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Assessing the Effects of User Accountability in Contracting Out

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ABSTRACT

How does contracting out affect service performance? Evidence to date is mixed. We argue that this is partially due to prior studies focusing often on whether—not how—services are contracted. Yet, how services are contracted matters. In particular, we argue that whether users pay user fees for services to contractors affects efficiency. Where they do, contractor revenue depends on user satisfaction and contractors face incentives to provide quality services to users to retain revenue. Where, by contrast, governments fund services, information asymmetry about the quality of services users receive allows contractors to shirk quality. The assertion is substantiated by empirical evidence derived from a comprehensive analysis of conditional efficiency within the water supply services across 2,111 municipalities in Spain, employing a two-stage conditional order-m data panel estimation. Our results show that contracting out where users pay service fees and thus have incentives to hold contractors accountable outperforms contracting out without user fees in quality-adjusted service provision.

Introduction

Contracting out aimed to introduce greater accountability for performance into public service delivery. Contractors are accountable to their government principals for meeting a range of requirements and performance targets specified in the contract. However, in practice, this form of accountability has not always produced the desired results. Despite some success, the performance of contracted public services has been mixed when accounting for service quality (Boyer 2023; Broms et al. 2023; Esteve and Reyes-González 2020; Hefetz and Warner 2004; Overman 2016; Savas 2002; Van Slyke 2003; Veronesi et al. 2022; Zullo 2008). Furthermore, initial cost savings from contracting out are often eroded over time as governments respond to quality failures or face unanticipated costs for monitoring (Bel, Fageda, and Warner 2010; Bel and Warner 2008; de la Higuera-Molina et al. 2023; Dijkgraaf and Gradus 2008; Perez-Lopez, Prior, and Zafra-Gómez 2015; Petersen, Hjelmar, and Vrangbæk 2018; Zafra-Gómez et al. 2013).

The most common explanation for these problems is that governments are not able to hold contractors to account for performance, either through the market or by managerial accountability mechanisms. The costs involved in monitoring public contracts are often too high for resource-constrained governments to meet and contractors regularly face little pressure from competitors. As a result, contractors are incentivized to prioritize cost-cutting over quality; which is often called "quality shading" (Domberger and Jensen 1997; Hart, Shleifer, and Vishny 1997).

This article contributes to a growing literature recognizes that how, not just whether, governments contract out matters (Brown, Potoski, and Van Slyke 2006; Jensen and Stonecash 2005; Kim and Brown 2012; Lamothe and Lamothe 2012; Malatesta and Smith 2014; Perez-Lopez, Prior, and Zafra-Gómez 2015). We investigate the effect of one element of contract design on the performance of contracted public services that has so far not been considered: the generation of revenue through user fees. We argue that charging users directly based on usage, rather than through taxation, rectifies accountability problems present in traditional contracting out by introducing user accountability. When a service is funded through user fees, poor service quality directly threatens the private supplier's revenue as users can respond to poor quality with lower consumption, thereby incentivizing them to maintain high service quality and lessening the need for costly monitoring and sanctions.

Although the service that we consider—water—is a natural monopoly, it exhibits two features which mean that service quality is connected to consumption and therefore the revenue generated by the contractor. The first is that quality failures reduce the supply of the service, and therefore usage, and the second is that their usage comprises a portion of nonessential consumption, which is elastic and therefore responsive to quality. Contractors' revenue is therefore at risk of quality failures, when users pay for the service wholly or in part through fees. We argue that this form of user accountability will compensate (at least partially) for weaknesses in market and managerial accountability under traditional contracting out, which is documented extensively in the literature.

We provide evidence for this argument by analyzing data on water services provided by Spanish municipalities with between 1,000 and 50,000 inhabitants during the period 2014–2016. Our analysis covers water services in 2,111 municipalities. This service is an essential part of municipalities' legal obligations. We apply the Conditional order-m data panel developed by Pérez-López et al. (2021), which enables a comparison between the efficiency of municipalities employing different organizational forms to deliver this service. Efficiency is understood as the ratio between outputs and costs. We compare direct public provision, contracting with fees, and contracting without fees. The approach allows us to estimate the efficiency of each form relative to the potential efficiency available to all municipalities. We measure cost-efficiency alone and overall efficiency accounting for quality. Following our theoretical argument, we find that, although contracting *without* user fees is at best as efficient as direct public provision when accounting for quality, contracting *with* user fees outperforms public provision. Contracting with user fees performs better in terms of quality-adjusted efficiency than the other two organizational forms considered and this holds across different municipality sizes.[1]

The article proceeds as follows. The next section outlines current empirical evidence on the performance of public services that are contracted out and the functioning of different accountability mechanisms. The third section presents our theory that contracting with user fees will introduce user accountability and thereby improve performance when accounting for service quality. The fourth section describes the data and methods to be used in our analysis and the fifth section presents the results. A sixth section concludes.

