"Do public-private partnership enabling laws increase private investment in infrastructure?"

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Abstract

Rising use of public-private partnerships, or PPPs, is an important development in U.S. infrastructure delivery. PPPs are detailed contracts between a public-sector infrastructure project sponsor and a private-sector provider that bundle delivery services. PPPs represent a middle ground between pure-public project delivery and complete privatization. As of 2016, thirty-five U.S. states had enacted PPP enabling laws. That legislation defines the broad institutional framework surrounding a PPP agreement. It addresses such questions as the mixing of public- and private-sector funds, the treatment of unsolicited PPP proposals, and need for prior legislative approval of PPP contracts, among other key issues. We provide the first thorough empirical assessment of the impact of PPP enabling laws on a state's utilization of private investment. We analyze the overall effect of having a PPP enabling law while controlling for a variety of factors, including the state's indebtedness, its broad political disposition, union membership, per-capita income, and other variables. We then assess the impact of thirteen individual PPP enabling-law provisions. We develop an expert-informed weighted index reflecting the degree to which a state's law is encouraging or discouraging of private investment. We find that more favorable PPP enabling laws increase private investment: when our favorability index increases by one-tenth, the proportion of infrastructure investment delivered via PPP in a state increases by 0.5-0.6. We find that PPP enabling-law provisions allowing unsolicited proposals and the comingling of public and private funds are particularly important in attracting private investment.

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1. Introduction

There is a robust global discussion decrying the lack of infrastructure investment across numerous economic sectors (Woetzel et al 2016). By one estimate, the global infrastructure gap – the difference between current investment rates and investment needs – is $350 billion annually (ibid). Public-private partnerships, or PPPs, are sometimes offered as a solution to bridging the infrastructure gap.[1]

Although PPPs do not generate additional funding for infrastructure (which must come from either users fees or broader tax revenue) *per se*, when properly structured they can improve on-time and on-cost project delivery, enhance innovation in project delivery, better allocate risks, and improve project performance.[2] In the United States, the PPP approach stands in contrast to what is often called "traditional delivery." Traditional project delivery refers to the use of design-bid-build (DBB) contracts, under which project design is placed out for bid. The construction of that design is bid out separately, usually to the lowest bidder. The public sector finances the project using tax-exempt municipal bonds. It also operates and maintains the project over its life span. That is, traditional U.S. infrastructure delivery is unbundled in the sense that the main tasks are conducted separately. Under a PPP approach, tasks such as facility design, construction, financing, operation and maintenance, can be bundled together in various combinations depending on the project to be delivered.[3] This facilitates exploitation of synergies between those functions (Bennett and Iossa, 2006; Martimort and Pouyet, 2008).

Appropriate PPP laws use are widely viewed as important prerequisites for the political and regulatory stability necessary to attract private participation in infrastructure (World Economic Forum, 2015, p. 11). Commentators stress that this is particularly important for the United States (Fishman, 2009), while others suggest that PPPs in the United States are hindered

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[1] According to the U.S. Federal Highway Administration, "Public-Private Partnerships (PPPs) are contractual agreements formed between a public agency and private sector entity that allow for greater private sector participation in the delivery and financing of transportation projects." See U.S. Department of Transportation, Federal Highway Administration, *P3 Defined*, http://www.fhwa.dot.gov/ipd/p3/defined/index.htm (accessed May 21, 2015).

[2] For summaries of the benefits of the PPPs, see e.g. Geddes (2011) and the National Surface Transportation Infrastructure Financing Commission (2009).

[3] See U.S. Department of Transportation (2007, pp. 11-17) for a discussion of PPP contract types.

by a lack of adequate state-level enabling legislation (e.g. Reinhardt, 2011).[4] Indeed, many legislatures state that their purpose in enacting such laws is to attract private infrastructure investment.

PPP enabling laws clarify such issues as treatment of unsolicited PPP proposals, whether a PPP can be used on existing (referred to as "brownfield") as well as new (referred to as "greenfield") transportation facilities, whether agreements can include the sharing of revenue with public sponsors, and whether the agreement may include non-compete clauses, among other questions.[5] From a potential private partner's perspective, it is risky to expend time, money, and effort developing infrastructure projects that may ultimately fail to receive the necessary authorization. Enabling legislation provides a framework for contracting that helps reduce such uncertainty while clarifying risk allocation between the public sponsor and the private partner (Iseki *et al*, 2009). Properly structured PPP enabling laws can thus reduce the transaction costs associated with private infrastructure investment.

