# THE DETERMINANTS OF PUBLIC-PRIVATE PARTNERSHIP CONTRACTUAL CHOICE IN THE UNITED STATES

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November 18, 2011

**Abstract**

U.S. states and localities confront outdated infrastructure in many sectors while facing severe borrowing constraints. Use of contractual arrangements with private firms, known broadly as public-private partnerships (or PPPs), is increasing. PPPs provide assistance in infrastructure design, construction, renovation, operation and financing, and encompass a variety of contractual arrangements and degrees of private involvement. Among this variety of contract types, management contracts, concession agreements, design-build-finance-operates (DBFOs) and asset sales are used most frequently. We examine the determinants of the degree of private participation as governed by contract type. We consider fiscal, political and infrastructure-type factors. We utilize local and state-level data on 472 PPPs of various types completed between 1985 and 2008 as reported in *Public Works Financing*. Our estimates indicate that infrastructure characteristics, particularly regarding stand alone versus network, are leading factors influencing the extent of private participation. Specifically, we find that network characteristics limit private involvement, while point-to-point transport infrastructure and stand alone facilities receive more private participation. Although political factors have little explanatory power, we find that fiscal variables such as a jurisdiction's debt stress, and basic controls such as population and locality of government, increase the degree of private participation. A greater tax burden reduces private participation.

**Keywords:** Privatization, Contracting out, Infrastructure, Public-Private-Partnerships.
**JEL Code:** H4; H54; H7; L88; L9

**Acknowledgements:** This research received financial help from the Spanish Ministry of Science and Innovation under Project ECO2009-06946, the Regional Government of Catalonia under project SGR2009-1066. Germà Bel acknowledges as well support from ICREA-Academia.

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## 1. Introduction

Critical infrastructure in the United States is deteriorating and past its original design life. The state and local governments responsible for that infrastructure are facing severe fiscal problems, and are unable to devote the resources necessary to properly expand and maintain it. The problem spans a variety of facilities and sectors, including roads, bridges, tunnels, transit systems, dams, schools, and wastewater treatment plants, among others. Federal funds for the maintenance of infrastructure are also dwindling.

State and local governments are turning to the private sector for assistance with the design, financing, construction, expansion, maintenance and operation of critical infrastructure facilities. Twenty-eight states now have public-private partnership enabling laws in place, which are designed to facilitate private participation in infrastructure provision and operation.

This type of cooperation typically occurs through a "public-private partnership," or a PPP, which is a contractual agreement between a group of private partners and a public project sponsor. Agreements can take on many forms. Private participation can occur through simple management contracts, where a private party is retained to operate existing facilities, such as schools, prisons, or toll roads. It can also occur through more complex end-to-end contracts where the private party designs, finances, constructs, and operates entirely new facilities. Private participation thus varies in intensity across different contract types.

Although the scholarly literature on PPPs is growing, there has not yet been systematic empirical study of the factors driving the choice of PPP contract type. We attempt to address that gap by categorizing private participation into four main contractual types: management contracts,

concession agreements, design-build-finance-operate (DBFO) agreements, and asset sales. We discuss these contract types in detail below. We use both binary logistic and ordered logistic regression analysis to examine the effect of a broad set of fiscal, political, and infrastructure-type variables, on the type of PPP contract used.

Analyzing the degree of private involvement in the delivery of public infrastructure is important given the increasing role of PPPs in the United States. Between 1990 and 2000 there were a total of 26 projects, valued at $14.4 billion. Between 2001 and 2010, however, there were 46 projects valued at $34.8 billion. This represents a decade-over-decade increase of 77 percent in the total number of projects, and a 140 percent increase in value.

Although definitions of PPPs vary, the most salient characteristic may be that they are contracts between public and private agents where private partners bear risks inherent in public infrastructure construction and operation. Indeed, the degree of risk sharing and risk transfer to private agents is linked directly to the degree of private involvement, as indicated in works such as the Asian Development Bank (2008: 28)) *Public-private Partnerships Handbook*, which distinguishes between five basic types of PPPs (including service contracts, management contracts, lease contracts, concessions, and build-operate-transfer (BOT)), on the basis of differences in (i) commercial risk; and (ii) overall level of risk assumed by the private sector.[1]

Our contributions are twofold. First, we provide evidence directly analyzing the drivers of contract choice in PPP agreements that relate to different levels of private involvement. We thus extend existing work treating the public/private choice as dichotomous. We instead consider different levels of private involvement. Second, after controlling for fiscal and political variables,

[1] Among other factors. See as well for this purpose Anthony Boardman, Carsten Greve and Graeme A. Hodge, eds. (2010), *International Handbook On Public–Private Partnerships*, Edward Elgar.

we show that infrastructure characteristics, particularly on its stand alone versus network nature, are leading factors explaining contract choice in the United States. This suggests that network characteristics, such as those related to transaction costs, sunk investments and limited competition, are important drivers of private participation.

In the following section we describe PPPs in more detail, review some common contractual types, and provide examples of several PPPs in the United States. Section III provides an overview of recent literature on PPPs. We describe our data set and both the dependent and independent variables we study in Section IV. Section V describes our empirical strategy, while Section VI reports and discusses our empirical estimates. Section VII concludes.

## 2. Types of PPP Contracts

The term "public-private partnership" is broad, and has evolved to include any contractual framework that allows 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.

The traditional procurement approach has in fact long utilized private sector participation, but in more limited ways. Under a traditional design-build (DB) approach, for example, a public sponsor engages (typically different) private firms to design and construct an infrastructure project. The public sponsor remains responsible for financing, operating, and maintaining the facility.