Accountability and Quality Problems Under Contracting

The practice of sacrificing quality in favor of cost-cutting, commonly called "quality shading," has long been a concern of the literature on contracting out and seriously threatens the potential gains from contracting (Domberger and Jensen 1997; Hart, Shleifer, and Vishny 1997; King and Pitchford 1998; Lopez-de-Silanes, Shleifer, and Vishny 1997; Sclar 2000). Studies have documented the practice of quality shading across several service areas, including prisons and detention centers (Alonso and Andrews 2016; Austin and Coventry 2001; Bauer and Johnston 2020; Bedard and Frech 2009; Greene 1999; Lindsey, Mears, and Cochran 2016; Logan 1990), job-market programs (Anderson, Burkhauser, and Raymond 1993; Bedard and Frech 2009; Courty and Marschke 1997; Greer, Schulte, and Symon 2018), health and social care (Amirkhanyan, Kim, and Lambright 2008; Bedard and Frech 2009; Elkomy, Cookson, and Jones 2019; Jilke, Van Dooren, and Rys 2018; King and Pitchford 1998; Young and Macinati 2012), as well as telecoms and waste management (King and Pitchford 1998). Strategies that contractors employ to cut costs include reducing staff welfare, wages, and training, which diminishes the quality of their work and creates problems retaining and attracting skilled personnel (Austin, and Coventry 2001; Bel, Fageda, and Warner 2010; Cope 1995; Greene 1999; Lindsey, Mears, and Cochran 2016; Quiggin 2002). They may also engage in "cream-skimming," prioritizing easy tasks and neglecting areas of the service or user groups that are more challenging (Anderson, Burkhauser, and Raymond 1993; Bredgaard and Larsen 2008; Brodkin 2007; Courty and Marschke 1997; Greer, Schulte, and Symon 2018; Jilke, Van Dooren, and Rys 2018; Koning and Heinrich 2013; Rees, Whitworth, and Carter 2014; Shaw and Rab 2003).

Quality shading occurs because the accountability mechanisms meant to ensure contractor performance fail. In theory, contractors face *market accountability* pressures through competition and the threat of replacement by rival suppliers (Hood 1991; Niskanen 1968, 1971; Osborne and Gaebler 1992; Pack 1987; Savas 1977, 1987) and are held to account by their government principals through *managerial accountability* processes such as performance monitoring, targets, and sanctions (Cunill-Grau and Ospina 2012; Jantz et al. 2018; Mulgan 2003, 151–87; Verhoest and Mattei 2010). In practice, however, both accountability mechanisms rarely function as intended and are "weak links" in the contracting process (Johnston, Romzek, and Wood 2004), resulting in contracts failing to deliver their promised efficiencies (Esteve and Reyes-González 2020).

First, public bodies frequently face weak or nonexistent competition when contracting out their services (Girth et al. 2012; Johnston and Girth 2012; Van Slyke 2003). In most public contracting situations, it is therefore not sufficient for governments to contract out and let the "magic" of the market regulate performance (Heinrich, Lynn, and Milward 2010; see also Lamothe and Lamothe 2009, 2010). This is especially the case in the presence of highly concentrated markets, structural monopolies, and high asset specificity, all of which are found in the services studied in this article (Bel and Warner 2008; Jensen and Stonecash 2005). Second, managerial mechanisms do not work as promised when government principals cannot or do not assess the relevant information or when they face high costs when sanctioning poor performance (Busuioc and Lodge 2016; Girth 2014; Johnston, Romzek, and Wood 2004). Principals rarely have perfect information about their agents' behavior in any principal–agent relationship (Grout 1984; Hart and Moore 1988; Williamson 2000), but managerial accountability mechanisms are particularly weak in government-contractor relationships, where contracts are often incomplete, monitoring costs are high, and governments lack the necessary capacity to hold contractors to account (Johnston and Romzek 2010; Romzek and Johnston 2005). Management capacity and expertise are regularly cited as crucial factors in the success of public contracts (Andrews and Entwistle 2015; Brown and Potoski 2003a; Cabral 2017; Campos-Alba et al. 2023; Lamothe and Lamothe 2010; Petersen et al. 2019; Romzek and Johnston 2002; Williamson 1985). Yet, government organizations frequently underinvest in this area (Provost and Esteve 2016) and struggle to retain the expertise necessary to scrutinize contractors' performance (Girth 2014; Van Slyke 2003). Governments also underestimate the high transaction costs associated with specifying and enforcing sophisticated contract terms and frequently

[1]As a caveat, we cannot distinguish between direct public provision with user fees and without user fees. Although our results thus suggest that contracting out with user fees is more efficient than public provision on average, we are unable to infer from our data whether contracting out with user fees outperforms direct public provision financed through user fees.

face pressure to reduce budgets by contracting out (Brown and Potoski 2003a; Provost and Esteve 2016; Rubin 2006; Young and Macinati 2012).

Even when public bodies can access and interpret information about service quality, sanctioning poor performance effectively can be challenging. The legal instruments available to impose financial sanctions are usually cumbersome and it can be difficult to meet the burdens of proof required by the contract (Busuioc and Lodge 2016; Girth 2014; Johnston, Romzek, and Wood 2004). Contract termination is often prohibitively costly and is particularly difficult when the market offers few alternatives (Johnston and Romzek 1999; Van Slyke 2007). Furthermore, contracts that make termination or financial sanctions too accessible can deter more capable suppliers and create "hold-up" problems where contractors are reluctant to risk making the necessary investments in a service (Albalate, Bel, and Geddes 2013; Hart 1995; Romzek and Johnston 2005; Terman and Feiock 2016). For these reasons, governments usually resort to weaker, nonfinancial incentives (Girth 2014; Romzek, and Johnston 2005) which do not affect a contractor's all-important bottom line.

Without effective systems to reward or punish a supplier for their performance, there is no benefit for them in improving or maintaining quality and they are incentivized to cut costs instead to maximize profits (Alonso and Andrews 2016; Andrews, Boyne, and Walker 2011; Hart 2003; Lindsey, Mears, and Cochran 2016). The literature on government contracting has proposed solutions to the problems described above, predominantly focusing on strengthening or reinserting market or managerial accountability mechanisms. For example, some studies suggest that retaining some portion of the service in-house helps to maintain expertise and ready access to information about quality as well creating some competitive pressure on the contractor (Brown and Potoski 2003b; Warner and Hefetz 2008). Another solution in this vein is to engage with networks of other governments and service providers to get a wider view of performance (Brown and Potoski 2004; Carr, LeRoux, and Shrestha 2009). Other proposals have focused on making it easier for governments to sanction and reward contractors through incentive contracts, where payment is linked to performance indicators (Girth 2017; Girth and Lopez 2019; Marvel and Marvel 2009). Whereas another group of potential remedies has looked at how informal performance management could be strengthened through closer, long-lasting relationships with contractors (Brown, Potoski, and Van Slyke 2007; Brunjes 2020; Malatesta and Smith 2014; Romzek, LeRoux, and Blackmar 2012; Van Slyke 2007).