Despite their rising popularity, there has been little empirical examination of PPP enabling laws' effects. We are the first to empirically explore the impact of state-level PPP enabling laws and their provisions on private investment in infrastructure. After controlling for numerous exogenous factors, we find that PPP enabling laws facilitate private investment in infrastructure. Although rising, private investment in U.S. transportation infrastructure remains low by international standards, and controversy surrounding the use of PPPs to finance and operate transportation infrastructure remains.[6]

We assess the effect of simply having a law as well as the impact of varying degrees of legal favorability to private investment. To do so, we develop an enabling law favorability index by considering thirteen key provisions of each law. Rather than weighting each provision

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[4] Istrate and Puentes (2011) stress PPP enabling laws as one of their three key recommendations for attracting private investment into U.S. infrastructure.

[5] A list of key provisions is provided in Table 1 below.

[6] Regarding low U.S. use of private investment in infrastructure, see Istrate and Puentes (2011, p. 4, Figure 1). Critics argue that PPPs do not create net social value, merely hide debt from the government's balance sheet, raise the social cost of capital, and help protect the interests of private parties who are likely to exploit market power and superior bargaining skills relative to the public sector (e.g. Quiggin 2004, Dannin 2011, Roin 2011). Others argue that PPPs generate net social value through improved incentives to innovate, additional sources of capital, greater contractual transparency, and clearer linking of project returns to performance (e.g. Gilroy 2009, Poole 1993, National Surface Transportation Infrastructure Financing Commission 2009). Our analysis instead focuses on PPP enabling laws' impact on private investment, and why states may pass laws explicitly inviting private investment in transportation infrastructure.

equally, however, we surveyed U.S. PPP experts to assign meaningful weights to various provisions.

We analyze data on 177 U.S. transportation PPP projects completed between 1998 and 2016 using information gleaned from the *Public Works Financing* monthly newsletter. *Public Works Financing* reports information on all North American PPP projects, allowing a comprehensive analysis of PPP enabling laws' effect on private investment. We consider the 1988 to 2016 period to examine how varying exposure to PPP enabling laws across time – and to their differing elements – impacts the cumulative number of PPPs as well as overall PPP investment. We focus on the proportion of PPP investment relative to total investment in a state's roads and highways in a cross-sectional setting. We describe our data set and empirical methods in detail below.

We find that PPP enabling laws increase the number of PPPs undertaken in a state and that more favorable laws result in more PPP contracts. We find a similar effect on PPP investment per capita and on the proportion of PPP investment relative to total investment in roads and highways.

We proceed as follows. We next discuss the basic structure of PPP enabling laws in the U.S. transportation sector. We describe the dataset, variables and our main predictions regarding the role of PPP enabling laws in facilitating PPP contracts and private investment in Section 3. Section 4 discusses empirical methods used, reports estimates, and offers a discussion. Section 5 concludes.

2. Public-Private Partnerships in Transportation

Private participation via PPP may include the management, operation, and renovation of an existing transportation facility, as well as the design, construction, financing and operation of a new facility. For both brownfield PPPs, and those greenfield PPPs that include an operational component, the public project sponsor contractually specifies how the facility is to be renovated, maintained and, if necessary, expanded. The contract also specifies the determination of tolls and concession length. Key performance indicators (or KPIs) are typically included, such as safety standards and pavement quality, with clear financial and operational performance incentives. According to *Public Works Financing*, PPPs have been used to help finance and build at least

177 transportation projects for a total of $115 billion between 1988 and 2016 in the United States.

Although investment in transportation infrastructure through PPPs accounts for about 11 percent of all national capital investment in new highway capacity in 2011, its use increased significantly in recent years. Between 2001 and 2010, five states on average started a new transportation PPP each year (Reinhardt 2011). Until 2010, PPP projects accounted for a yearly average of about $2.4 billion (in constant 2010 dollar terms), while the amount significantly increased between 2011 and 2016, reaching a yearly average of $7.5 billion.

