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"Recovery Risk and Labor Costs in Public-Private-Partnerships: Contractual Choice in the U.S. Water industry"

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Abstract

We use an ordered logistic model to empirically examine the factors that explain varying degrees of private involvement in the U.S. water sector through public-private partnerships. Our estimates suggest that a variety of factors help explain greater private participation in this sector. We find that the risk to private participants regarding cost recovery is an important driver of private participation. The relative cost of labor is also a key factor in determining the degree of private involvement in the contract choice. When public wages are high relative to private wages, private participation is viewed as a source of cost savings. We thus find two main drivers of greater private involvement: one encouraging private participation by reducing risk, and another encouraging government to seek out private participation in lowering costs.

JEL classification: H4; H54; H7; L88; L9
Keywords: Privatization, Public-Private Partnerships, Water, Contracting out.

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1. Introduction

After several decades of water delivery privatization, a widespread view among scholars is that water delivery is a complex service featuring high contracting costs. In his study of concession contract renegotiation, Guasch (2004) documents the high frequency of renegotiation in Latin America and the Caribbean water and sanitation services between the mid-eighties and 2000. Renegotiation affected 74.4 percent of concession contracts in the sector, significantly higher than in other important sectors, such as transportation. Moreover, the period of time between contract award and renegotiation was only 1.7 years on average (Guasch, 2004). Although overall favorable to privatization, Megginson (2005) considers water to be the clearest case among user-paid services where privatization has failed to deliver clear welfare improvements.

There is now a substantial empirical literature showing that water private delivery has not provided superior efficiency and productivity relative to public delivery in most developed countries (e.g., Warner and Bel 2008). However, because private participation allows access to additional expertise and greater financial capabilities, studies suggest that private participation in less-developed countries has delivered improvements in quality and accessibility. Mixed effects of privatization in several services have led to reforms that go beyond a pure public/pure private split (Warner and Bel, 2008; Bel and Fageda, 2010). Greater use of public-private partnerships (PPPs) is one result of such a trend. In fact, PPPs can be viewed as a way to extend a standard procurement method, similar to contracting out. Moral hazard and quality measurement problems, among others, have arisen in contracting out (Levin and Tadelis, 2010). Contracting out has evolved to include high-powered incentives, which require shifting substantial risk to the private partner, to help address those problems. The private partner demands compensation to bear that risk however, which requires the public sponsor to pay a risk premium.

The term “public-private partnership” has evolved to encompass any contractual framework allowing for greater private sector participation in infrastructure projects than under a traditional approach. PPPs range from relatively simple management contracts to complex design-build-finance-operate (DFBO) contracts, to outright asset sales.

Under a traditional design-build (DB) approach, for example, private firms design and construct an infrastructure facility on behalf of a public sponsor. The sponsor remains responsible for financing, operating, and maintaining the facility. A greater degree of private involvement is found in design-build-operate-maintain (DBOM) contracts. Under DBOM, the additional duties of the private partner(s) include operating and maintaining the facility after it has been built. Both DB and DBOM contracts take advantage of private sector incentives and expertise to design and build facilities so as to minimize operation and maintenance costs.

Greater private involvement also occurs through design-build-finance-operate-maintain (DBFOM) contracts, which extends private participation to the project's financing. In a typical DBFOM contract, the private partner uses some combination of debt and equity to design and build a new facility, and then operates and maintains it for a specified time period in exchange for the right to collect revenues from facility users over the lease term. Two versions of this project type are (a) a greenfield PPP, through which the private partner builds a new facility; and (b) a brownfield PPP, through which an upfront concession fee is paid by the private partner in order to lease a pre- existing facility. Other contractual types include build-transfer-operate (BTO) agreements, under which the private partner owns the facility until its ownership rights are transferred to the public sector when construction is finished. Similarly, under a build-operate-transfer (BOT) agreement, the private partner retains ownership rights until title is transferred at the end of the specified operation and maintenance period. In a build-own-operate (BOO) agreement, ownership remains with the private partner unless the public sector purchases it.

The contractual diversity facilitated by PPPs has increased the array of types and degrees of private involvement in public infrastructure delivery. However, empirical analysis of the motivation behind public services privatization has remained largely focused on a clear bifurcation between pure-public and pure-private delivery (Bel and Fageda 2007, 2009), with few extensions to other mixed forms such as mixed public-private firms (Bel and Fageda, 2010).

