers might decide to differentiate their water tariffs for residential users by either setting higher fixed charges, which

leads to more stable and safe revenue, or assigning greater importance to variable charges. In addition, setting the number of blocks the variable quota is based on and the price for each block is also a possible strategy to differentiate prices. Furthermore, it should also be taken into account that in addition to residential uses there are also other urban users of water, such as industrial or retail users, which opens up the possibility of establishing cross-subsidy schemes in the structure of urban water tariffs.

In this multifaceted scenario, we have observed that public utilities have opted for assigning more importance to the fixed charge than the variable charge. We have suggested that this finding could be related to the investment that, unlike private companies, some public utilities undertake in order to make the infrastructures required for the provision of the urban water service available. However, this is just a hypothesis that should be interpreted cautiously because a lack of data on investment prevents us from testing it. In addition, we should recall that, due to a lack of information about the distribution of water consumption, we explain the price of an average bill for a monthly consumption of 15 m^3 of water, which means the prices corresponding to higher blocks of consumption are not accounted for.

In conclusion, we have detected significant differences in the level of water prices and tariff structures depending on the kind of ownership/management regime employed to provide the urban water service. Residential water tariffs are not homogeneous, and this, jointly with the lack of available information, certainly makes comparisons across municipalities difficult. In this sense, we strongly recommend that public authorities contribute to reducing this lack of information, by compiling and publishing data on quality, costs, investment and water consumption distribution in each municipality. In the case of Andalusia, we also suggest that the regional government develop its competences in the water industry by establishing some common rules for the design of water tariff structures.

5. Summary and suggestions for further research

The scientific literature has debated the *pros* and *cons* of different ownership regimes to provide public services for decades now. There has been serious debate on efficiency, equity and quality. In this research we focus on the urban water service and, more specifically, on water provision for residential users, analysing whether the ownership regime has an impact on the price of water.

Using a sample of Spanish municipalities, we compare ownership regimes sequentially using Heckman selection models, which provide consistent and asymptotically efficient estimates in the presence of sample selection bias. Once we have controlled for the impact on prices of some factors related basically to production costs, some interesting results are worth highlighting. In the first place, the formula that leads to the lowest residential water prices is in-house provision. Surprisingly, and in the second place, when the urban water service is contracted out public companies set higher prices than utilities with private participation. Finally, entirely private utilities set lower water prices than private-public partnerships. As discussed throughout the paper, differences in terms of efficiency, quality and equity could explain these findings. Furthermore, our results concerning the factors behind externalisation and privatisation processes are in line with the previous literature, highlighting the relevance of operational difficulties in providing water services or the greater revenue opportunities in richer municipalities when explaining privatisation.

The abovementioned results suggest that the criteria that guide the design of water tariffs could differ substantially depending on the ownership regime. Subject to information availability, future research should include analysing the relative weight of different criteria, testing hypotheses such as whether public managers are fonder of including equity aims in the design of residential water tariffs than managers of private utilities, e.g., discounts in water tariffs provided for particular groups of households. Furthermore, the impact on water tariffs of compliance with environmental issues and requirements included in the European Water Framework Directive could be another interesting extension of this paper. Moreover, performing water price comparisons using a weighted average price calculated on the basis of the distribution of residential water consumption would also be also an interesting avenue to follow. All these issues warrant, in our opinion, further research.

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Table 1. Management of water urban services in Andalusia, 2009

	Municipalities (%)	Population (%)
In-house	48,8	11,6
Public company	27,8	49,6
Private-public company	10,4	15,1
Private company	13,0	23,7

Source: Own elaboration.

Table 2. The price of water for residential use in Andalusia, 2009 (monthly consumption of 15 m^3 in €)

	Mean	SD	Maximum	Minimum
All municipalities	10.88	3.30	20.65	1.56
In-house	7.68	2.82	13.81	2.68
Externalised	11.18	3.18	20.65	1.56
Externalised				
Public company	12.23	2.99	20.65	1.56
Privatised	9.89	2.94	16.12	2.90
Privatised				
Private-public company	10.49	2.83	14.51	2.90
Private company	9.22	2.92	16.12	4.39