PPPs extend the traditional approach in that they enlist the private sector to undertake a variety of added tasks. One such arrangement is a design-build-operate-maintain, or DBOM contract, under which the additional duties of the private partner or partners include operating and

maintaining the facility after it is built. Similar to DB contracts, DBOM contracts seek to take advantage of private sector incentives and specialized expertise to design and build facilities in a way that will minimize operation and maintenance costs.

Other PPP contracts extend private participation through assistance in financing the project. In a typical DBFOM (design-build-finance-operate-maintain) contract, for example, the private sector agrees to design and build a new facility using some combination of debt (leveraged against future toll revenue in the toll road case) and equity, and then operates and maintains the facility for a specified period of time in exchange for the right to collect revenues from the facility's use over the lease term. This project type, in which the private sector builds a new facility, is known as a greenfield PPP. This is in contrast to a brownfield PPP, under which the private partner pays an upfront concession fee in order to lease an existing facility.

Other contractual types include build-transfer-operate (BTO) agreements, under which the private partner actually owns the facility until its ownership rights are transferred to the public sector following the construction period. Similarly, under a BOT (build-operate-transfer) agreement, the private partner holds title to the facility until its ownership right is transferred at the end of the specified operation and maintenance period. In a build-own-operate (BOO) agreement, title remains with the private partner unless the public sector decides to purchase it. We next discuss four examples of PPPs in the transportation sector in the United States, which has been the most widely studied so far. These examples help to illustrate various contractual agreements and project types.

**Hartsfield-Jackson Atlanta International Airport.** The Hartsfield-Jackson International Airport in Atlanta, Georgia provides an example of a management contract PPP. It is the busiest airport in the world, with almost 100 million passengers and nearly 1 million air traffic operations

annually. International Concourse E was opened in 1994, and became the largest international concourse in North America. While most of the airport is managed by the city of Atlanta, the 28-gate international Terminal E is managed by TBI, an international airport operator controlled by Abertis, a Spanish infrastructure operator of tollroads, airports and other infrastructure.

In 1994, Terminal T was replaced with new terminal E, but kept under TBI management. TBI managed the old Atlanta Terminal T under a 30-year management contract concluded in 1980, which expired in 2010. Discussions focusing on a new management contract (with Abertis) are ongoing.

Abertis took over TBI in 2005, and Abertis Airports manages and controls many of the usual facilities, as well as information panels and flight runways. Hartsfield-Jackson is one of five airports in North America managed by Abertis Airports.

**California 91 Express Lanes**. The 91 Express Lanes in Orange County, California provide an example of a management contract in the toll road sector. The lanes are a ten-mile (16 km) high-occupancy toll road/full tollway combination. They are contained entirely within the median of the Riverside Freeway (State Route 91). Although owned by the Orange County Transportation Authority, they are operated under a management contract signed in 2006 with Cofiroute USA. There are no tollbooths on the lanes, and all tolls are collected electronically using onboard transponders. To help manage congestion, the toll lanes use time-of-day pricing (as opposed to real-time, variable tolling). The project was developed through a partnership between the California Department of Transportation (Caltrans) and the California Private Transportation Company (CPTC). The 91 Express Lanes management contract represents a relatively low level of private involvement.

**Chicago Skyway.** The Chicago Skyway concession is an example of a long-term toll road leasing, or brownfield, PPP contract. The Skyway is a 7.8-mile toll road that is part of the I-90 interstate highway. It connects the Dan Ryan Expressway in Chicago to the Indiana Toll Road (I-90). The Skyway carried about 50,000 vehicles per day in 2005.[2]

In March 2004, the City of Chicago issued a request for qualifications from bidders interested in leasing the Skyway for a ninety-nine-year term. The city received ten responses, and five bidders were asked to submit detailed proposals. The high bid of $1.83 billion came from a partnership of Cintra Concesiones de Intrastructures de Transporte S.A. (Cintra) of Madrid, Spain, and the Macquarie Infrastructure Group of Sydney, Australia, which cooperated to create the Skyway Concession Company LLC (or SCC). The city awarded the contract to SCC in the first modern long-term lease of an existing U.S. toll road.[3]

**Dulles Greenway.** The Dulles Greenway is an example of a greenfield DBFO PPP contract. The Dulles Greenway is a 14-mile, limited-access highway outside of Washington, D.C. It extends from the state-owned Dulles Toll Road, which connects the Washington, D.C., beltway going to Dulles Airport to Leesburg, Virginia. It opened to traffic in September 1995.

The Greenway was built under the Virginia Highway Act of 1988. The 1988 act did not grant the investors—the Toll Road Investors Partnership II (or TRIP II)—the power of eminent domain. Rather, the assembly of private lands required to build the Greenway was purchased at market price.[4] The Greenway's regulation by the Virginia State Corporation Commission is also

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[2] Nicholas Hann, *PPPs in North America—A Private Sector Partner's Perspective*, Maquarie North America Ltd., December 2006, http://csgb.ubc.ca/files/workshop06/Region4-Hann.pdf (accessed February 10, 2010).
[3] U.S. Department of Transportation, Federal Highway Administration, Office of Innovative Program Delivery, "Case Studies: Chicago Skyway," http://www.fhwa.dot.gov/ipd/case_studies/il_chicago_Skyway.htm (accessed February 10, 2010).
[4] *Ibid.*

unusual. Its return is limited to 18 percent, similar to utility-style regulation. Unlike typical utility regulation, however, the Greenway receives no legally enforced monopoly through an exclusive territory. It continues to pay real estate taxes on property purchased to build the road, thus generating tax revenue that would not be forthcoming under a traditional public ownership approach in the United States

**Tampa Bay Water at Brandon, Florida.** In September 2011, Veolia Water North America and Tampa Bay Water in Florida began operation of the Tampa water treatment plant. This final phase of the project completed one of the largest design-build-operate (DBO) PPPs in U.S. history. A first phase greenfield project with Veolia was completed in 2002 with a design capacity of 60 million gallons per day (mgd). In two more expansions leading up to September 2011, the project increased to 120 mgd. Tampa Bay Water chose Veolia's consortium after receiving bids from other groups to carry out this DBO project.