We contribute to the literature by empirically analyzing the factors that explain varying degrees of private involvement through PPPs in the water sector. The water sector provides insights relevant for the study of PPPs more broadly. First, water distribution involves large investments in networks, which makes this sector subject to financial constraints. Second, water sector investments typically require long amortization schedules. There is great uncertainty associated with long-term changes in demand and other variables. Risk sharing and risk transfer over the life of the contract are more important in the water sector than in many other local services. Water

services are thus characteristic of other services involving large, sunk investments and long contracting periods, such as transportation.

We explore the determinants of private participation through PPPs in the water sector. Our estimates indicate that fiscal and political variables are not relevant for the determination of PPP contract type in the water industry. Instead, contract size coverage – our proxy for market attractiveness – and the ratio of government and private sector wages, are positively related to private partner involvement via PPPs. Thus, lower cost-recovery risk and higher relative public sector wages lead to greater private involvement.

The paper is organized as follows. We next review empirical evidence on the relationship between privatization of water delivery, productivity and service efficiency. We then examine quality and accessibility. We discuss empirical analysis of factors explaining the degree of water privatization in Section 3. Section 4 describes our data and variables. In Section 5, we describe our methods and empirical estimates. Section 6 offers concluding remarks.

2. Privatization of water delivery and wastewater treatment: efficiency, prices and quality

We here provide a brief overview of literature on water services privatization, which can be divided into two broad categories. The first focuses on the search for measurable differences in productivity or cost efficiency across the two basic ownership forms. This accounts for the majority of empirical water privatization studies. The second is a smaller set of studies examining what could be characterized as “other outcomes” related to water privatization. These other outcomes include the number of connections and the related issue of child mortality from water-borne diseases.

With several exceptions, the first set of studies concludes that there are no significant differences in productivity and efficiency between public and private water utilities. These researchers typically estimate a cost function and include a dummy variable for ownership structure. One early and widely cited study is Crain and Zardkoohi (1978), who tested the property-rights theory of the firm. They posit that, because privately owned firms feature tradable ownership shares, owners are able to capitalize value created through efficiency-enhancing activities, and will thus have stronger incentives to undertake such activities, even if the firm

operates in a non-competitive environment. Crain and Zardkoohi estimate a cost function derived from a Cobb-Douglas production function and included a dummy variable for firm ownership. They found that private water utilities were more efficient than their public sector counterparts.

Alternatively, Feigenbaum and Teeples (1984), using 1970 data, examine 57 private and 262 public water utilities in the United States. Using both a hedonic cost function and a non-hedonic approach, they could not reject the hypothesis that, under either approach, the parameters of the cost function were the same for public and private firms. Byrnes, Grosskopf and Hayes (1986) examine 68 publicly owned and 59 privately owned U.S. water utilities in 1976. They focus on technical and scale efficiencies, and again find that there are no significant differences across ownership forms.

Fox and Hofler (1986) use cross-sectional data for 1981 with a sample of 156 publicly owned and 20 privately owned utilities and find no significant difference in technical efficiency across public and privately owned firms. They do, however, find differences in allocative efficiency across the two ownership types. Battacharyya, Parker, and Raffiee (1994) examine 225 public and 32 private water utilities in the United States from a 1992 water industry survey. They find that public water utilities are more efficient than their private counterparts. Battacharyya et al (1995) find that public ownership is more efficient for large water companies, but less efficient for small ones.

Saal and Parker (2001) examine prices and productivity for privatized water and sewer companies in England and Wales. They use non-parametric methods to compare growth in labor and total factor productivity for the pre-privatization period (1985 to 1990) with the post-privatization period (1990 to 1999). They find that, despite reductions in the use of labor, that total factor productivity did not improve after privatization. They also find that increases in prices exceeded increases in cost over the period, which accounts for an observed increase in profits.

Estache and Rossi (2002) extend these studies. They estimate a stochastic cost frontier using a sample of 50 water companies from 29 Asian and Pacific regional water companies. Using two methods of measuring efficiency, an error components model and a technical efficiency effects model, they find no significant differences in efficiency across the two ownership forms.

Several authors (e.g. Kirkpatrick, Parker, and Zhang 2006) note that the highly specific, fixed nature of investment in water infrastructure, along with the inherent difficulties in introducing competition (except in peripheral services, such as billing and metering), lead to an environment where ownership is unlikely to have large effects on efficiency.