The failed attempt to lease the Pennsylvania Turnpike illustrates enabling laws' role in attracting investment. In May 2008, Pennsylvania's government announced that a partnership of Citi Infrastructure Investors and the Spanish firm Abertis Infraestructuras was the chosen concessionaire for a 75-year lease of the Pennsylvania Turnpike with a winning bid (i.e. lease payment) of $12.8 billion. The state's legislature, however, allowed the bid to expire by failing to pass the requisite enabling legislation. The process of generating bids for which there was ultimately no return – even for the winning bidder – was costly.[7] Costs include holding in place commitments on $12.8 billion in financing as well as direct contracting costs. PPP enabling laws thus help reduce the risk of political uncertainty by granting *ex ante* legislative approval. *Ex post* legislative approval of individual PPP agreements concluded by other units in a state, which can be proscribed by a PPP law, is a major disincentive to private-sector investment (Rall, Reed, & Farber, 2010).[8]

There is anecdotal evidence that PPP laws encourage investment. Commentators stress that states with the most advanced PPP legislation receive the greatest private-sector attention (Gilroy, 2009). Moreover, sixty percent of all PPP projects between 1989 and 2012 **occurred** in

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[7] Commentators view such unrecovered bidding costs as a major deterrent to private participation. John Durbin, former executive director of the Pennsylvania Turnpike Commission, noted that "[t]here will not be another consortium that will proceed in any state where they have to put their bids in first and then gain legislative approval to lease the asset" (Pew Center on the States 2009, p.18). The lack of enabling legislation was dispositive for the investors in this case. Samuel (2008) states that, "The Abertis-Citi current offer of $12.8 billion for a 75 year lease/concession of the Pennsylvania Turnpike expires next Tuesday Sept 30, and signs are it won't be extended. Last week a senior officer of the two companies was saying that without movement on enabling legislation this month, they were done. " See Geddes and Wagner (2013) for further discussion of the importance of PPP enabling laws.

[8] Several states nevertheless have provisions in their enabling legislation requiring legislative approval. Addressing the disincentive to invest created by legislative approval requirements, one commentator claims that, "[i]n those states whose PPP enabling acts required legislative approval of negotiated deals no such deals were ever proposed." Poole (2009).

only six large states. All of those states have PPP enabling legislation.[9] We expect that both passing a law and enacting a more favorable law will increase PPP investment over time.

We utilized the Federal Highway Administration (FHWA) website and other key sources to determine which states have enacted PPP enabling laws.[10] All information was verified through examination of state PPP statutes and traced back to its passage using LexisNexis. Figure 1 displays the evolution of U.S. PPP enabling laws. Since passage of the first modern PPP law in 1988, the number of states with laws steadily increased over time until 2000.[11] From 2000 to 2005, the number of states with laws remained constant. Law adoption restarted in 2006 with the passing of an enabling law in Indiana, followed by several other states. By December 2012 thirty-four states (plus Puerto Rico) had legislation giving explicit authority to an agent of the state (such as the state's department of transportation), to enter into a PPP agreement. After 2012 the enactment of laws slowed; only Kentucky was added to the list. Figures 2 and 3 show total annual and cumulative PPP investment from 1988 to 2016, respectively.

FIGURE 1. Number of U.S. States with a PPP Enabling Law (1988-2016)