The solutions above have predominantly focused on strengthening or rectifying problems with managerial accountability and to a lesser extent on augmenting market accountability. However, to date, the literature has not investigated the potential benefits of introducing new forms of accountability into the contracting process. Our article addresses (part of) this gap and explores an innovative solution to the quality-shading problem.

Introducing User Accountability Into Public Service Contracts

Rather than examining market or managerial accountability mechanisms as much of the literature has done, we investigate the potential of direct accountability to users by funding contracted services wholly or partially through user fees. Although contracting relies on market and managerial accountability, we argue that user fees can, additionally, introduce *user accountability* by making contractors' revenue dependent on service quality. The effect of charging user fees on service performance has not yet been investigated. However, we argue that it has the potential to improve contract performance when accounting for quality because it places contractors' revenue at risk if they engage in quality shading.

Our first hypothesis follows the existing literature on quality shading. We expect contracting out to reduce service quality without user accountability for public service provision. We expect the "quality-shading hypothesis" to apply to the water services studied in this article because both market and managerial accountability are weak. Markets for utilities, such as water, are highly concentrated because potential competitors face extremely high costs to gain the assets needed to enter the market. Suppliers of water contracts therefore face little pressure from the market to improve or maintain quality. Furthermore, utility contracts involve considerable initial outlay for setting up or taking over local infrastructure and therefore have lengthier terms than other contracts, frequently running for several decades (Grafton, Chu, and Kompas 2015, 55). As a result, the costs of contract termination are exorbitant and governments struggle to effectively sanction service providers, leading to weak managerial accountability. When governments pay a contractor to provide water services on its behalf, market and managerial accountability mechanisms will not be adequate to prevent the contractor from shirking on quality for our particular services of interest. We expect to find the same result as previous work that, when accounting for quality, keeping services in-house will be more efficient than contracting out alone.

H_1: Public provision will outperform contracting without user fees in quality-adjusted service performance.

Introducing accountability to users through the mechanism of fees, however, could remedy the accountability and performance problems outlined above. We anticipate that user fees will improve performance by linking contractors' revenue to service quality. Users of a service are directly affected by its quality and therefore have information that governments do not. They can also act on that information in a timely and effective manner by withdrawing their demand, where governments cannot. Rather than incentivizing contractors to cut costs to maximize profits, as with traditional contracting, user fees thus align contractors' profit motive with providing high-quality services.

As suppliers of water services remain monopoly providers, at first glance, we may not expect their revenue to be threatened by poor performance, even when some or all their revenue comes from user fees. Like most public services, the water services studied in this article may be considered essential and do not have direct substitutes. Users are also unlikely to exercise exit by moving to a different area, as predicted by the Tiebout model of local public goods provision (Tiebout 1956), because of the costs associated with this option and the influence of numerous other factors in moving (Buchanan and Goetz 1972). On closer inspection, however, supply- and demand-side features of water services mean that poor service quality does pose a risk to contractors' revenue when it is generated by user fees. These features are (1) that quality itself directly affects usage and (2) that demand comprises a portion of luxury or discretionary consumption that remains elastic and therefore responsive to quality.

In the water context, the quality of the service influences the level of users' consumption and therefore the fees they pay, where fees are charged. Higher-quality water services provide better water pressure and have fewer unplanned service interruptions, which, unlike scheduled maintenance, cannot be arranged during times of low demand. This means that higher-quality services are likely to result in higher water consumption and, as a result, greater revenue through volumetric charges for the contractor. This effect of quality on supply and therefore usage means that poor quality does threaten contractors' revenue when user fees are charged for water services.

The second way in which quality is linked to contractor revenue is through discretionary consumption by some users. Although water is an essential good, those with the means can consume it as a luxury. The OECD (2003, 37) notes that "an increasing proportion in some of the more affluent societies is associated with 'luxuries' such as power showers, garden sprinklers, and pressure washers." Several studies have also established that water consumption is divided into inelastic "lifeline" demand and nonessential demand that remains elastic (Al-Qunaibet and Johnston 1985; Gaudin, Griffin, and Sickles 2001; Monteiro 2010; Schleich and Hillenbrand 2009). Although there can be some regional variation in terms of water consumption, the dynamics of service demand are very stable in the Spanish context (Arbués and Villanúa 2006; García-Valiñas, Martínez-Espiñeira, and González-Gómez 2010; Martinez-Espiñeira 2002, 2007; Martínez-Espineira and Nauges 2004). Users can thus react to poor quality service provision in ways that affect contractors' revenue.

We, therefore, expect that when a contractor's revenue is placed at risk through user fees, the introduction of user accountability will make contractors more sensitive to quality. Contracting with user fees may thus be expected to outperform contracting without fees in quality-adjusted service provision.

H_2: Contracting with fees will outperform contracting without fees in quality-adjusted service performance.