Bel and Warner (2008) conduct a comprehensive survey of all published econometric studies from 1970 onwards on the privatization of solid waste and water services. They review thirty-five studies in all, seventeen of which examine the water sector. They note that, although many early studies used U.S. data, there is significantly more experience with water privatization in Europe. They focus on the question of whether the studies generally conclude that privatization reduces costs. They did not focus on issues of rates or service quality as related to ownership form. They review several theoretical approaches that generate predictions about the effects of ownership on cost efficiency.

They find no evidence that water privatization lowers cost. They attribute this to the inherent nature of water utility assets, which are sunk, highly specific, have low value in alternative uses, with strong natural monopoly characteristics. These attributes make competition –from which many of the efficiency benefits are expected to arise – difficult. Meta-regression analysis conducted in Bel, Fageda and Warner (2010) finds results that are consistent with the conclusion that private delivery of water services does not show significant productivity differences with respect to public delivery.

Another set of studies focuses on the effects of water utility ownership on service quality. These studies typically examine service coverage, or the number of connections provided, under each ownership type. One might be surmise that private for-profit water providers would serve wealthier areas while poorer areas would go un-served. Alternatively, the pricing of water services may become politicized under government provision, resulting in water prices depressed to the point where full cost recovery becomes impossible. Without subsidies, revenues become insufficient to fund adequate maintenance or expansion of the network into poor areas, and the sector becomes starved for capital. For example, Clarke et al (2009) note that charging prices below cost may not benefit the poor in low-income countries because high initial connection costs combined with the resultant rationing imply that the poor will be unable to obtain service even if they could afford rates that fully covered costs. The question is thus inherently empirical.

Wu and Malaluan (2008) focus on water privatization in Manila, and examine two case studies in detail. Those include two private companies that received concession contracts: Maynilad Water Services and the Manila Water Company. Their findings corroborate the view that private water companies can bring additional capital to bear.

They find that the two companies increased the total number of water connections by 30 percent in their first five years of operation, which they state (p. 225) "would have taken (the municipal utility) 30 years to achieve on the basis of its historical performance." They also find that worker productivity increased significantly after water privatization, rising from 9.4 staff members per 1,000 connections in 1996 to 4.1 per 1,000 connections in 2003.

Clarke et al (2009) use household-level survey data collected over many years from Argentina, Bolivia, and Brazil, where large water privatizations took place. The time and space variation in the data allow them to examine how ownership form affects connections. They find that privatization increased the share of households with water connections, but find increases in non-privatized areas, suggesting that observed improvements may be due to factors other than privatization. They conclude that, at a minimum, private participation does not harm the poor.

Similarly, Harris (2003) reports that, after privatization, 60 to 80 percent of new connections in the Columbian cities of Cartagena, Barranquilla, and Tunja went to low-income households. **Clarke and Wallsten (2003)** find that, although prices increased after privatization in Dakar, Senegal, connections in low-income areas rose faster than did coverage under eight publicly managed utilities in Africa.

In studying service coverage, Galiani et al (2005) examined the impact of water privatization on child mortality in Argentina. Young children are particularly vulnerable to water-borne diseases, and diarrhea alone accounts for about 15 percent of all childhood deaths. Argentina offers a useful case study because it embarked on one of the largest water privatizations in the world in the 1990s, allowing sufficient time for study.

The Argentine privatization included about 30 percent of the country's municipalities and about 60 percent of the population. Exploiting this variation across time and space, the authors find that the privatization of water utilities is associated with roughly an 8 percent reduction in child mortality from water-borne diseases. They find that most of the reduction occurred in low-income areas where expansion of the water network was the greatest.

Water privatization is clearly an important policy topic. Private delivery has not generally delivered increased productivity and efficiency in developed countries. However, private sector participation is considered valuable because private firms can access new, large pools of capital, which is particularly important in rapidly growing cities in developing countries, where municipalities and central governments often lack the resources necessary to provide piped water (Hewett and Montgomery 2001). Water privatization has also been seen as a way to depoliticize the pricing of water services. Government-owned utilities may price water services below cost, which necessitates ongoing subsidies that are difficult for governments in many developing countries to pay (Wu and Malaluan 2008). Nonetheless, more evidence is needed to ascertain whether higher prices under private delivery in developed countries (Carpentier et al., 2006; Chong et al., 2006; Martínez-Espiñeira et al., 2009; Ruestes and Zschille, 2010) is due to pricing water services closer to actual costs or a consequence of competitive failures in the private market for service delivery.