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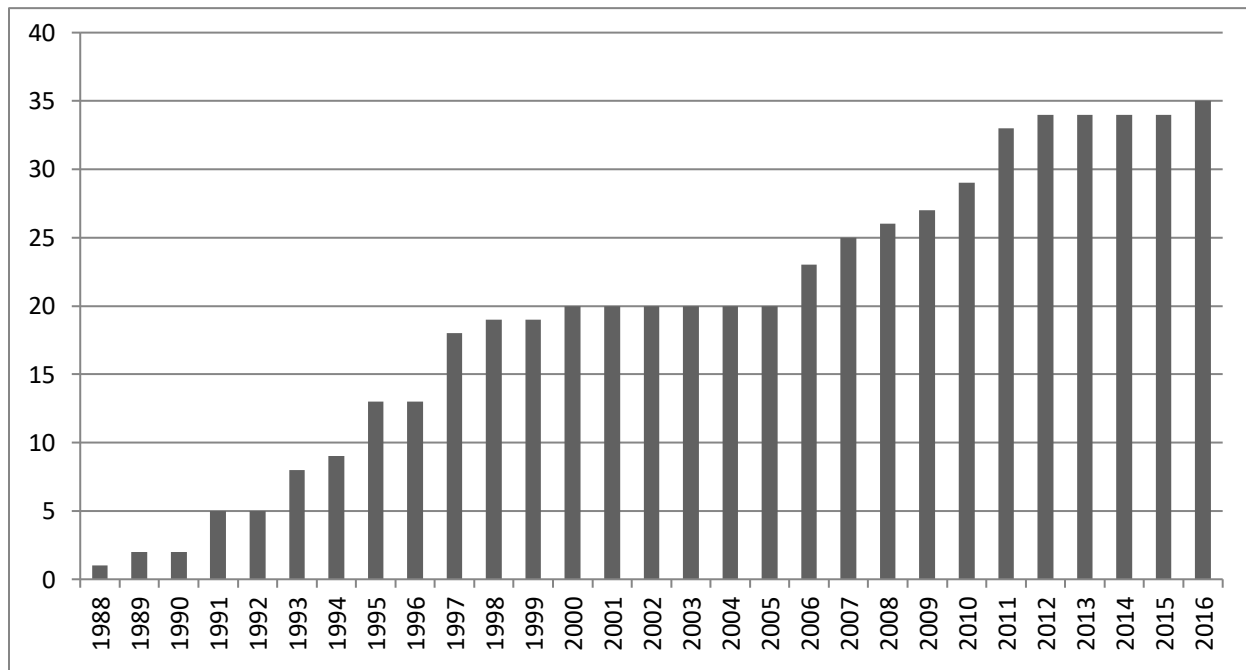
[9] Those states are Florida, California, Texas, Virginia, North Carolina, and Colorado.

[10] Federal Highway Administration, *State P3 Legislation*, (available at: http://www.fhwa.dot.gov/ipd/p3/state_legislation/index.htm, accessed May 21, 2015). Additional sources include Pikiel & Plata (2008); Iseki *et al* (2009); and Rall, Reed & Farber (2010).

[11] Modern PPP legislation began with Virginia's Highway Corporation Act, which was passed in 1988. New Jersey had an enabling law passed by mid 1990s, but it ceased to be in effect as of 2003. The District of Columbia City Council voted unanimously to enact Bill 20-595 on December 2, 2014