We expect contracting with fees to be more efficient than not only traditional contracting but also traditional public provision. Although public managers may want to provide a high-quality service, they do not have the same incentives to run a cost-effective service as contractors paid through user fees. Here classic arguments for contracting based on property rights theory apply. The assignment of property rights within private firms creates incentives for employees to become more productive, which are not present among employees of public organizations owned by the state (Grossman and Hart 1986; Hart and Moore 1990; Shleifer and Davies 1971; Shleifer and Vishny 1994). The potential for managers of contracted services to derive personal benefit from improved performance fosters internal competition which in turn encourages innovation and greater efficiency (Alchian and Demsetz 1972). In the water services studied in this article, contractors' bottom line is directly affected by the quality of service they provide. When quality dips, users will both reduce their luxury water usage and receive less water overall through interrupted or reduced flow. However, the profit motive also incentivizes contractors to balance cost and quality efficiently and prevents them from prioritizing quality over cost, which can be a problem for public organizations (Niskanen 1968, 1971). For these reasons, we should expect contracting with fees to outperform direct provision by municipal governments.

H_3: Contracting with fees will outperform public provision in quality-adjusted service performance.

Data and Methods

Data

We test our hypotheses with data from Water Supply Services in Spanish municipalities. In Spain, the supply of potable water is one of the public services that local municipalities are required to provide under Article 26 of the Spanish Law 7/1985 (*Bases de Regimen Local*). We focus on the period of 2014–2016 and analyze data from 2,111 municipalities. Due to data limitations, we focus on the municipalities with between 1,000 and 50,000 inhabitants, which represents 77.5% of all municipalities in this population bracket, and 26% of all Spanish municipalities. Our sample is restricted as data is not available for municipalities with fewer than 1,000 inhabitants (Olmo and Brusca 2021; Pérez-López et al., 2016, 587); and data on service quality in particular is not available for municipalities with over 50,000 inhabitants.

Spanish municipalities offer a suitable empirical setting for our analyses, as they (1) are large enough in number for panel data analyses, (2) offer objective data on service quality (see below), and (3) offer variation in organizational forms (public, contracted out with fees, contracted out without fees) for the same service across municipalities of similar size. We return to the potential generalizability of our findings for other settings in the conclusion section.

Dependent Variable

To measure the efficiency of the municipal services, we rely, first, on the Effective Cost of Local Services (CESEL[2]), which considers the real costs, both direct and indirect, for the public service[3]; and second, on a service quality-adjusted performance measure. Service quality is measured through the Survey of Equipment and Local Infrastructures, an official survey run by the Spanish Ministry for Political, Territorial, and Public Function. This survey includes objective quality characteristics for each service (EIEL 2017), giving a value from 1 to 3 if the quality is bad (1), regular (2), or good (3).

Although the literature acknowledges the myriad of indicators that could be used to assess the performance of water supply (see, for a review, Boyd 2019), the database used in this study contains information regarding water purity, the volume of water flow, and water pressure to homes (EIEL 2017). Indicators such as water pressure are plausibly observable to users, and thus aspects of service quality on which users can hold service providers accountable.

Explanatory Variables

Our main explanatory variables are the organizational forms used to provide public services and their effective cost, calculated following the Spanish Order HAP/2075/2014. We distinguish three different organizational forms:

[2]The effective cost of these public services has been defined in the Rationalization and Sustainability Law of the Local Administrations (Law 27/2013, December 27th of 2013).

[3]This estimation is done in accordance with the criteria specified by the Spanish Ministry of Taxes (Orden HAP/2075/2014, November 6th of 2014).

1. Public Service Provision: these are services provided directly by the municipality, where the effective cost is calculated with the sum of direct expenditure related to the provision of the service (personnel, current expenses in goods and services, amortization, transfers, and other nonfinancial expenses) and indirect costs (expenses related to the General Administration).
2. Services contracted out with government payment of the service: in this organizational form, the contractor has agreed to share risks and benefits with the government. Here, the effective cost for each service is determined by the totality of spending by the municipality, including the contract price, as well as, where appropriate, operating subsidies or coverage of the price of the service.
3. Services contracted out with user fees to pay for the service, where the contractor's remuneration is received directly by the user (through fees) and has all the risks and benefits of providing the service. In this case, the effective cost will be determined by the income derived from the fees paid by them and any service price subsidies from the municipality.

Methodology

To assess our hypotheses, we follow Pérez-López et al.'s (2021) two-stage Conditional Order-M Data Panel estimation. This estimation approach allows us to obtain robust long-term efficiency estimates, which "facilitate the evaluation of municipal efficiency by taking into account the structure of the data panel and the inter-relations between observations over time" (Pérez-López et al. 2021, 445). The approach also accounts for environmental factors—such as population density and industrial activity—as the provision of local public services is made in different environments across municipalities (Cordero et al. 2017; Da Cruz and Marques 2014; Gearhart and Michieka 2018). It should be noted that when obtaining the efficiency measures through this methodology, they are influenced and corrected by the environmental factors, as opposed to a regression, which searches the significant factors which influence a dependent variable.

For the first part of the analysis, we perform an unconditional model using an order-m data panel estimation. In the second stage, we estimate the conditional order-m data panel model, where environmental factors are introduced. Finally, we calculate the conditional efficiency ratio data panel (CERdp) to analyze the effects of environmental factors on our efficiency estimations and compare the different organizational forms.

Unconditional Order-M Data Panel (Ucorderm-DP)

For S units $s = 1, \ldots, S$ assume there are N inputs $x^s = x_1^s, \ldots, x_n^s, \ \ldots, x_N^s \in \Re_+^N$ that produce M outputs $y^s = y_1^s, \ldots, y_m^s, \ \ldots, y_M^s \in \Re_+^M$ with a data panel structure. We define a variable t $(t = 1, \ \ldots, T)$ that is representative of the corresponding period of time for the inputs and outputs: $x^{s,t} = x_1^{s,t}, \ldots, x_n^{s,t}, \ \ldots, x_N^{s,t} \in \Re_+^N$ and $y^{s,t} = y_1^{s,t}, \ldots, y_m^{s,t}, \ \ldots, y_M^{s,t} \in \Re_+^M$.