3. Background on factors explaining private participation in water services

PPPs can be viewed as extending the typical procurement method of contracting out. Therefore, theoretical and empirical analyses of private delivery of public services provides a useful background with which to study why a government will choose a PPP contract to deliver a public service, as well as the degree of private involvement in a PPP contract. Bel and Fageda (2007, 2009) review the literature on factors explaining local privatization and propose a typology distinguishing between different families of variables (fiscal motivations, economic efficiency and network effects, and political processes and ideological attitudes). Within the empirical literature devoted to analyzing the determinants of privatization of public services (Bel and Fageda 2007, 2009) only a few papers had been published focusing on water services (e.g. Ménard and Saussier, 2000).[1] However, in recent years, several multivariate empirical works have appeared examining motivations for water privatization. We next review those papers taking into account Bel and Fageda's typology of factors.

Using a 2002 sample of 459 counties in 45 U.S. states (out of the 483 counties in charge of water supply), Pérard (2009) examines financial and fiscal variables, environmental variables (such as density and population), economic, and political variables. 300 of those counties directly deliver water supply while 159 outsource the service. The most robust and persistent determinants of privatization are fiscal burden, housing density and republican vote (all positively associated with privatization), whereas percentage of public employees in the population is negatively related to privatization. A similar approach is taken in Bel, Fageda and Mur (2010), who use a sample of 73 municipalities from the Spanish region of Aragon, where very small towns predominate. Based on those estimates, privatization appears to be positively related to investment requirements and budgetary restrictions. The dispersion of population (as a proxy for the complexity of service), is instead negatively related to privatization. Additionally, political and ideological factors do not appear to significantly influence the privatization decision.

Miralles (2009) applies a duration model to analyze the factors determining the privatization of local water services. That method explicitly controls for time when examining the effect of various factors the privatization decision. Miralles uses a sample of 133 municipalities between 1980 and 2002 from Catalonia (Spain) composed of medium and large population-size municipalities. Three periods are examined: 1980-1987, 1988-1995, and 1996-2002. Empirical results show that such factors as financial constraints, efficiency improvements, industry interests and political factors, influence privatization in some periods but not others. The economic environment and the initial state of the service in each period examined are important in determining the influence of these factors.

Several studies using Spanish data have been published based on the same data base of municipalities of the Andalusia region.[2] González-Gómez and Guardiola (2009) and González-Gómez et al, (2011) use 744 and 741 municipalities respectively for the period 1985-2006. These papers use different instrumental techniques and slightly different models to explain local government's privatization decisions. Financial constraints are important in the decision, especially for large municipalities. Privatization increases with population, but very large cities privatize less than medium size cities. Having private delivery in neighboring municipalities is positively related to privatization, whereas politics and ideology does not play a role.[3]

These papers suggest that financial constraints may positively affect when large investments need to be made, that the intensity of public employment is negatively related to privatization, and that political and ideological factors do not significantly influence the privatization decision. In all, the reviewed literature confirms that the typology distinguishing between different families of variables (fiscal motivations, economic efficiency and network effects, and political processes and ideological attitudes), offers a useful framework to analyze the motivations behind government's decisions regarding the public-private delivery decision and, because of this, the degree of private involvement in public service delivery. Given this framework, we move beyond the pure public/pure private distinction and examine the PPP approach as a hybrid approach. We empirically explore these groups of determinants on the degree of private involvement. In the next sections we present our empirical strategy.

4. Data and Variables

We next describe the data, variables, and methods used to evaluate the impact of fiscal, political, economic, and service-type variables, together with other controls, on the extent of private participation through PPPs at the local level in the U.S. water industry. We begin by describing the main data source and discussing our sample. We then define and discuss the dependent variables in our empirical analysis, and move to independent variables. This section ends with the models to be estimated.

Data

Our main data source is the *International Major Projects Survey 2008* from *Public Works Financing* (October 2008 issue). This survey contains information on 165 PPP projects signed from 1988 to 2008 between local governments and private firms for the production and delivery of water services in the United States. The data provide detailed information on PPP contracts, which ensures examination of a wide range of contract types. This variation is critical for our dependent variables measuring the intensity of private involvement and risk transfer to the private sector.