FIGURE 2. Total Annual PPP Investment in U.S. Roads and Highways (Constant Million US$ of 2010) (1988-2016)
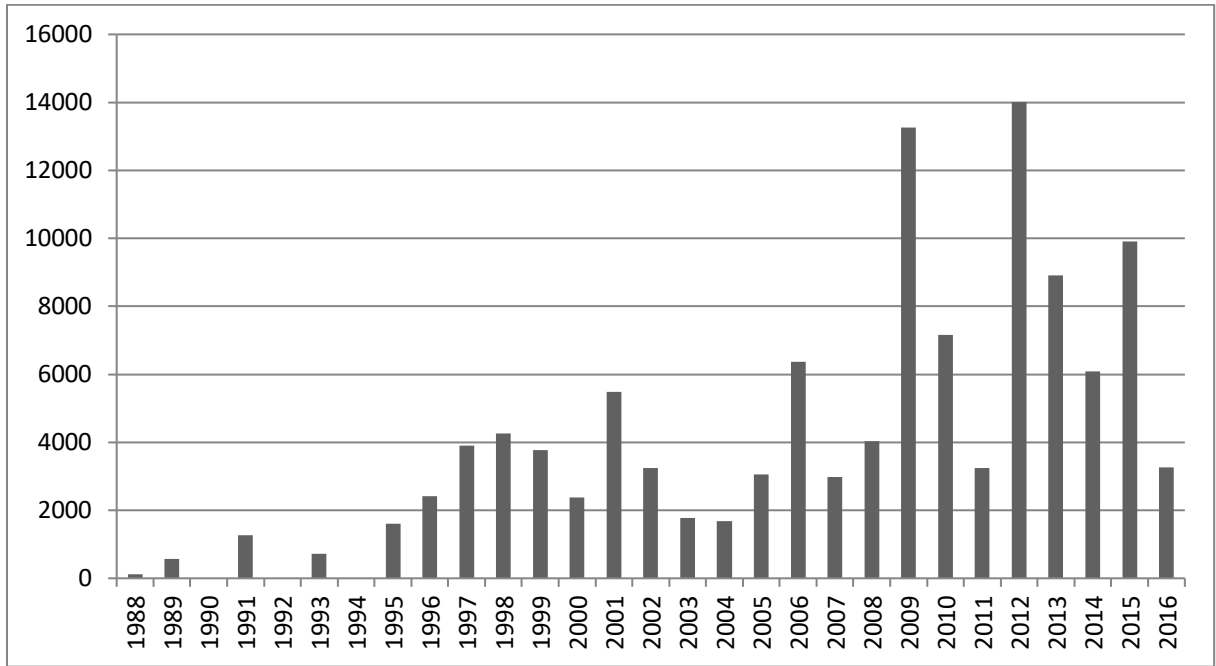
FIGURE 3. Cumulative PPP Investment in U.S. Roads and Highways (Constant Million US$ of 2010) (1988-2016)
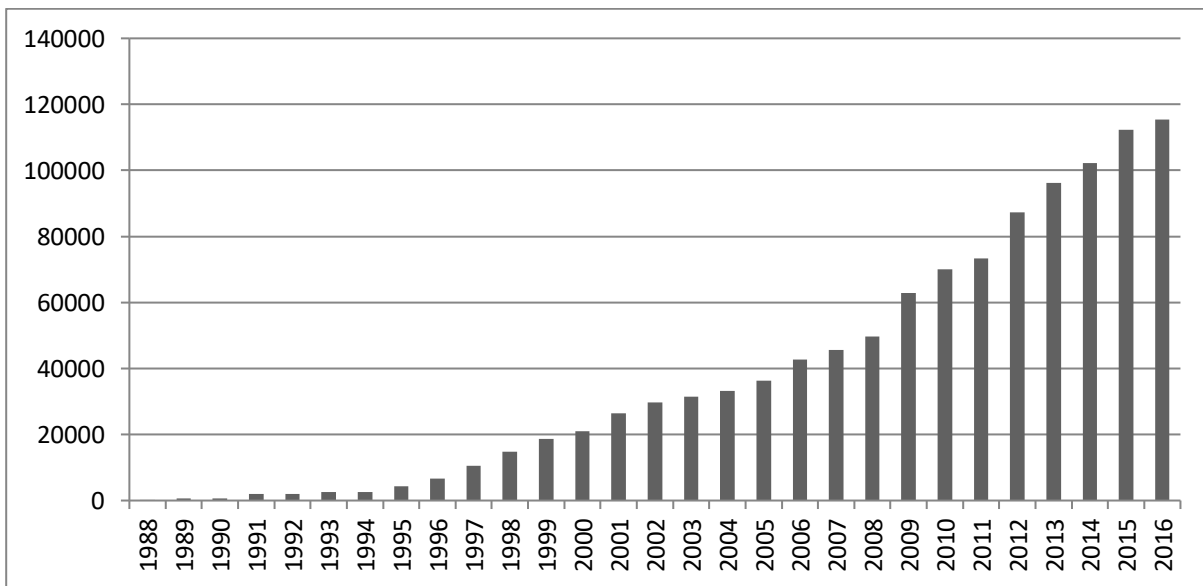
3. PPP enabling laws and the favorability index.

We next describe our data. Our dataset includes an indicator for the year in which a state first passed a PPP enabling law, and the provisions included. Our time frame begins with the passage of the first modern PPP law, Virginia's Highway Corporation Act of 1988, and ends in 2016, which is the last year for which we have complete independent-variable data. Our data are thus a state-by-year panel from 1988 to 2016 forming a sample of 1,450 observations. In addition to evaluating the effect of having an enabling law (or not) on PPP investment, we address a second empirical question: how important are particular PPP law provisions in attracting private investment?[12]

We first examined the broader literature on state legislation to assess which provisions are generally viewed as important.[13] Poole (1993) and Hedlund and Chase (2005) provided initial guidance.[14] Using those and several additional sources, we identified thirteen enabling law provisions to form our basic PPP law favorability index. We then conducted a survey of PPP experts to assign weights to each provision. We asked respondents to rank each provision on a five-point Likert scale from "very discouraging" to "very encouraging" of private investment.[15] We then assigned each rank an integer value as follows:

-2 = Very discouraging of private investment

-1 = Somewhat discouraging of private investment

 0 = No effect on private investment

 1 = Somewhat encouraging of private investment

 2 = Very encouraging of private investment

We calculated the mean value for each provision and divided it by two to produce a favorability score for each provision between -1 and 1. Table 1 reports the resulting "survey-weighted

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[12] Understanding these effects is of more than academic interests. It may also provide guidance to the remaining states about the most desirable PPP enabling law structure.