## 3. Related Literature

PPPs can be viewed as extending the practice of contracting out for the provision of public services, which is a typical procurement method. Contracting out has often been subject to problems related to moral hazard because of full additional cost reimbursement under cost-plus contracts, as well as problems associated with quality measurement, among others (Donahue 1989; Levin and Tadelis 2010). Contracting out has evolved to include high-powered incentives to help address those problems. That involves shifting risk to the private partner, which typically requires the public sponsor to pay a risk premium. Risk sharing between government and a private partner is a key issue in PPPs (Engel, Fischer and Galetovic 2009, 2010).

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. There are many branches of the literature, which we now discuss.

Public Choice theory predicts that, when politicians and bureaucrats monopolize the delivery of public services, overproduction and inefficiency results (Niskanen 1971). This can be solved by introducing competition for contracts, from which lower costs and more technical efficiency in service delivery can be obtained (Boyne 1998). Another relevant approach emerging from property rights theory builds on seminal works by Alchian (1967) and Alchian and Demsetz (1972). The theory of incomplete contracts developed in important works such as Grossman & Hart (1986) and Hart & Moore (1990) provides a useful analytical framework for studying situations in which contracting is a complex operation. Within that framework, Hart et al. (1997) show that private production provides incentives to reduce costs without reducing quality. Contract completeness is a crucial issue regarding the choice of public services delivery, and this is linked directly to transaction costs (Williamson 1979, 1999). Because of this, monitoring and control play a central role in the privatization of public services (e.g. Sappington & Stiglitz 1987).

Based on these theoretical approaches, the available literature (see Bel and Fageda 2007, 2009 for summaries) has emphasized the relevance of different groups of factors in the decision to contract out: fiscal restraints, economic factors, and political factors.[5] We discuss each of those variable groups below.

[5]Hammami, Ruhashyankiko and Yehoue (2006) analyze the determinants of the extent of private participation in infrastructure with a sample of PPPs in a variety of undeveloped countries. They find the control of corruption and common law origin are positively related to the extent of private participation. The sample and institutional heterogeneity used in that work make it substantially different from our own.

*Fiscal constraints*. Fiscal constraints have been one of the main drivers of privatization through asset sales (Yarrow 1999, Bortolotti and Milella 2008). At the local level in the United States, the trend toward increasing tax burdens ended in the 1970s (Hoene 2004). Evidence of the influence of fiscal constraints in contracting out public services is less systematic than that for asset sales. Although fiscal constraints do not appear to influence contracting out of local services in Europe, they have been a key factor in local privatization in the United States (Bel & Fageda 2009). "Tax revolts" in the 1970s and states' legislation limiting increases in local taxation might have been important drivers of this finding.[6] Available evidence suggests that privatization in smaller municipalities is more strongly influenced by financial difficulties. Similarly, privatization can be used both to increase payments by users and to reduce funding from the general budget (Bel and Miralles 2010). Including fiscal variables designed to measure the effects of such restrictions is now common in the literature. The underlying hypothesis suggests a positive relationship between fiscal constraints and private sector involvement and privatization.

*Economic efficiency and network effects*. Contracting for the delivery of public services using private participation breaks the public delivery monopoly and introduces competition. It is also a way to encourage cost reduction (Savas 1987). Expectations of cost reduction from private delivery diminish when transactions costs are important (Sappington & Stiglitz 1987). According to Williamson (1999), the relative requirement of long-term investments specifically related to the transaction, or sunk costs, is a key consideration in contracting.[7] Because of these factors, the institutional organization required to establish and uphold contracts can be very complex,

[6] Hoene (2004) contains an analysis on the effects of Proposition 13 on the fiscal regime of cities in California.

[7] This argument can be seen as closely related to that in Besley and Ghatak (2001) regarding the impurity of the goods and services as per their public goods characteristics.

particularly when the contract involves network industries.[8] Empirical evidence suggests that transaction costs are negatively related to private involvement in public services delivery (Brown & Potoski 2003; Levin & Tadelis 2010). Evidence also indicates that cost reductions are less likely to be realized in services with important network characteristics, such as water distribution (Bel, Fageda & Warner 2010).

*Political Processes and Ideological Attitudes.* Variables measuring non-economic factors that might help explain the decision to privatize public services, such as political processes and ideological attitudes, have also been examined (Bel & Fageda, 2007, 2009). Two main motivations guide politicians' decisions in a democratic environment. Politicians seek to win elections and obtain governmental positions. However, they also have preferences for some policies over others according to their ideological predispositions.[9] Within the domain of political interests, the decision to privatize is dependent on the existence of pressure groups focused on obtaining the rents derived from a given form of service delivery (see e.g. McGuire, Oshfeldt & van Cott (1987) for school buses; Dubin & Navarro (1988) and Hirsch (1995) for solid waste collection; Chandler & Feuille (1994) for sanitation; and Miralles (2009) for water). Hence, a high unionization rate is associated with lower propensity to privatize (Warner & Hebdon, 2001; Levin & Tadelis 2010). Ideology may also influence privatization. Right-wing parties have been linked to more pro-business policies, whereas left-wing organizations are often associated with public values. If those characterizations are correct, right-wing control of government will be positively associated with privatization, while left-wing control will be associated with public

[8] Network industries are typically defined as industries with an extensive set of lines, pipes or routes, usually with strong physical interconnections between component parts.