Table 1 displays basic information on the distribution of contractual choice in local PPPs, distinguishing between water delivery and wastewater treatment services. Our sample is distributed almost evenly between water delivery and water treatment services. PPPs are concentrated in two main contract types: Management contracts and build-operate-transfer (BOT) contracts. Design and Build (DB) and Asset Sales represent a small number of water sector PPP contracts as reported in *Public Works Financing.*

Table 1. The Distribution of PPPs by Type of Contract in the 2008 *International Major Projects Survey* for Water Services

Type of contract	Water	Wastewater	Full Sample
Management Contracts	43	41	84
Design and Build	5	3	8
Concession / BOT type contracts[1]	34	37	71
Asset Sales	1	1	2
Number observations	83	82	165

Source: International Major Projects Survey 2008, *Public Works Financing*.
Notes: [1] This group includes the following contracts: BOT, BOO, BOOT, BTO, DBFO, DBO, DBM, DBOM, DFBO, etc.

These contract types imply different degrees of private participation and risk transfer. We thus examined two kinds of dependent variables: a four-category ordered contract variable and a binary contractual variable. We discuss each in turn.

Variables

Ordered Contract Variable:

This is an ordered categorical variable that assigns low values to PPP project types featuring relatively low private involvement and low risk transfer, and high values to project types featuring relatively high private participation and greater risk transfer. In Table 2 we present the type of contracts and values designated according to the extent of private involvement.

Table 2. Categorical dependent variable construction

PPP contract	Private involvement	Risk Sharing
Management Contracts	1	VERY LOW
Design-Build (DB)	2	LOW
Concessions & Build-Operate-Transfer (BOT) Contracts	3	HIGH
Asset Sale	4	VERY HIGH

Management contracts receive the lowest value, given the low associated level of risk transfer to the private partner. In these contracts, private operators simply manage existing infrastructure to deliver services. Few, if any, new investments are employed. The risk assumed by the private counterpart is thus limited. The next level of private involvement is Design-Built (DB) contracts. The private partner designs and constructs water plants, but does not operate the infrastructure, and does not provide delivery or treatment services. Although DB contracts for water plant construction require large initial investments, which generate risks associated with construction and design, the private partner does not bear demand (or market) risk in this case. Risk transfer to the private firm is limited to cost uncertainty. DB contracts are thus relatively low risk in the spectrum of PPP contracts. Risks associated with construction costs can generally be well managed by the private partner.

Concessions and Build-Operate-Transfer contracts are placed in category 3 because of the larger risks assumed by the private partner. Under a BOT contract or a Concession, the private partner builds and operates the facility for a pre-specified time period. Facility title is transferred back to the public sponsor at the end of that period. The private partner is here assuming substantial risk associated with the facility's construction (i.e. construction cost risk) and operation (i.e. operational cost and demand risk). Concessions and BOT contracts add demand risk to the construction risk typically assumed by the private partner under DB contracts. For these reasons, BOT contracts imply a greater level of private participation.

The last category is full privatization through asset sales. The private partner here actually acquires title to the facility, and assumes all risks associated with its ongoing operation, maintenance and refurbishment. We assign this category a value of four, reflecting the highest degree of private involvement and risk assumption.

Binary Contract:

Both management and DB contracts carry significantly lower levels of risk relative to assets sales or concession/BOT-type contracts. Moreover, management contracts are significantly more common in the water sector than are Design and Build PPPs. We thus created a second dependent variable, which assumes a value of zero if the PPP is a management or a DB agreement, and a value of one otherwise. A non-zero value thus includes concessions, BOT-type agreements (which include DFBO, DBO, DBM, BOO, DBOM, etc.), and asset sales. This dummy variable distinguishes between PPP contracts with a low versus high degree of private involvement/risk transfer.

We next discuss independent variables. We consider four variable groups: fiscal variables, economic variables, political variables, and basic controls. We discuss the motivation behind each regressor, focusing on the role played by relative public-sector salaries as a key driver of the level of private PPP participation and risk transfer.