[13] This includes the so-called "secondary literature," which is composed of government reports, working papers, white papers, expert commentary, etc.

[14] See Geddes and Wagner (2013) for a discussion of the development of our PPP enabling law index. Additional sources include Fishman (2009); Iseki et al (2009); and Rall, Reed, & Farber (2010).

[15] Fifteen experts answered the survey. Table A1 in the Appendix reports the distribution of experts across ten major organizational types, such as federal and state government, think tanks and academia. Experts are well-distributed across organizational types, with the exception of law firms and toll road operators. We thus do not view our survey weightings as systematically biased.

enabling score" for each provision relevant to our empirical analysis. A higher score indicates a more encouraging provision.

TABLE 1. Description of PPP Law Provisions and Enabling Scores

Concept	Provision	Survey-Weighted Enabling Score
Fundmix	The law allows both public and private sector money to be combined in the financing of a PPP project.	0.90
Eligibility	Road and highways are not eligible for PPPs under the statute	-0.84
Avail	The law explicitly permits the state to make payments to the private entity in lieu of direct user fees (e.g. availability payments, shadow tolls).	0.82
Unlimitedpro	The law does not put a limit on the number of projects that can be developed under the PPP approach.	0.79
Confident	The law protects the confidentiality of proprietary information contained in a private entity's proposal.	0.79
Priorleg	The law does not include a provision that allows the state legislature (or another public body) to reject a PPP agreement.	0.77
Brown	The law allows existing transportation facilities, as well as new transportation facilities, to be PPP-eligible.	0.77
Others	The law explicitly grants authority to entities other than the state DOT (i.e. counties, municipalities) to enter into PPP agreements (assuming that the state DOT also has authority).	0.67
Exemptpro	The statute exempts PPPs from the state's procurement laws.	0.61
Revenue	The law permits revenue sharing in PPP agreements.	0.60
Noncomp	The law allows PPP agreements to contain non-compete clauses or compensation clauses.	0.57
Unsolic	The law allows the responsible public entity to receive both solicited and unsolicited PPP proposals.	0.54
Proptax	The law exempts the private entity from paying property taxes on the land required to operate the facility.	0.47

Source: Authors' compilation

We next catalogued the provisions contained in each state's enabling law. We then divided the total by 13 (the total number of possible provisions in any given law) to generate an overall favorability index for each state's law.[16] Some states replaced older PPP laws with newer ones during our study period. We used LexisNexis to track changes in those laws since their inception, which we incorporate into the favorability index. This provides a time-varying favorability score for each state that varies between zero and ten. States without laws received favorability index scores of zero. Scores for each state are reported in Table 2.

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[16] We scale the favorability index to be between zero and ten to aid interpretation of regression coefficients.

TABLE 2 - Dates of First Passage of U.S. PPP Laws and Favorability Scores

State	Year	PPP Index	State	Year	PPP Index
Alabama	1996	4.3	Montana	-	-
Alaska	2006	1.7	Nebraska	-	-
Arizona	1991	5.2	Nevada	2003	2.7
Arkansas	2011	3.4	New Hampshire	-	-
California	1989	3.0	New Jersey	1997	^
Colorado	1995	6.3	New Mexico	-	-
Connecticut	2011	4.1	New York	-	-
Delaware	1995	4.2	North Carolina	2000	3.4
Florida	1991	4.7	North Dakota	1993	4.5
Georgia	1998	6.3	Ohio	2011	5.4
Hawaii	-	-	Oklahoma	-	-
Idaho	-	-	Oregon	1995	6.1
Illinois	2011	4.4	Pennsylvania	2012	4.7
Indiana	2006	4.1	Rhode Island	-	-
Iowa	-	-	South Carolina	1994	3.4
Kansas	-	-	South Dakota	-	-
Kentucky	2016	5.9	Tennessee	2007	1.1
Louisiana	1997	5.7	Texas	1991	5.8
Maine	2010	3.1	Utah	1997	5.2
Maryland	1997	3.1	Vermont	-	-
Massachusetts	2009	5.0	Virginia	1988	6.3
Michigan	2010	5.1	Washington	1993	2.7
Minnesota	1993	2.1	West Virginia	2008	5.0
Mississippi	2007	4.6	Wisconsin	1997	3.4
Missouri	2006	2.4	Wyoming	-	-

Notes: Dash indicates that no law was ever passed. ^: Enabling law in New Jersey expired in 2003.
Source: Author's compilation.