[9] This double dimension of the politician in a democratic system has been named the citizen-candidate approach. Osborne & Slivinski (1996) and Besley & Coate (1997) offer theoretical insights; Levitt, 1996 and Lee et al., 2004 offer empirical support.

production, as shown by evidence in Dubin & Navarro (1988), Dijkgraaf, Gradus & Melemberg (2003), Walls, Macauley & Anderson (2005), and Picazo-Tadeo et al (forthcoming). We next describe our empirical analysis examining the effects of these variable groups.

## 4. Empirical Analysis

This section describes the data, variables and methods used to evaluate the impact of fiscal, political, infrastructure-type and other control variables on the extent of private participation in U.S. PPP projects. We first describe the main data sources and report descriptive statistics. We then define and discuss the dependent variables in our dataset, moving to independent variables. This section ends with a discussion of the models to be estimated and a summary of predicted effects.

### 4.1 Data

We use the *International Major Projects Survey 2008* from *Public Works Financing* (published in the October 2008 issue) as our main data source. This source contains information on PPP projects from around the world. For the United States, we located 508 PPP projects between 1985 and 2008, although necessary information on contract types is only specified for 472.[10] The data provide detailed information on PPP contracts for different sectors, and on a wide range of contract types, which is important for construction of our dependent variables measuring the intensity of private involvement.

Table 1 displays basic information regarding sectors and services represented in the data, as well as sector characteristics. Table 2 shows the distribution of PPPs by sector characteristics and by type of contract. The data span a variety of sectors and services with very different

[10] Unfortunately, missing information on some characteristics prevents us from using a non-trivial share of this sample, as will be shown in the results section.

economic or infrastructure characteristics. Network transportation and water are prevalent in the data, representing 26.5 and 31 percent of the sample respectively. There are, however, significant percentages of PPPs in stand-alone facilities and non-network transportation sectors like ports and airports. These PPPs are governed by different contract types. Management contracts (23%) and BOT-type contracts (31%) are the most frequent. There are, however, several other contract types in the sample, such as design-build (15%), concessions (7%) and leveraged agreements (19%). Asset sales (1%) and joint development agreements (3%) are much less important.

**Table 1. Description of the International Major Projects Survey 2008 for the United States. Sectors and Services included.**

| | Sectors and Services | Sector Characteristics |
|---|---|---|
| 1 | Roads | Network Transportation |
| 2 | Rail | Network Transportation |
| 3 | Airports | Non-Network Transportation |
| 4 | Ports | Non-Network Transportation |
| 5 | Water | Water/Network Services |
| 6 | Prisons | Stand-alone Facilities |
| 7 | Housing | Stand-alone Facilities |
| 8 | Post Office | Stand-alone Facilities |
| 9 | Schools | Stand-alone Facilities |
| 10 | Waste | Stand-alone Facilities |
| 11 | Parking | Stand-alone Facilities |
| 12 | Military Housing | Non-Network/Military |
| 13 | Street Lights | Other |
| 14 | Space Flight centers | Other |
| 15 | Sports | Other |
| 16 | Shuttles | Other |

**Source:** International Major Projects Survey 2008, *Public Works Financing.*

**Table 2. The distribution of PPPs according to sector characteristics and type of contract in the 2008 *International Major Projects Survey***

| Characteristics | Nº | % of sample | | Contract Types | Nº | % of sample |
|---|---|---|---|---|---|---|
| Network Transportation | 125 | 26.5 | | Management Contracts | 109 | 23.1 |
| Non Network Transportation | 29 | 6.1 | | Leverage | 91 | 19.3 |
| Water Sector/Network Services | 170 | 36.0 | | Joint Development | 14 | 3.0 |
| Facilities | 61 | 12.9 | | Concession | 34 | 7.2 |
| Military | 78 | 16.5 | | Asset Sale | 5 | 1.0 |
| Other | 9 | 1.9 | | Design and Build | 72 | 15.3 |
| | 472 | 100 | | BOT Type contracts [1] | 147 | 31.1 |
| | | | | | 472 | 100 |

**Source:** International Major Projects Survey 2008, *Public Works Financing*.

1. This group includes the following contracts: BOT, BOO, BOOT, BTO, DBFO, DBO, DBM, DBOM, DFBO, etc.

### 4.2. Dependent Variables

We next discuss the dependent variables in our data set. We divide our dependent variables into two types: a four-category ordered contract variable and a binary contractual variable. We discuss each in turn.

#### 4.2.1 Ordered Contract

This is an ordered categorical variable that assigns low values to PPP projects with low private involvement (and consequently low private risk assumption), and high values to projects with higher private participation. In Table 3 we present the type of contracts and values designated according to the extent of private involvement.

**Table 3. Categorical dependent variable**

| PPP contract | Private involvement | Risk Sharing |
|---|---|---|
| Management Contracts | 1 | VERY LOW |
| Design and Build | 2 | LOW |
| Concessions and BOT-type Contracts | 3 | HIGH |
| Asset Sale | 4 | VERY HIGH |

Management contracts receive the lowest value, given the low associated level of risk sharing. In these contracts, private operators simply manage existing infrastructure, such as Terminal E in Atlanta, and few if any new investments are employed. The next level of private involvement is design and built (DB) contracts. The private partner designs and constructs but does not operate the infrastructure. Although DB contracts involve relatively large initial investments, and the private partner may face risks encountered in construction and design, the private partner does not assume demand risk, so they are relatively low-risk in the spectrum of PPP contracts.

Concessions and build-operate-transfer (BOT) contracts are the next category, receiving a value of three. Under a BOT approach, the private partner builds and operates the facility for a pre-specified time period. Transfer of facility title back to the public sponsor occurs at the end of that period. Under this approach, the private partner typically assumes substantial risk associated with the facility's construction and operation, such as demand risk.