After that, through the data panel methodology proposed by Surroca, Prior, and Tribó (2016), for each unit $s = 1, \ldots, S$ we define the mean values of input n and output m, for the complete period T, as $\tilde{x}_n^s = \sum_{t=1}^{T} c^{s,t} / T$ and $\tilde{y}_m^s = \sum_{t=1}^{T} y_m^{s,t} / T$, respectively. Thus, the production set (of feasible input–output combinations) Ψ is defined as:

$$\Psi = \left\{ (\tilde{x}^s, \ \tilde{y}^s) \in \ \Re_+^{N+M} \mid \tilde{x}^s \ can \ produce \ \tilde{y}^s \right\} \quad (1)$$

Next, we describe the production process as a measure of probability in the production space $\Re_+^{N+M}$, based on the probability of dominance of random variables (X, Y) as Cazals et al. (2002), which are determined by:

$$H_{XY} \ (\tilde{x}^s, \ \tilde{y}^s) = P\,(X \leq \tilde{x}^s, \ Y \geq \tilde{y}^s) \quad (2)$$

where $X \in \Re_+^N$ is the vector of inputs and $Y \in \Re_+^M$ is the vector of outputs of a given production process.

It is important to observe $H_{XY} \ (\tilde{x}^s, \ \tilde{y}^s)$, which is monotone nondecreasing in $\tilde{x}^s$ and monotone nonincreasing in $\tilde{y}^s$, reflecting the probability that a unit operating at the input–output level $(\tilde{x}^s, \ \tilde{y}^s)$ will be dominated, that is, the probability that another unit will produce at least the same level of output although using the same inputs as the unit operating at the level $(\tilde{x}^s, \ \tilde{y}^s)$.

Taking an input orientation, equation (2) can be explained as:

$$H_{XY} \ (\tilde{x}^s, \ \tilde{y}^s) = P\,(\ X \leq \tilde{x}^s \mid Y \geq \tilde{y}^s) \ P\,(Y \geq \tilde{y}^s) = F_{X \mid Y}\,(\tilde{x}^s \mid \tilde{y}^s)\, S_Y\,(\tilde{y}^s) \quad (3)$$

where $F_{X \mid Y}\,(\tilde{x}^s \mid \tilde{y}^s) = \frac{H_{XY} \ (\tilde{x}^s, \ \tilde{y}^s)}{H_{XY} \ (0, \ \tilde{y}^s)}$ represents the survival function of X and $S_Y\,(\tilde{y}^s)$ is the marginal survivor function of Y, for which it is assumed that $S_Y\,(\tilde{y}^s) > 0$.

As Pérez-López et al. (2021, 445) affirm, the traditional efficiency estimator is naturally deterministic, and all observations belong to the production boundary. In other words, $prob \ ((\tilde{x}^s, \ \tilde{y}^s) \in \ \Psi \ ) = 1$ (Kourtesi et al. 2012). This makes the estimation sensitive to the presence of outliers, and this can influence the lower boundary of the support of $F_{X \mid Y}\,(\tilde{x}^s \mid \tilde{y}^s)$. The partial order-m frontier approach proposed by Cazals et al. (2002) helps overcome this limitation.

An empirical survival function is defined for a sample $(\tilde{x}_i^s, \ \tilde{y}_i^s)$, $i = 1, \ldots, n$ of the random vector $(X, \ Y)$, taking into account Surroca, Prior, and Tribó Giné's (2016) extension data panel for frontier estimations:

$$\hat{H}_{XY,n} \ (\tilde{x}^s, \ \tilde{y}^s) = \frac{\sum_{i=1}^{n} I\,(\tilde{x}_i^s \geq \tilde{x}^s, \ \tilde{y}_i^s \geq \tilde{y}^s)}{n} \quad (4)$$

and the empirical analog of $F_{X^t \mid Y^t}\,(x^{s,t} \mid y^{s,t})$ is then given by:

$$\hat{F}_{X \mid Y}\,(\tilde{x}^s \mid \tilde{y}^s) = \frac{\hat{H}_{XY,n}\,(\tilde{x}^s, \ \tilde{y}^s)}{\hat{H}_{XY,n} \ (0, \ \tilde{y}^s)} \quad (5)$$

For $X^1, \ \ldots, \ X^m$ random variable vectors generated by the empirical distribution of X given $Y \geq \tilde{y}^s$, the survival function of which is equation (5), the estimator of the unconditional order-m data panel (UOM-DP) efficiency function is defined as:

$$\hat{\theta}_{m,n}\,(\ \tilde{y}^s) = \hat{E}\left(min\left(X^1, \ \ldots, \ X^m \mid Y \geq \tilde{y}^s\right)\right) \quad (6)$$

which is computed as follows:

$$\hat{\theta}_{m,n}(\tilde{y}^s) = \int_0^{\infty} \left[\hat{F}_{X \mid Y,n}\ (u \mid \tilde{y}^s)\right]^m du \qquad (7)$$

where u is a dummy of integration[4]. Resampling techniques are used in the algorithm to estimate the efficiency coefficients of the order-m data panel, where the estimation process is repeated B times, thus producing B efficiency coefficients, from which the efficiency value is obtained as the arithmetic mean of the B efficiency coefficients.