Table 3a. Sample description: variables in the price equations

			Price equation			
	All municipalities (386)		Externalised (353)		Privatised (158)	
Variable	Mean	SD	Mean	SD	Mean	SD
POPULATION	12.6	24.8	13.3	25.8	18.8	32.5
HOUSING STOCK	7.78	13.99	8.06	14.43	12.65	16.91
WATER TREATMENT (dummy)[a]	0.666	-	0.708	-	0.646	-
CONSORTIUM (dummy)	-	-	0.776	-	0.557	-
EXTERNALISED (dummy)	0.915	-	-	-	-	-
PUBLIC (dummy)	-	-	0.552	-	-	-
PRIVATE MIXED (dummy)	-	-	-	-	0.525	-
EMPROACSA (dummy)	-	-	0.133	-	-	-
GIAHSA (dummy)	-	-	0.190	-	-	-
AGUAS DEL HUESNA (dummy)	-	-	0.048	-	-	-
MARKET CONCENTRATION	-	-	-	-	0.429	0.184
AQUALIA (dummy)	-	-	0.125	-	0.278	-
AQUAGEST (dummy)	-	-	0.147	-	0.329	-
ACCIONA (dummy)	-	-	0.099	-	0.221	-
AGUA Y GESTIÓN (dummy)	-	-	0.034	-	0.075	-
GESTAGUA (dummy)	-	-	0.025	-	0.057	-

[a] The mean for dummy variables represents the percentage of cases with value one. Standard deviations are not provided for these categorical variables.

Table 3b. Sample description: variables in the selection equations[a]

	Selection equation			
	Externalisation equation (386)		Privatisation equation (353)	
Variable	Mean	SD	Mean	SD
EXTERNALISATION (dummy)[b]	0.915	-	-	-
PRIVATISATION (dummy)	-	-	0.448	-
POPULATION	10.19	20.93	10.62	21.76
FINANCIAL BURDEN	4.85	3.78	4.94	3.88
INCOME PER CAPITA	2.60	1.17	2.62	1.20
PUBLIC EMPLOYMENT	8.79	5.18	8.89	5.14
CONSORTIUM (dummy)	0.466	-	0.499	-
WATER CAPTURE SYSTEM (dummy)	0.819	-	0.827	-
IDEOLOGY (dummy)	0.132	-	0.124	-

[a] Time dimension is accounted for in constructing these variables (see Appendix 1b).

[b] The mean for dummy variables represents the percentage of cases with value one. Standard deviations are not provided for these categorical variables.

Table 4. Determinants for the price of water for residential use in Andalusia

Variable	All municipalities (OLS)	Externalised (OLS)	Privatised (Heckman)
Price equation			
CONSTANT	7.357 (0.000)***	7.868 (0.000)***	5.257 (0.000)***
POPULATION	0.021 (0.021)**	0.021 (0.011)**	0.022 (0.021)**
HOUSING STOCK	-0.064 (0.000)***	-0.034 (0.030)**	-0.040 (0.031)**
WATER TREATMENT	2.396 (0.000)***	2.108 (0.000)***	1.186 (0.008)***
CONSORTIUM	-	0.208 (0.272)	-2.198 (0.000)***
EXTERNALISED	**2.363** (0.000)***	-	-
PUBLIC	-	**2.595** (0.033)**	-
PRIVATE MIXED	-	-	**2.225** (0.001)***
MARKET CONCENTRATION	-	-	3.100 (0.005)***
DUMMY FOR PUBLIC COMPANY1	-	1.404 (0.009)***	-
DUMMY FOR PUBLIC COMPANY2	-	-0.423 (0.266)	-
DUMMY FOR PUBLIC COMPANY3	-	-2.732 (0.000)***	-
DUMMY FOR PRIVATE COMPANY1	-	-0.757 (0.523)	0.331 (0.754)
DUMMY FOR PRIVATE COMPANY2	-	1.286 (0.286)	2.158 (0.052)*
DUMMY FOR PRIVATE COMPANY3	-	1.071 (0.398)	2.607 (0.031)**
DUMMY FOR PRIVATE COMPANY4	-	0.678 (0.564)	0.825 (0.488)
DUMMY FOR PRIVATE COMPANY5	-	0.985 (0.480)	0.683 (0.580)
R-squared adjusted	0.218	0.315	
F-Statistic	27.83 (0.000)***	13.48 (0.000)***	
Number of observations	386	353	
Selection equation			
CONSTANT			-1.006 (0.001)***
POPULATION			0.020 (0.005)***
POPULATION-SQUARED			-9.3e-8 (0.018)**
FINANCIAL BURDEN			0.003 (0.841)

Income per capita	0.485 (0.000)***
Public employment	-0.055 (0.002)***
Consortium	0.433 (0.002)***
Water capture system	-0.411 (0.035)*
Ideology	0.203 (0.337)
Rho	0.641
LR test of rho=0 (Chi-squared)	12.67 (0.000)***
Log likelihood	-551.62
Wald test (Chi-squared)	82.81 (0.000)***
Number of observations	353
Observations in the price equation	158

[a] * Significant at 10%; ** significant at 5%; *** significant at 1%.