Amendments have made extant enabling laws more favorable to PPPs over time. Figure 3 indicates that the average value of our favorability index has increased significantly since 1988, reaching its peak in 2012, where it stayed constant until 2016.

FIGURE 3. Annual Average Value of PPP Index (1988-2016)
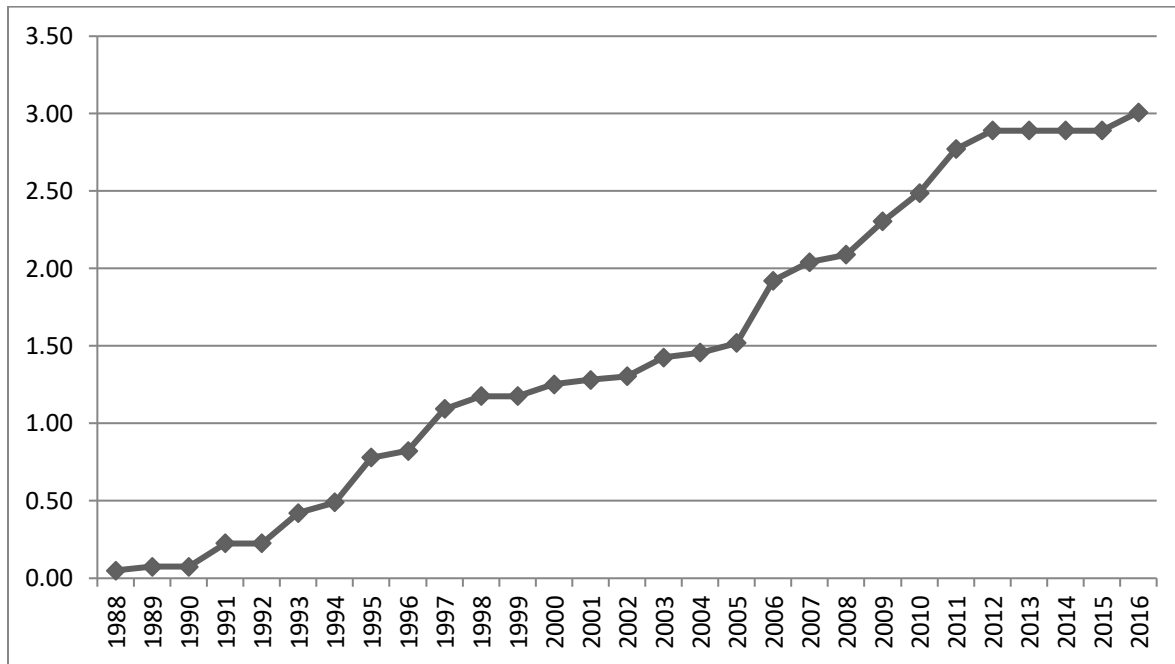
Our index is broadly consistent with commentator views regarding which states are receptive to private investment. For example, Texas, Virginia, Georgia, and Florida are often cited as examples of states with a favorable climate.[17]

4. Empirical Strategies and Estimates

We next empirically examine PPP enabling laws' impact on private infrastructure investment. We utilized data on all PPP projects as reported annually in the "U.S. Transportation Projects Scorecard" in *Public Works Financing* to measure PPP investment. We evaluate the effect of enabling laws on the number of PPP projects completed and on the amount of PPP investment considered as a share of PPP investment relative to total road and highway investment in a state.

We next describe both dependent and independent variables. Our main dependent variable is the proportion of PPP expenditure relative to total expenditure on roads and highways in each State. It is important to consider a proportion because states with larger total spending (public and private) may receive more PPP investment, thus biasing estimates. To compute the percentage of PPP investments we use data reported in tables entitled, "Total State Investments

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[17] Consistent with our hypothesis that PPP enabling laws in those states facilitate investment, Gilroy (2009, p. 14) notes "States like Texas, Virginia, Georgia, and Florida are generally regarded as offering the best models [of PPP legislation], as evidenced by the fact that they are reaping the most private sector interest and investment."

in Roads and Highways" from the U.S. Census Bureau's *Annual Survey of State Government Finances*. In other models, we use the number of projects as the dependent variable to examine if PPP laws helped more PPP projects to reach financial close.