Contract_Coverage: State per capita income in the year prior to the PPP agreement relative to project size (or cost) in millions of U.S. dollars. This captures the appeal of the PPP to the private sector according to the relative size of the project or the initial cost with respect to the purchasing power of the potential market. This ratio is also a proxy for risk transfer to the private sector because we account for the difficulty associated with recovering payments involved in the public-private collaboration. Small contracts in communities with high income per capita are more attractive for private participants because initial payments are easily recovered in running the PPP. On the contrary, expensive projects in states with relatively poorer consumers generate less private sector interest in accepting commercial risk. Our hypothesis that governments undertake PPPs that can inspire interest to the private sector predicts a positive sign on this variable. The data sources for this variable are *Public Works Financing* and the *Statistical Abstract of the United States.*

Tax_Burden: Tax revenues divided by income in the state where the PPP is signed in the year prior to the agreement. This controls for fiscal pressure and the ability of governments to raise money from taxpayers in a given state. We predict that this variable will be negatively correlated with the level of private PPP involvement because states with higher revenues are likely to be less reliant on private investment. The source for this variable is *The Tax Foundation,* tables entitled *"State and Local Tax Burdens: All Years, One State 1977-2008.*[4]

Spending_Limits: Binary variable equal to one if the State in which the municipality resides has a law constraining public spending at the municipal level.[5] Local governments will have stronger incentives to restrict spending if they reside in a State where fiscal limits are enforced. In fact, fiscal constraints are transferred from State to local governments. These limits generate more willingness to rely on the private sector. We expect this variable to have a positive effect on the extent of private involvement.

Ratio_Wages: Average public-sector wages relative to average private-sector wages in the State. This variable captures the cost of public servants relative to private workers in the labor force. If the relative cost of public servants is high, local governments are likely to increase private participation through PPPs in order to reduce costs. We thus expect a positive relationship between this ratio and the degree of private involvement. The source for these data is the *Statistical Abstract of the United States.*

Republican_Mayor: A binary variable set to one for those cities with a Republican Mayor at the time the PPP contract was signed, zero otherwise. This captures a business friendly and general market orientation associated with the Republican Party. Democrats may be predisposed to use public resources, while Republicans may be more likely to rely on the private sector. Data were obtained through direct consultation of documents published by city councils, and press articles that allow identification of the Mayor's party at the time the PPP was signed.[6]

Population: Total Population (in thousands) of the Metropolitan Area where the PPP was signed (and its square) are used to capture the size of the market. Private investors are likely to be more willing to provide facilities in highly populated markets. We expect that larger markets will result in greater private involvement.

Wastewater: A dummy variable set to one for wastewater services and zero for water delivery services. This variable captures different contractual choice patterns derived from the type of service contracted. The data source for this variable is also the *Public Works Financing* database.
Year: This additional control variable identifies the year in which the PPP was signed. It controls for any drivers of contract choice related to time.

5. Methods and estimation results

Methods

We use different estimation models to evaluate the impact of these regressors on the extent of private participation in completed PPPs. Our sample is a pool of local PPP projects in the water sector signed in the United States over the last 25 years. We are unable, however, to follow particular PPP projects across time, and do not have access to particular characteristics of contracts beyond the ones used in this analysis.[7] As a result we have a pool of different projects signed in different time periods. Monetary variables are not affected by this time difference because they are ratios where both monetary values are measured in the same time period. Also, we account for time trend with the inclusion of the variable *Year*.

We use two estimation strategies. We first use an ordered logit model to estimate the *Ordered Contract* dependent variable. We then estimate a standard logit model using *Binary Contract* as the dependent variable because the ordered logit assumes a monotone, one dimensional relationship between the latent and unobserved variable. We also consider the concentration of contract types within the Management Contracts and Concession/BOT categories, which leads us to utilize a binary variable distinguishing between large and small private involvement. Indeed, the privatization literature has typically focused on the decision of whether to privatize (contract out) or not, which has led to widespread use of logit and probit models. Indeed, one of our key contributions is the use of models that consider different privatization intensities. We thus utilize models applicable to categorical ordered discrete dependent variables.