Conditional Order-M Data Panel (Corderm-DP)

To evaluate the effect produced by environmental variables, we consider the vector of the exogenous environmental variables $Z \in \Re^k$ which may influence the probabilistic production process. In this case, we focus on the conditional distribution of (X, Y) for a given value of Z, and therefore equations (2) and (3) can be specified as follows:

$$\begin{aligned} H_{XY \mid Z}\ (\tilde{x}^s,\ \tilde{y}^s \mid \tilde{z}^s) &= P\,(X \le \tilde{x}^s,\ Y \ge \tilde{y}^s \mid \ \ Z = \tilde{z}^s) \\ &= F_{X,Y \mid Z}\,(\tilde{x}^s \mid \tilde{y}^s,\ \tilde{z}^s)\, S_{Y \mid Z}\,(\tilde{y}^s \mid \tilde{z}^s) \end{aligned} \qquad (8)$$

where $F_{X,Y \mid Z}\,(\tilde{x}^s \mid \tilde{y}^s,\ \tilde{z}^s) = \frac{\partial_Z H_{XY \mid Z}\ (\tilde{x}^s,\ \tilde{y}^s \mid \tilde{z}^s)}{\partial_Z H_{XY \mid Z}\ (0,\ \tilde{y}^s \mid \tilde{z}^s)}$, and ∂_Z is the operator of the order-k derivative for all the components of $\tilde{z}^s$.

Accordingly, the conditional order-m data panel efficiency is defined as:

$$\hat{\theta}_{m,n}(\tilde{y}^s, \tilde{z}^s) = \int_0^{\infty} \left[\hat{F}_{X,Y \mid Z}\ (u \mid \tilde{y}^s;\ \tilde{z}^s)\right]^m du \qquad (9)$$

where $\hat{F}_{X,Y \mid Z}\ (u \mid \tilde{y}^s;\ \tilde{z}^s) = \dfrac{\sum_{i=1}^{n} I\left(\tilde{x}_i^s \ge u,\ \tilde{y}_i^s \ge \tilde{y}^s\right) K\left(\tilde{z}^s - \tilde{z}_i^s / b_n\right)\ /_n}{\sum_{i=1}^{n} I\left(\tilde{y}_i^s \ge \tilde{y}^s\right) K\left(\tilde{z}^s - \tilde{z}_i^s / b_n\right)\ /_n}$, and $K\ (.)$ is the kernel density and b_n the smoothing bandwidth.

Conditional Efficiency Ratio Data Panel (CERdp)

Once the estimations of the long-term conditional and unconditional efficiencies have been obtained, we calculate the efficiency ratio, to measure the distance between the two frontiers and to evaluate the effects of municipal environment variables on the efficiency of each organizational form of service provision. The conditional efficiency ratio is calculated as follows:

$$CERdp\ \ (Efficiency\ ratio) = \frac{UOMDP}{COMDP} = \frac{\hat{\theta}_{m,n}(\tilde{y}^s)}{\hat{\theta}_{m,n}(\tilde{y}^s, \tilde{z}^s)} \qquad (10)$$

For values close to one, the conditional and unconditional order-m data panel estimations are similar, and there is a scant effect of the municipal environment (e.g., population density) variables. However, for values considerably far from 1, there is a noticeable distance between the frontiers, which indicates that municipal environmental factors have a significant impact on long-run municipal efficiency.

Finally, to compare the different levels of efficiency by organizational form, the Kruskal–Wallis test, the Mann–Whitney U test, and the Li test have been applied. The Kruskal–Wallis test determines whether there are differences in the efficiency values calculated for each organizational form analyzed. This nonparametric test assumes the normality of the analyzed variables and determines if two or more samples are independent, although it does not establish what differences exist between the samples. Therefore, the Mann–Whitney U test is applied, which tests the independence of two samples with the null hypothesis that there are no differences. Li test (Li 1996) is used to compare the distributions of the different groups analyzed and measures the distance between two density functions through their integrated mean square error (Zafra-Gómez and Muñiz 2010).

Next, Table 1 explains the variables used as input and output, and Annex I shows descriptive statistics. Our main input is the Effective Cost of the Local Service, explained above. As outputs, we will use the average daily consumption, consumption adjusted by quality[5], and network size.

Results

After applying the proposed methodology, all the results are shown in Table 3. We, first, take into account the analysis of the main categories to deliver water services, public provision, and contracting out. As can be observed in Table 2, in general, contracting out is more efficient than public provision, even when environmental factors are included in the process. Contracting out is also more efficient when quality measures are introduced, and it has a greater improvement than public provision observing the rates of change.

After making a global analysis of the efficiency levels, we assess which organizational forms deliver services most efficiently in the first stage of the analysis, without considering municipal environment factors (Ucorderm-DP), both with and without accounting for service quality (see Table 2 and Annex III).

Our results show that, among the three organizational forms studied, contracting out with user fees is the most efficient. Consider, first, the analysis without adjusting for quality. Contracting out with user fees outperforms both other forms, with contracting out without user fees being the least efficient. When accounting for service quality, contracting out with user fees remains the most efficient organizational form, ahead of public service provision and contracting out with public funding.

These results support the second hypothesis of this study, showing that contracting out with user fees is more efficient than contracting out with public funding when adjusting for the quality of the service.

Our results also support our third hypothesis, showing that contracting out with user fees is more efficient than

[4]The frontiers in an order-m data panel represent the efficiency values of each unit by comparison with a sub-sample of m units, such that for an average input of $(\tilde{x}^0)$ and an average output of $(\tilde{y}^0)$, we consider m production units, chosen randomly, with output variables $(Y_1, \ldots, Ys, \ \ldots, \ Y_m)$, which are derived from the distribution of the output matrix Y that meets the condition $Y_s \ge \tilde{y}^0$.

[5]To adjust by quality, we interacted with production and the quality index published by the Survey of Local Infrastructure and Equipment (EIEL). Both greater production and higher quality thus increase the quality-adjusted index.