The final category is asset sale. In this type of contract, the private partner actually acquires title to the facility, and assumes all attendant risks associated with its ongoing operation, maintenance and refurbishment. We assign this category a value of four, which reflects the highest degree of private involvement and risk assumption.

#### 4.2.2 *Binary Contract*

Both management and DB contracts carry significantly lower levels of risk relative to assets sales or concession/BOT-type contracts. We thus created a dummy variable assuming a value of zero if the PPP is a management or a DB agreement. This variable is assigned a value of one for all other contract types, in which we include concession and BOT-type agreements (DFBO, DBO, DBM, BOO, DBOM, etc.), as well as asset sales. This variable thus captures contracts with a high degree of private involvement, and therefore large private investment and risk assumption.

### 4.3. Independent Variables

We next discuss our independent variables, categorizing them fiscal variables, political variables, economic characteristics, basic controls, and regional dummy variables. We discuss each group in turn, and provide a definition of the variable with its interpretation and anticipated effect.

**a) Fiscal variables**

***Tax Burden:*** Tax revenues divided by income in the state where the PPP is signed in the year prior to the agreement. This variable controls for fiscal pressure and the ability of governments to raise money from taxpayers in a given state. We expect that this variable will be negatively correlated with the level of private involvement through the PPP because states with larger 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.*[11]

[11] Available at: http://www.taxfoundation.org/research/topic/9.html.

***Debt Stress*:** State debt outstanding (in millions of current dollars) divided by state income in the year prior to the PPP agreement. This captures states with fiscal stress resulting from high debt levels. We expect a positive relationship between Debt Stress and private participation in PPPs. In this case, public officials seek private sector participation to help address fiscal constraints. The data source for this variable is the *Statistical Abstract of the United States,* Table entitled: *"State and Local Governments -- Expenditures and Debt by State" (various years).*

***Bond Rating*:** Current-year Standard & Poor's State Bond Rating, where alphabetical rankings are converted into a numerical index. States with higher ratings can obtain bond financing at lower cost than those with low ratings, thus lowering the cost of traditional infrastructure financing. Such states will be less in need of private participation. This suggests a negative relationship between a state's bond ratings and the level of private participation. The source for this variable is Standard and Poor's.

***Contract Size*:** Project size (or cost) in thousands of U.S. dollars divided by the gross domestic product of the region. Inexpensive projects can be undertaken by states with even modest resources. However, expensive projects might require private participation in order to share investment costs and/or risks. We expect a positive impact of project cost on the degree of private involvement. The data source for this variable is the monthly newsletter *Public Works Financing*.

**b) Political variables**

***Republican legislature*:** Share of votes cast for the Republican Party in the state legislative election prior to the PPP agreement. This political variable 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. The data source for this variable is Michael Barone, the *Almanac of American Politics* (various years).

***Republican Governor*:** This is a dummy variable assigned a value of one if the governor in place when the PPP is signed is Republican, zero otherwise. Similar to the above, we expect that Republican governors will be more business friendly and more market oriented than Democratic governors. The data source for this variable is also Barone's *Almanac of American Politics* (various years).

**c) Project characteristics**

***Network*:** A binary variable assigned a value of one for road, rail, and water projects, zero otherwise. These industries enjoy network characteristics and are usually defined as natural monopolies. They are associated with sunk investments, larger transaction costs, and lower levels of competition. Smaller efficiency gains are therefore expected from private participation in these projects. We expect network characteristics to have a negative effect on the degree of private participation. The data source for this variable is *Public Works Financing.*

***Point-to-Point (non-network transportation)*:** A binary variable assigned a value of one for port and airport projects, zero otherwise. This type of transport infrastructure does not belong to a network and is usually operated as a stand-alone entity, facing varying degrees of competition. We expect larger efficiency gains from this type of private involvement. We predict that this variable will positively impact the extent of private participation in PPPs. The data source for this variable is *Public Works Financing*.

***Facilities*:** A binary variable set to one for prisons or post office projects, zero otherwise. Similar to the previous variable, we expect efficiency gains from private involvement. We thus predict that there will be a positive relationship between *facilities* and the extent of private participation in PPPs. The data source for this variable is also *Public Works Financing*.

***Others:*** A binary variable set to one for a miscellaneous set of projects such as parking garages, waste treatment facilities, and shuttles, zero otherwise. This combines all PPP projects not included in the previous three variables. Regarding the network vs. non-network property, these are stand-alone projects not having network characteristics. We thus predict a positive impact of this variable on the degree of private involvement in PPPs. The data source for this variable is *Public Works Financing*.

**d) Control variables**

***Income pc*:** State income per capita in constant 2009 U.S. dollars. We use constant dollar terms in order to avoid problems related to time and inflation in a pool sample composed by projects signed in different years. Citizens' purchasing power in a state will positively private investors' decisions regarding how much to invest, particularly for user-funded projects. However, users are also taxpayers, and richer areas are likely to provide more public funds – through greater tax revenue – that will help in undertaking public investments. Alternatively, richer areas may be more attractive to private investors. More public funding is likely to lead to lower private PPP involvement. The source for this variable is *The Tax Foundation,* tables entitled *"State and Local Tax Burdens: All Years, One State 1977-2008.*[12]

[12] Available at: http://www.taxfoundation.org/research/topic/9.html.

***Population*:** State population (in thousands). This variable captures the size of the market where the PPP is signed. Private investors are likely to be more interested in providing facilities in highly populated markets. We expect that larger state populations will result in greater private involvement. The data source for this variable is the *Statistical Abstract of the United States*, Table entitled: *"State and Local Governments -- Expenditures and Debt by State" (various years).*

***Sponsor*:** Categorical variable assigned a value of one if the project sponsor is a local government, two if a state government and three if the federal government. Higher levels of government typically receive more public resources, so we expect a negative impact of this variable on the degree of private participation in PPPs. The data source for this variable is *Public Works Financing*.