The specification of the above models includes all regressors for both estimation strategies (ordered logistic and standard logistic) presented above and is as follows:

$$\mathrm{Contract}_i = \alpha + \beta_1 \mathrm{Contract\_Size}_i + \beta_2 Tax\_Burden_i + \beta_3 \mathrm{Spending\_Limit}_i + \beta_4 \mathrm{Ratio\_Wages}_i + \beta_5 \mathrm{Republican\_Mayor}_i + \beta_6 \mathrm{Population} + \beta_7 Population\_Squared_i + \beta_8 Wastewater_i + \beta_9 \mathrm{Year}_i + \varepsilon_i \quad \textbf{(1)}$$

We applied a specification error test and a multicollinearity diagnostic to these models. The first test for specification error (*linktest* in STATA) shows the meaningfulness of covariates chosen, the absence of omitted variable bias, and a correct assumption for the specified link function. The second test for multicollinearity (variance inflation factors) finds no significant collinearity in our specification.[8]

Estimation Results

Table 3 below displays our main estimates. Columns 1 and 2 report estimates for ordered logit and the standard logit models, respectively. These estimates indicate that fiscal variables and political variables are not relevant for the determination of PPP contract type in the water industry. Two economic variables, contract size coverage and the wage ratio, display positive and significant coefficients.

On the one hand, our results indicate that project attractiveness as measured by contract coverage is a significant determinant of private involvement and contract choice. Indeed, we find a statistically significant and positive relationship between private participation and the ratio of income to contract size. Recall this is the variable capturing the risk transferred to the private sector. Private sector participation is higher where it is easier to recover costs. This suggests that local governments are only able to significantly involve the private sector in PPPs where the commercial risk transferred is relatively lower.

On the other hand, the cost of labor for local governments relative to private labor is statistically significant and displays the expected positive sign. When public servants are more expensive, that is, when they receive higher wages than private workers in a given State, those governments have stronger incentives to promote PPPs with higher private involvement in the U.S. water industry. Behind this relationship we find an efficiency motivation due to the greater ability of private firms to operate with lower labor costs. In terms of marginal effects we find an estimate of 1.05. The probability change from 0 to 1 for the logit model associated with this variable is 0.45. As a result, we find that the economic cost of labor in the water industry is an important determinant of the role of private partners in PPP projects.

Our results also indicate that the size of the market is important for the determination of PPPs. The population variable indicates that, as expected, the largest markets with more potential consumers in the water industry do increase the presence of private partners in the PPP due to higher demand levels that may diminish risk and demand uncertainty. However, we find that this relationship is non-linear.

We also find no differences between water delivery and wastewater treatment services. However, the time trend indicates that private involvement is larger in PPPs signed in more recent years, suggesting that private participation is growing over time.

Table 3. Ordered logistic and logistic estimates for PPP contract choice.

Regressors	**Ordered Logit**	**Logit (*Coef.*)**	**Marginal Effects**
Contract_ Coverage	0.0029**	0.0028*	-0.0001
	(1.90)	(1.82)	
Tax_Burden	- 3.3016	-0.2977	-1.3254
	(-0.31)	(-0.03)	
Spending_Limit	-0.7369	-0.809	-0.2017
	(-1.50)	(-1.57)	
Ratio_Wages	4.5777***	4.6347**	1.0524
	(2.65)	(2.37)	
Republican_Mayor	-0.6378	-0.5220	-0.0514
	(-1.31)	(-1.08)	
Population	-0.0051**	-0.0052**	-0.0011
	(-2.33)	(2.35)	
Population^2	4.20e-12**	4.31e-12**	1.17e-12
	(2.35)	(2.36)	
Wastewater	0.2230	0.3964	0.0224
	(0.52)	(0.91)	
Year	0.2065***	0.2064***	0.0339
	(3.37)	(3.35)	
N. observations	108	108	
Log pseudolikelihood	-74.86	-61.47	
Pseudo-R2	0.15	0.17	

Note: T-statistics robust to heteroskedasticity in parentheses. * significant at 10%, ** at 5% and *** at 1%

Table 3 also presents the marginal effects of each variable on the probabilities of utilizing a high (or very high) level of private involvement. Marginal effects are calculated when all variables are evaluated at their means. This allows us to identify the magnitude of the effects produced by statistically significant coefficients. Wage differentials between private and public workers are the major determinant of private involvement in U.S. water PPPs. Although Contract Coverage is statistically significant, its economic significance as reflected in its impact on probabilities is much less than the ratio of wages.