Table 1. Inputs and Outputs

Type	Variable	Definition	Source
Input	Effective cost	Effective Cost of the Local Service (ECLS).	Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury
Output	Average daily consumption (m3)	Average consumption of water of the municipality in m3	Survey of Local Infrastructure and Equipment (EIEL), from the Ministry of Public Administration's Web site
	Consumption * Quality	Average consumption of water of the municipality in m3 corrected by the index of service quality	
	Network size	Meters of pipe installed in the municipality	
Municipal environment	Population size	Total population of the municipality (natural logarithm)	National Institute of Statistics
	Population density	Number of inhabitants of the municipality divided by its surface area (square kilometers)	
	Urban agglomeration	Number of population centers within the municipal area	
	Income per capita	Level of wealth of the municipality per inhabitant	
	Unemployment level	Rate of unemployed people in the municipality	
	Live debt (LN)	Live debt of the municipality in LN	Ministry of Finance
	Cash Surplus Index	Difference between net short-term receivables, liquidity, and net short-term liabilities	Directorate General for Financial Coordination with Regional and Local Authorities (DGCFCAEL, Ministry of Finance and Public Administration)
	Nonfinancial Budgetary Result Index	Nonfinancial current budgetary receivables and nonfinancial capital budgetary receivables divided by current budgetary payables and nonfinancial capital budgetary payables	
	Tourist activity	Index of tourism-oriented activities.	Spanish Economic and Social Yearbook: La Caixa
	Industrial activity	Index of industry-oriented activities.	
	Commercial activity	Index of commerce-oriented activities.	

Source: Based on data supplied by the Virtual Office of Local Government Financial Coordination and the Survey of Local Infrastructure and Equipment.

direct provision. As a caveat to this, as noted, we cannot distinguish between those services that are provided directly by the municipality and rely on user fees, and those cases of public direct provision in which the user does not pay for the service. However, given that previous studies have shown greater quality shading in private provision—and thus a greater effect on quality-adjusted efficiency in private provision—we do not expect to see a strong difference in terms of performance between direct public provision with fees and without—thought it remains for future research to assess whether this expectation holds (Alonso and Andrews 2016; Elkomy, Cookson, and Jones 2019; Young and Macinati 2012). Finally, in support of our first hypothesis, we also find that public provision is more efficient than contracting out with public funding.

Second, we assess whether there are significant differences in average efficiency levels between different organizational forms, using the Kruskal–Wallis test. Our null hypothesis is that the *k* samples or groups have equal means. This test is applied to the efficiency estimates of the municipalities included in each organizational form for the analyzed period (Table 2). Results from the Kruskal–Wallis test, both for measures with and without quality, allow us to reject the null hypothesis with a significance level of 99%: the cost-efficiency of each of the organizational forms studied is significantly different from each other.

Third, we perform the Mann–Whitney U tests and the Li test (Balaguer-Coll et al. 2010; Li 1996; Simar and Zelenyuk 2006) to assess differences in efficiency levels between each organizational form and service. We find, again, significant differences between them (Table 3).

After obtaining results for unconditional efficiency, we, next address municipal environment factors more fully in our analysis, estimating Conditional Efficiency. Results are shown in Table 2. Li and U Mann–Whitney tests for these results are provided in Table 3.

Once environmental factors are taken into account, the efficiency levels have increased their values, both with and without quality, which means that the municipal environment has an important role in the efficiency of water services. At the same time, contracting out with user fees remains the most efficient organizational form with and without quality adjustment, followed by public provision. Our results thus remain supportive of our hypotheses.

We, next, assess the statistical significance of the differences between conditional and unconditional density functions by organizational form, by applying a Li test, where we find a significant difference ($p = 0.000$), which highlights the importance of including these environmental factors, as efficiency could be underestimated.

Finally, to ensure that our results are not driven by municipalities of different sizes selecting different organizational forms for service delivery, we estimate the conditional models next by population size, following the population bands of the Spanish Public Administration regulations. After analyzing population ranges, we observe a similar pattern across population sizes, suggesting our results do not simply mask differences in population across municipalities.

Table 2. Efficiency Levels for Water Provision[6]

Organizational Form	Without Quality*	With Quality*	Rate of Change
Unconditional efficiency			
Public service provision	0.273	0.302	10.62%
Contracting out	0.368	0.433	17.66%
Contracting out with public funding	0.265	0.286	7.91%
Contracting out with user fee funding	0.404	0.472	16.75%
Conditional efficiency			
Public service provision	0.818	0.830	0.98%
Contracting out	0.825	0.849	2.67%
Contracting out with public funding	0.678	0.704	3.85%
Contracting out with user fee funding	0.823	0.881	6.58%
Conditional efficiency ratio			
Public service provision	0.326	0.363	10.15%
Contracting out	0.459	0.515	11.82%
Contracting out with public funding	0.335	0.372	9.94%
Contracting out with user fee funding	0.481	0.553	11.48%

Source: The authors.

Table 3. Assessing Differences in Efficiency Between Different Organizational Forms (Test U of Mann–Whitney and Li Test)

Null Hypothesis (H_0)	Test U Mann–Whitney		Li Test	
	Water No Quality	Water Quality	Water No Quality	Water Quality
Unconditional order-m data panel				
Public service provision = contracting out	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with public funding = contracting out with user fee funding	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with public funding = public service provision	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with user fee funding = public service provision	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Conditional order-m data panel				
Public service provision = contracting out	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with public funding = contracting out with user fee funding	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with public funding = public service provision	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with user fee funding = public service provision	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Conditional efficiency ratio data panel				
Public service provision = contracting out	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with public funding = contracting out with user fee funding	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with public funding = public service provision	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)
Contracting out with user fee funding = public service provision	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)	H_0 rejected (0.000)

Source: The authors.
Note: Level of significance on parenthesis. Test U of Mann–Whitney estimated in SPSS 21; Li Test estimated in R.