***Unionization*:** Percent of public employees who are members of labor unions in the year prior to the PPP agreement. This captures the bargaining power of public workers as well as the potential efficiency gains (from lower salaries and improved management) that the public sector can achieve through the privatization of public services and infrastructure. A positive impact on the dependent variable implies that efficiency gains exceed bargaining power against privatization, while a negative effect implies the opposite. However, this variable is correlated with several other covariates in our model. Estimates using this variable are presented in the appendix.

***Public Servants pc*:** State and local full-time public employees (in thousands) per inhabitant in the year in which the PPP was signed. Similar to the above, public servants per capita measures the likely intensity of public opposition to private participation. As noted above, unionization is highly correlated with fiscal, political and regional variables. We therefore

substitute the number of public employees per capita to account for the size of the public sector labor force. The source for this variable is the *Statistical Abstract of the United States*, Table entitled: *"State and Local Governments -- Expenditures and Debt by State" (various years).*

**e) Regional variables**

**$D^{West}$ :** Dummy variable assigned a value of one for states in the U.S. census region designated as "west," zero otherwise.

**$D^{Northeast}$**: Dummy variable assigned a value of one for states in the U.S. census region designated as "northeast," zero otherwise.

**$D^{South}$:** Dummy variable assigned a value of one for states in the U.S. census region designated as "south," zero otherwise.

**$D^{Midwest}$:** Dummy variable assigned a value of one for states in the U.S. census region designated as "midwest," zero otherwise.

## 5. Estimation Strategy

We use different models to evaluate the impact of fiscal, political, economic and control variables on the extent of private participation in completed PPPs. These considerations affect our choice of econometric model. Our sample is a pool of PPP projects signed in the United States between 1985 and 2008. We are unable, however, to follow particular PPP projects across time.

Given the limitations of OLS for discrete and binary dependent variables, our main estimates utilize ordered logit and standard logit models, where estimates are robust to heteroskedasticity for ordered categorical discrete variables (*Ordered contract*) and binary

variables (*Binary contract*), respectively.[13] Indeed, the literature on privatization has focused more on the decision of whether to privatize (contract out) or not, which has expanded the use of logit and probit models within this field. One of our key contributions in addition to the new approach we take to studying privatization – the extent of private participation once the contracting out decision has been made – allows us to use models that consider different privatization intensities. We thus utilize models applicable to categorical ordered discrete dependent variables.

We use an ordered multinomial logistic model to estimate private participation in PPP contracts (*Ordered contract*). The ordered logit model is based on a continuous latent variable specified as a linear equation in (1):

$$y_i^* = \beta' x_i + \varepsilon_i \ , \quad -\infty < y_i^* < \infty \qquad (1)$$

where $y_i$* (unobserved) measures the degree of private participation in the PPP contract, $x_i$ is a vector of factors explaining $y_i$*, with associated parameters $\beta$. The error term $\varepsilon$ indicates the effect of all unobserved factors on $y_i$*. Assuming that $y_i$ is the observed discrete variable reflecting different levels of private involvement for project *i*, the relationship between the latent variable and the observed variable is obtained according to:

$$\begin{aligned}
&y_i^* = 1 \text{ if } -\infty \le y_i^* < \mu_1 \ \ i = 1...., n. \qquad (2)\\
&y_i^* = 2 \text{ if } -\infty \le y_i^* < \mu_2 \ \ i = 1...., n.\\
&y_i^* = 3 \text{ if } -\infty \le y_i^* < \mu_3 \ \ i = 1...., n.\\
&\ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots\\
&y_i^* = J \text{ if } \mu_{J-1} \le y_i^* < \infty \ \ i = 1...., n.
\end{aligned}$$

[13] However, the use of ordered logit also introduces some limitations due to its assumptions. It assumes a monotone one dimensional relationship between the latent and unobserved variables.

The $\mu$'s are the estimated thresholds where the discrete observed responses are defined. This model estimates the probability that PPP project *i* sustains private involvement of level *j* or lower (*j*−*1*,…,*1*). The model specification is:

$$\log\left[\frac{\gamma_j(x_i)}{1-\gamma_j(x_i)}\right] = \mu_j - \left[\beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_K x_{Ki}\right], j = 1,\ldots,n \qquad (3)$$

where $\gamma_j$ is the cumulative probability, $\beta$ is the vector of parameters ($\beta_1$, $\beta_2$,…, $\beta_K$) and $x_i$ is the vector of regressors. Parameter estimates are obtained by maximum likelihood.

The first specification of the above models (Specification 1 below) considers all variables (except regional dummies) that could be correlated with fiscal, political and demographic variables.[14] In contrast, Specification 2 includes regional dummies, where southern states are the omitted category. We apply ordered logit and logit models to both specifications.

**Specification 1**

$$Contract_i = \alpha + \beta_1 Taxburden_i + \beta_2 Debt\_Stress_i + \beta_3 Contract\_Size_i + \beta_4 Bond\_Rating_i + \beta_5 Republican\_Legislature_i + \beta_6 Republican\_Governor_i + \beta_7 Point\_Infrastructure_i + \beta_8 Facilities_i + \beta_9 Other_i + \beta_{10} Income\_pc_i + \beta_{11} Population_i + \beta_{12} Sponsor_i + \beta_{13} Public\_servants\_pc + \varepsilon_i \qquad \textbf{(1)}$$

**Specification 2**

$$Contract_i = \beta_1 Taxburden_i + \beta_2 Debt\_Stress_i + \beta_3 Contract\_Size_i + \beta_4 Bond\_Rating_i + \beta_5 Republican\_Legislature_i + \beta_6 Republican\_Governor_i + \beta_7 Point\_Infrastructure_i + \beta_8 Facilities_i + \beta_9 Other_i + \beta_{10} Income\_pc_i + \beta_{11} Population_i + \beta_{12} Sponsor_i + \beta_{13} Public\_Servants\_pc + \beta_{14} D^{Northeast} + \beta_{15} D^{West} + \beta_{16} D^{Midwest} + \varepsilon_i \qquad \textbf{(2)}$$

[14] In fact, we find some large pair correlations between the dummy variables $D^{Northeast}$ and $D^{South}$ with fiscal variables like *Debt Stress*.