Political variables are also of interest. Our estimates indicate no differences across political parties. This suggests that PPPs are decided under pragmatic rather than ideological views. One possibility is that partnerships are not viewed as privatisation and more pro-government parties might be more open to arrangements that are viewed as "partnerships" rather than as privatizations. Another possibility is that Republican mayors and Democratic Party mayors do not differ in terms of their attitudes towards the extent of private involvement in the USA.[9]

6. Conclusions

Private delivery of urban water services has not generally provided better productivity and efficiency outcomes than public delivery. Nonetheless, and particularly in the less developed countries, private production has delivered enhanced quality and accessibility. Mixed outcomes from privatization in several sectors has led to reforms that go beyond the pure-public/pure-private divide, and increased using of public-private partnerships can be seen as one result of such a trend. Greater PPP use has generated a variety of degrees of involvement of private partners in the delivery of public services. However, empirical analysis of the motivations for public services privatization has remained largely within the domain of pure-public versus pure-private delivery.

We contribute to the literature by empirically analyzing factors explaining different degrees of private involvement through PPPs in the water sector. Our estimates indicate that a variety of factors lead to greater private participation through public-private partnerships in the water industry. We find that the risk associated with cost recovery as measured in terms of the relative size of contract cost with respect to the purchasing power of the market (income per capita) is a driver of private participation. However, the magnitude of this effect is not very large.

We also find that the relative cost of labor is another key factor explaining the extent of private involvement in the contract choice. When public wages are high relative to private wages, private participation might be viewed as a source of efficiency gains due to lower salaries. In all, we find two sources motivating greater private involvement: one encouraging private participation by reducing risk, and another encouraging government to seek out private participation in order to lower its costs.

Going beyond the pure-public/pure-private split in the delivery of public services allows new understanding of government's decisions on this margin. Future research –by means of larger samples- should focus on further distinguishing among different types of PPPs, and on extending this type of analysis to other sectors.

Notes

1. It is worth noting that other non empirical papers have provided interesting insights in factors influencing privatization of water services, as that of interest groups and institutional structures of power (Fitch, 2007). See as well Bel, Hebdon and Warner (2007).
2. Bel and Fageda (2008) conduct an empirical analysis where they merge data on solid waste and on water. They find that water is less prone to contracting than solid waste.
3. In a more recent paper, Picazo-Tadeo et al (2012) use the same data base to conduct a detailed study on political and ideological factors.
4. Available at: http://www.taxfoundation.org/research/topic/9.html (accessed November 16, 2011).
5. Data for this variable were obtained from Table 1: Tax and Expenditure Limitations Currently Imposed Statewide on Local Governments, in Mullins and Wallin (2004). See the appendix for a more detailed description of the construction of this variable.
6. There are, however, several other variables included in the *Public Works Financing* database, such as contract duration and private firm identification, which cannot be exploited due to the number of missing values such that the number of observations would be significantly reduced. Indeed, the inclusion of the Contract Size variable reduces the number of observations from 165 to 108.
7. Variance Inflation Factor (VIF) = $1.16 < 10$ (Rule of thumb)
8. Geddes and Wagner (2012), however, find a large effect of political party affiliation on the likelihood that a state passes a public-private partnerships enabling law in a particular year.

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Appendix

A1. Correlation matrix

	Contract_ Coverage	Tax_Burden	Spending_Limit	Ratio_Wages	Republican_Mayor	Population	Wastewater	Year
Contract_ Coverage	-							
Tax_Burden	-0.14	-						
Spending_Limit	-0.06	0.08	-					
Ratio_Wages	0.00	0.05	0.32	-				
Republican_Mayor	0.17	0.01	-0.18	-0.10	-			
Population	0.57	0.01	0.01	0.04	0.05	-		
Wastewater	0.03	-0.06	-0.18	-0.06	0.12	0.01	-	
Year	-0.06	0.30	0.07	-0.28	-0.05	0.15	-0.16	-

A2. Source for Republican Mayor Variable

The ***Republican_Mayor*** variable was created in several steps. First, the names of mayors for relevant cities were gathered using the *Municipal Year Book* reference collection (various years), which provides data on many local governments across the United States.

Second, *Access World News* (various dates), which is a worldwide news archives database, was used to locate newspapers from those cities. Newspaper archives were then searched to determine the individual mayor's political party affiliation.

Twenty-four mayors (out of 163) were not affiliated with any political party. In those cases, party affiliation of the chief elected county official was used if it could be located. In other cases, using political affiliation of the county official was more appropriate given the nature and scope of the PPP, and again the political party of the chief elected county official was recorded. If there were multiple county commissioners or no clear chief commissioner, and political affiliation of the mayor could not be determined, the data point was delineated missing.

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