[6]All differences between efficiency and quality-adjusted efficiency are statistically significant across organizational forms (Annex II).

Table 4. Results of Nonparametric Regression by Organizational Form

Variable	Contracting Out With Public Funding	Contracting Out With User Fee Funding	Public Service Provision
Population (Ln)	1.78 (0.000)	3.52 (0.000)	3.45 (0.000)
Population density	3.67 (0.020)	9.21 (0.032)	1.58
Agglomeration	1.13	1.58	2.14
Income per capita	1.99 (0.013)	2.85 (0.039)	3.79 (0.009)
Unemployment level	−2.54 (0.040)	−2.16 (0.042)	−3.21 (0.035)
Live debt (LN)	−0.36	−0.15	−0.64 (0.006)
Cash surplus Index	3.09 (0.004)	3.32	4.27 (0.008)
Nonfinancial budgetary result Index	0.76	0.21	0.98 (0.000)
Tourism	12.91 (0.046)	16.48	11.23
Industrial	2.23	3.29	1.57
Commercial	5.97	4.15	3.22

Source: The authors.
Note: Level of significance on parenthesis.

Observing the results, hypotheses 1, 2, and 3 are accepted for all the different population ranges[7].

Finally, we assess the impact of municipal environment factors on the efficiency of the water services through a nonparametric regression. In other words, after having assessed the effect of environmental factors on efficiency estimations generally using the conditional efficiency ratio (CERdp), we now examine the effects of specific factors that may influence organizational forms of the provision of water services. We will employ nonparametric regressions to the efficiency ratio (Pérez-López et al. 2021) to determine how organizational forms relate to different environments. We use a nonparametric bootstrap procedure, used also by Pérez-López et al. (2021), which obtains standard errors and levels of significance for environmental factors on average efficiency values (Table 4).

We find significant effects for population size, population density, urban agglomeration, the tourism index, unemployment level, live debt, income per capita, solvency, and budgetary sustainability. We also find that effects vary by organizational form. For instance, population size and Income per capita have a positive effect in all organizational forms, but the effect is greater in the case of public provision. On the opposite, the unemployment level has a negative effect in all organizational forms, but public provision has also a greater effect. Population density is only significant for contracting out, with a particularly large positive effect for contracting out with user fees. The cash surplus index has a positive effect on public provision and contracting out with public funding, being this effect greater in public provision. Finally, in the case of public provision, we can also observe a significant influence on the live debt of the municipality (negative effect) and the budgetary result index (positive effect).

Discussion and Conclusion

Our findings suggest that the accountability problems that have so far plagued governments in their attempts to involve private contractors in the provision of public services may, at least in part, be mitigated when user accountability is introduced through user fees. First of all, our results confirm previous findings that the market and managerial accountability mechanisms present under the traditional form of contracting out, where the service is funded through taxation, are not sufficient to ensure superior performance. Our results show that, without user fees, contracting out is less efficient than public provision when accounting for service quality. However, the promised benefits of contracting out are realized when contractors are made responsive to service quality through user fees. The use of long-term efficiency evaluation methodologies thereby "allows us to contrast which forms of management are more efficient in a long period, which provides a more robust evaluation than analyzed through cross-section" (Garrido-Rodríguez et al. 2018, 28).

We contribute to a growing literature that moves beyond the evaluation of a simple public-private dichotomy and investigates specific variants of public service contracting out and, in particular, important managerial questions about not only whether but also *how* to best contract out. The design we employ allows us to compare the efficiency of different organizational forms directly. Furthermore, by introducing a quality-adjusted measure of efficiency, we can assess service efficiency holistically and speak to current debates about the quality implications of contracting out (Alonso and Andrews 2016; Amirkhanyan, Kim, and Lambright 2008; Hefetz and Warner 2004; Overman 2016; Petersen, Hjelmar, and Vrangbæk 2018; Savas 2002; Van Slyke 2003; Zullo 2008).

Although this article provides strong evidence that user fees can remedy some of the quality failures, questions remain to be investigated by future research. We have argued that funding through user fees places pressure on private contractors to maintain or improve service quality, but we do not yet know, for instance, whether user fees could have similarly beneficial effects in the absence of contracting out. Analysis of other service areas, where direct public provision is combined with fees to users could contribute to this research agenda. In a similar vein, we have only controlled by some managerial factors of those organizations providing public services. However, future research could delve into how the managerial capacity of each municipality influences the results of contracting out with or without fees, as one

[7]It is possible to find the results by population size and region on Annex IV.

could expect that those municipalities with more managerial resources would become stronger at monitoring their contracting out initiatives, increasing their accountability.

Furthermore, the service that we have analyzed is a monopoly. Users' accountability for services not provided by a monopoly provider (i.e., when users have the option to switch providers) may, however, be expected to exert an even stronger effect, as users can shift to other private providers. Whether this expectation holds could be explored in future studies assessing whether our findings apply to services with different market structures.

Our analysis is also limited to data from one country (Spain), one type of public entity (municipality), and one type of service (water). Whether our findings generalize beyond these settings remains an empirical question. Some plausible scope conditions apply. For instance, our hypotheses rest, in part, on (some) elasticity in demand for water. In poorer countries in which water is consumed for essential reasons only, user accountability may not exert similar effects. Similarly, our hypotheses rest on incomplete managerial accountability of contractors, which user accountability partially mitigates. In settings with strong managerial accountability of contractors—for example, of a high-capacity national government institution, rather than municipalities—user accountability may not exert similar effects. Whether these expectations hold remains for future research to assess.

Supplementary Material

Supplementary data is available at the *Journal of Public Administration Research and Theory* online.

Data Availability

The data that support the findings of this study are available in the Harvard Dataverse Repository, at https://doi.org/10.7910/DVN/I1TQ2O.

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