We applied a specification error test and a multicollinearity diagnostic to these models, which generate satisfying results.[15] 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.[16]

**6. Estimates**

Our main estimates are displayed in Table 4 below. Columns 1 and 2 report estimates without regional variables. Generally, all variable groups (except the political group), display significant coefficient estimates. Fiscal variables, infrastructure-type variables, and controls all contribute to determining the intensity of private participation in the PPP contract. This is consistent with joint tests of the significance of the major variable groups. The *p*-values for significance tests for fiscal variables is 0.05, for political variables it is 0.23, for infrastructure type it is 0.00, and 0.01 for controls.

Within fiscal variables, tax burden and debt stress display the expected negative and positive signs, respectively, but only tax burden is statistically significant without regional dummies and only debt becomes statistically significant with the extended model. Regarding contract size, we find statistical significance for specification 1, in which we apply the ordered logit model without regional variables. This significance disappears when we apply the logit model in which we change the dependent variable from a categorical ordered variable to a binary variable. In the case of the bond rating variable, we do not find any significant relationship with the type of PPP contract.

[15] Linear predicted *p-value = 0.000* and squared predicted *p-value = 0.213*
[16] Variance Inflation Factor (VIF) = *1.61 < 10* (Rule of thumb)

Our main focus is on the sector or infrastructure characteristics of PPP contracts and its importance for the degree of private participation. Because we use the contracts for network infrastructure (water, road and rail) as a reference category, we compare results for the other sectors to this base category. The coefficient associated with the binary variable of point-to-point transport infrastructure (airports and ports) is significant and positively related to the extent of private participation. Similar results are obtained for the coefficient associated with Facilities. Marginal effects are presented in Table 5 for the logistic estimation in order to provide a magnitude of the effect found. The first column (min→max) shows the estimated change in predicted probability as x changes from its minimum to its maximum. The second column displays the partial derivative (instantaneous change) of the predicted probability/rate with respect to a given independent variable.

Hence, PPP contracts with larger private participation and risk appear more frequently in those types of infrastructure and facilities not enjoying network characteristics. In addition, their coefficients show how these properties play a central role in PPP involvement. This confirms our main hypothesis: network attributes are a key determinant of the extent of private participation. This is consistent with previous literature on the influence of transaction costs and limited expected efficiency gains with private delivery of public services.

Regarding control variables, population and the public sponsor promoting and signing the PPP contract, are also related to the extent of private participation. PPP contracts signed in larger (i.e. more populated) States reflect greater private participation and risk transfer. The coefficient associated with the number of public servants per inhabitant is not statistically significant. The same finding obtains when using unionization instead of the number of public servants (See Table A1). Nonetheless, several changes occur in other coefficients when we include

unionization in our specification due to correlation between this variable and the other fiscal and regional covariates.

Finally, the governmental level of the sponsor affects private participation. There is more private involvement in projects sponsored by local governments than by their Federal and State-level counterparts. However, this is not present in the ordered logit model without regional dummies, so we are cautious about this finding.

The introduction of regional variables in specification 3 leads to similar conclusions.[17] The partial correlation between these variables and some fiscal variables affects their coefficients. However, most of the previous results are unchanged, particularly in the case of infrastructure or service characteristics. The only regional variable displaying a statistically significant coefficient is the Northeast. The negative sign indicates that in this region, PPP contracts contain less private participation than PPPs signed in the South (the base category). No significant differences exist between PPPs signed in Western and Midwestern States with those concluded in Southern States**.**

[17] We do not perform logistic regressions extending the standard model with regional variables because these variables do not add anything to the explanatory power of the model and do not appear statistically significant. The rest of coefficients have a consistent behavior after their inclusion, with the exception of fiscal variables as happens in the ordered logistic model.

**Table 4. Ordered Logistic and Standard Logistic Estimates for Type of PPP Contract.**

| **Regressors** | **Ordered Logit (1)** | **Logit (2)** | **Ordered Logit (3)** |
|---|---|---|---|
| **Fiscal Variables** | | | |
| Tax Burden | -0.2455** | -0.2841** | -0.065 |
| | (-1.97) | (-2.19) | (-0.47) |
| Debt stress | 0.0407 | 0.0673 | 0.0922** |
| | (1.08) | (1.54) | (2.13) |
| Contract Size | 0.0611** | 0.0413 | 0.0360 |
| | (2.06) | (1.39) | (1.19) |
| State Bond Rating | 0.1440 | 0.1269 | 0.1289 |
| | (1.26) | (0.91) | (0.93) |
| **Political Variables** | | | |
| Republican Governor | -0.5247** | -0.4525 | -0.1913 |
| | (-2.05) | (-1.56) | (-0.67) |
| Republican Legislature | -1.4394 | -1.6364 | -1.7644 |
| | (-0.77) | (-0.85) | (-0.93) |
| **Type of infrastructure** *(Base Category: Network)* | | | |
| Point to Point | 1.9830*** | 2.6021*** | 2.2405*** |
| | (2.82) | (2.84) | (2.78) |
| Facilities | 1.5071*** | 1.8834*** | 1.7020*** |
| | (3.15) | (2.62) | (3.04) |
| Other | 0.9152 | 1.5433* | 1.4139 |
| | (0.71) | (1.68) | (1.02) |
| **Control Variables** | | | |
| Income pc | 7.54e-07 | -2.98e-06 | 0.00001 |
| | (0.04) | (-0.13) | (0.58) |
| Population | 0.0001*** | 0.0001** | 0.00004* |
| | (3.28) | (2.53) | (1.94) |
| Sponsor | -0.3076 | -0.8539*** | -0.4319* |
| | (-1.20) | (-2.68) | (-1.68) |
| Public Servants | 5.50e-07 | 4.82e-07 | 5.80e-07 |
| | (1.26) | (1.50) | (1.22) |
| **Regional Variables** | | | |
| North East | - | - | -1.4335** |
| | | | (-2.27) |
| West | - | - | 0.2191 |
| | | | (0.57) |
| Midwest | - | - | -0.4357 |
| | | | (-0.88) |
| | | | |
| **N. Observations** | 280 | 280 | 280 |
| **Pseudo R2** | 0.08 | 0.13 | 0.09 |
| **Log Likelihood** | -269.58 | -169.02 | -264.41 |
| **Wald (Chi2)** | 42.48*** | 47.51*** | 34.44*** |