[b] Due to confidentiality commitments, the dummies for both public and private companies have been randomly renamed.

Table 5. Water prices for residential use in Andalusia, 2009: fixed *versus* variable quota (monthly consumption of 15 m^3 in €)

	Fixed quota		Variable quota	
	Mean	SD	Mean	SD
All municipalities	2.45	0.73	8.43	2.89
In-house	1.99	0.86	5.69	2.72
Externalised	2.50	0.70	8.69	2.77
Externalised				
Public company	2.77	0.56	9.46	2.64
Privatised	2.18	0.72	7.71	2.63
Privatised				
Private-public company	2.10	0.60	8.39	2.59
Private company	2.25	0.84	6.97	2.48

Appendix 1a. Variables in the price equation: description and sources

Dependent variable	Description and source
PRICE	Price for a bill of an average consumption of 15 m^3, including fixed quota (€). Town councils and companies.
Explanatory variables	
POPULATION	Number of inhabitants in 2009 (thousands). National Institute of Statistics.
HOUSING STOCK	Percentage of houses on the fourth and top floors over total houses (%). Housing Census 2001. National Institute of Statistics.
WATER TREATMENT	Dummy variable taking a value of 1 if water is treated using strong chemical treatments (treatment A_1 and A_2) and 0 if soft treatments are used (treatment A_0). Town councils and companies.
CONSORTIUM	Dummy variable that takes a value of 1 if the company provides the service to several neighbouring municipalities in 2009 and 0 otherwise. Ministry of Regional Policy.
EXTERNALISED	Dummy variable that takes a value of 1 if water services are supplied by an external company in 2009 and 0 if they are provided in-house. Own elaboration.
PUBLIC	Dummy variable defined for municipalities where water services have been contracted out in 2009. It takes a value of 1 if water is provided by a public company and 0 if it is provided by a private company (including both private utilities and private-public partnerships). Own elaboration.
PRIVATE MIXED	Dummy variable defined for municipalities that have privatised water services in 2009. It takes a value of 1 if water is provided by a private-public partnership and 0 if it is provided by a private company. Own elaboration.
MARKET CONCENTRATION (HHI)	Hirschman-Herfindahl Index defined as the sum of the squares of the market shares of all supplying companies, calculated on the basis of the population supplied in the provincial market in the year of privatisation. This variable is only defined for municipalities that have privatised water services. Own elaboration.
DUMMIES FOR EMPROACSA, GIAHSA AND AGUAS DEL HUESNA	Dummies that take a value of 1 if the observation belongs to one of these three public water utilities, and 0 otherwise. This variable is only defined for municipalities that have externalised water services. Own elaboration.
DUMMIES FOR AQUALIA, ACCIONA, AQUAGEST, AGUA Y GESTIÓN AND GESTAGUA	Dummies that take a value of 1 if the observation belongs to one of these five private water utilities, and 0 otherwise. This variable is only defined for municipalities that have externalised urban water services. Own elaboration.

Appendix 1b. Variables in the selecting equations: description and sources

Independent variables	Description and source
EXTERNALISATION	Dummy variable that takes a value of 1 if the council has externalised the management of urban water services at the end of the period 1986-2009 and 0 if the service is provided in-house. Town councils and companies.
PRIVATISATION	Dummy variable that takes a value of 1 if the council has privatised the management of urban water services at the end of the period 1986-2009 and 0 if the service has not been privatised. Town councils and companies.
Explanatory variables	
POPULATION	Number of inhabitants (thousands). If the management of water services is externalised (privatised), it takes the value from the year prior to externalising (privatising). In the case of not externalising (privatising), it takes the average value over the period 1986-2009. National Institute of Statistics.
FINANCIAL BURDEN	Sum of financial expenditures over the sum of ordinary revenues of the local government. In the case of externalising (privatising), this variable takes the value of the year before the decision was taken. In the case of not externalising (privatising), it takes the mean over the period 1986-2009. Ministry of Economic Affairs.
INCOME PER CAPITA	Income per inhabitant (thousands €). If the municipality externalises (privatises), it takes the value from the year before externalising (privatising). In the case of not externalising (privatising), it takes the average value over the period 1986-2009. Andalusian Government.
PUBLIC EMPLOYMENT	Percentage of public employment over total employment in the municipality. The data refer to year 2001. Andalusian Government.
CONSORTIUM	In the case of externalising (privatising), this dummy variable takes a value of 1 if the council belonged to a consortium the previous year and 0 otherwise. In the case of not externalising (privatising), it takes a value of 1 if the municipality belongs to a consortium in the middle of the period 1986-2009 and 0 if not. Ministry of Regional Policy.
WATER CAPTURE SYSTEM	Dummy variable taking a value of 1 if water is captured using mechanical means and 0 if it is captured using the force of gravity
IDEOLOGY	Dummy variable that equals 1 if PP (right-wing party) was in power when the decision to externalise (privatise) was taken and if the municipality did not contract out (privatise) and PP was in power at the end of the period. Conversely, it takes a value of 0 if PSOE, IU or PA (left-wing parties) were in power

	when the decision to externalise (privatise) was taken and if the municipality did not externalise (privatise) and PSOE, IU or PA were in power at the end of the period. Home Office.

Appendix 2. Determinants for the variable quota of water prices for residential use in Andalusia

Variable	All municipalities (OLS)	Externalised (Heckman)	Privatised (Heckman)
Price equation			
CONSTANT	5.459 (0.000)***	5.274 (0.000)***	3.244 (0.001)***
POPULATION	0.015 (0.056)*	0.020 (0.008)***	0.016 (0.071)*
HOUSING STOCK	-0.057 (0.000)***	-0.030 (0.025)**	-0.039 (0.020)**
WATER TREATMENT	1.958 (0.000)***	1.696 (0.000)***	0.779 (0.031)**
CONSORTIUM	-	0.638 (0.135)	-1.606 (0.002)***
EXTERNALISED	**2.092** (0.000)***	-	-
PUBLIC	-	1.717 (0.104)	-
PRIVATE MIXED	-	-	**2.113** (0.001)***
MARKET CONCENTRATION	-	-	2.594 (0.009)***
DUMMY FOR PUBLIC COMPANY1	-	2.015 (0.000)***	-
DUMMY FOR PUBLIC COMPANY2	-	-0.215 (0.614)	-
DUMMY FOR PUBLIC COMPANY3	-	-2.080 (0.001)***	-
DUMMY FOR PRIVATE COMPANY1	-	-0.385 (0.702)	0.705 (0.461)
DUMMY FOR PRIVATE COMPANY2	-	1.433 (0.164)	2.290 (0.023)**
DUMMY FOR PRIVATE COMPANY3	-	1.242 (0.251)	2.486 (0.028)**
DUMMY FOR PRIVATE COMPANY4	-	1.047 (0.357)	1.323 (0.220)
DUMMY FOR PRIVATE COMPANY5	-	1.298 (0.269)	1.322 (0.237)
R-squared adjusted	0.210		
F-Statistic	25.39 (0.000)***		
Number of observations	386		
Selection equation			
CONSTANT		-0.032 (0.935)	-0.980 (0.001)***
POPULATION		-0.042 (0.351)	0.020 (0.005)***
POPULATION-SQUARED		1.9e-6 (0.295)	-9.8e-8 (0.014)**
FINANCIAL BURDEN		0.058 (0.201)	0.007 (0.655)

Income per capita	0.203 (0.025)**	0.475 (0.000)***
Public employment	0.023 (0.261)	-0.058 (0.001)***
Consortium	0.950 (0.000)***	0.436 (0.002)***
Water capture system	0.292 (0.166)	-0.423 (0.029)**
Ideology	-0.140 (0.593)	0.266 (0.201)
Rho	0.736	0.651
LR test of rho=0 (Chi-squared)	5.86 (0.015)**	13.06 (0.000)***
Log likelihood	-883.30	-536.43
Wald test (Chi-squared)	172.24 (0.000)***	75.93 (0.000)***
Number of observations	386	353
Observations in the price equation	353	158

[a] * Significant at 10%; ** significant at 5%; *** significant at 1%.

[b] The dummies for both public and private companies have been randomly renamed.