Note: Robust- to- heteroskedasticity *Z*-statistics in parentheses. * significant at 10%, **5% and *1%, respectively.

**Table 5. Changes in Predicted Probabilities for Contract Choice.**

| Regressors | min->max | Marginal Effect |
|---|---|---|
| Point to Point | 0.4050 | 0.6420 |
| Facilities | 0.3604 | 0.4647 |
| Other | 0.3003 | 0.3808 |

## 7. Summary and Conclusions

This article is the first to examine the determinants of the choice of PPP contractual arrangement across a range of economic sectors, an advance over the traditional binary public vs. private approach. Study of the extent of private involvement in PPPs across sectors offers the first evidence on the role of fiscal, political and infrastructure-type characteristics in driving the degree of private involvement and rsik assumption. With this goal in mind, we focus on four types or groups of PPP contracts in the United States, representing an increasing role for private participants and a greater transfer of risk onto private partners: simple management contracts, design-and-build contracts, BOT-type contracts, and asset sales.

We examined several groups of variables that may affect contract choice, including fiscal and political variables. However, the main focus of our analysis is on the role played by variables measuring whether or not the infrastructure in question is part of a network. Indeed, this characterization of single vs. network infrastructure is a leading driver of private participation: private involvement is more likely in the case of point to point infrastructure and facilities, and less likely for network infrastructure. The estimated effect of switching from network to stand-alone or point-to-point is substantial.

Our models indicate that the probability of having large private involvement in the PPPs of single projects is much larger than it is in network infrastructure. This effect remains after

controling for a variety of additional factors in our analysis, such as fiscal, political, management and control variables, among others.

This is consistent with the observation that network infrastructure is associated with sunk investments, larger transaction costs, and lower levels of competition. For these reasons, smaller efficiency gains are expected from private participation. This helps explain why private involvement is limited in this type of project. However, further theoretical research is necessary to better understand this relationship.

Political variables do not explain a significant portion of the extent of private involvement in PPPs, but we do find that fiscal variables are, as a group, an important determinant, and that a jurisdiction's level of debt-stress in particular is also a driver of the level of private involvement in PPP contracts.

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## Appendix

## Table A1. Ordered Logistic and Logistic estimates for type of PPP contract.

| Regressors | Ordered Logit (1) | Logit (2) | Ordered Logit (3) |
|---|---|---|---|
| **Fiscal Variables** | | | |
| Tax Burden | -0.3093(-2.34)** | -0.3831( -2.66*** | 0.1453(-1.07) |
| Debt stress | 0.0416( 1.04) | 0.0594( 1.27) | 0.0830( 1.79)* |
| Contract Size | 0.0003(2.03)** | 0.0002( 1.41) | 0.0667( 1.68)* |
| State Bond Rating | 0.1357( 1.14) | 0.1414( 0.99) | 0.1768(1.13) |
| **Political Variables** | | | |
| Republican Governor | -0.4438(-1.65) | -0.4015(-1.34) | -0.1078(-0.35) |
| Republican Legislature | -0.5780(-0.29) | -0.9563(-0.48) | -1.262( -0.54) |
| **Type of infrastructure** *(Base Category: Network)* | | | |
| Point to Point | 1.909( 2.62 )*** | 2.528( 2.77)*** | 2.192( 2.60)*** |
| Facilities | 1.536( 3.13)*** | 1.850( 2.52*** | 1.860(2.85)*** |
| Other | 0.8896(0.71) | 1.471( 1.62) | 1.6495( 1.25) |
| **Control Variables** | | | |
| Income pc | 0.0000( 0.65) | 8.40e-06(0.41) | 0.0000( 0.98) |
| Population | 0.0001(3.14)*** | 0.0001(2.67)*** | -0.0000( 1.31) |
| Sponsor | -0.2840( -1.14) | -0.8282(-2.55 )** | -0.4405(-1.50) |
| Unionization | 0.0044( 0.44) | 0.0078(0.69) | 0.0475(2.34 )** |
| **Regional Variables** | | | |
| North East | - | - | -2.563(-3.24)*** |
| West | - | - | -1.817(-0.96) |
| Midwest | - | - | -0.5336( -2.18)**** |
| | | | |
| **N. Observations** | 280 | 280 | 280 |
| **Pseudo R2** | 0.08 | 0.12 | 0.11 |
| **Log Likelihood** | -269.73 | -169.81 | -261.389 |
| **Wald (Chi2)** | 46.51*** | 36.26*** | 51.10*** |

Robust to heteroskedasticity Z-statistics in parentheses. * significance at 10%, **5% and *1%, respectively.