Two key independent variables are *PPP Act* and *PPP Index*. Each will display a positive coefficient if enabling laws increase the amount of investment and the number of PPP projects. A two-sample *t*-test for equal variances for both the proportion of PPP investments and the total amount of PPP projects by the presence or not of a PPP law (*PPP Act*) is reported in Table 3. As expected, there is a positive association between laws and PPPs. The average percentage of PPP investments and the average annual number of projects are both statistically different and larger for States with a PPP law.

TABLE 3. Two-sample *t*-test with Equal Variances Using Presence of a PPP Law

All States (1450 observations)

	Percentage of PPP investments	Annual mean Number of Projects
Without PPP Laws (0)	0.0010	0.0203
With PPP Laws (1)	0.0062	0.2814
diff = mean(0) - mean(1)	t = -5.60***	T = -11.67***
null H0= diff = 0	pvalue =0.000	pvalue =0.000

Only (Treated) States with PPP law enacted between 1988 and 2016 (1044 observations)

	Percentage of PPP investments	Annual mean Number of Projects
Without PPP Laws (0)	0.0007	0.0187
With PPP Laws (1)	0.0062	0.2814
diff = mean(0) - mean(1)	t = -5.09***	t= -8.79***
null H0= diff = 0	pvalue =0.000	pvalue =0.000

The same test applied only to States that enacted a law at some point between 1988 and 2016 confirm that treated States have larger proportion of PPP investment and more PPP projects after PPP law enactment.

Our choice of other time-varying regressors for a multivariate analysis was based on a review of both the privatization and contracting out literatures. Researchers argue that governments utilize private investment in response to constraints on traditional financing sources for public-service provision. Capital constraints, rather than a quest for efficiency, thus drive private-sector participation (e.g. Bel and Fageda, 2007). We consequently include proxies for a state's general fiscal health and its access to traditional sources of infrastructure financing (which

we call "traditional finance").[18] Those are measured by the state's debt outstanding per capita (*Real_Debt_pc*), gas tax receipts per capita (*Real_Gastax_pc*) and federal aid for highways per capita (*Real_Fedaid_pc*). All these monetary variables are in constant 2010 dollar terms.

Measures of political disposition and pressure groups are typically introduced in PPP empirical analysis. However, Albalate, Bel and Geddes (2013, 2015) find that political ideology is not relevant. Our attempts to consider the percentage of democrats in the state legislature or the political party of the Governor produce similar results (i.e. lack of significance). They are not included in our final specification as predictors, but they are used to instrument our key variable *PPP Act,* as described below. Albalate, Bel and Geddes (2013) find that the relative wage differential between the private and public sectors is significant in PPP choice in the U.S. water industry. If unions (perhaps to protect salaries and jobs), oppose PPPs in favor of an approach more likely to involve union labor, then the union variable will negatively impact PPP utilization. Similarly, if privately operated roadways are more likely to employ electronic tolling, then toll-collector unions may oppose PPPs. We include the unionization rate as a control.

Other basic controls include real per-capita income and the state's population. It is difficult to predict *ex ante* the impact either variable will have on the percentage of PPP investment relative to total investment in roads and highways. Table 4 reports summary statistics for all variables. We next describe our empirical strategy and estimating equations.

4.a) The effect of PPP enabling laws in encouraging PPP investments.

We use two complementary empirical strategies to assess the impact of PPP enabling laws on private investment in U.S. infrastructure. We first exploit our data's panel features to examine the effect of a law and its favorability on PPP investment as well as on the total amount of PPP projects. We also estimate how exposure to evolving legal frameworks impacts the cumulative number of PPPs and cumulative private investment. This allows us to evaluate the long-term effects of favorable laws and to assess the role of specific provisions that may, by themselves, have only a short-term impact on annual PPP investment.

Our key dependent variable is the proportion of private investment relative to overall investment in roads and highways. Because our dependent variable is a proportion, we generalize

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[18] We were unable to locate adequate state-by-year data for our time period that measures the condition of transportation infrastructure. Available measures were highly incomplete.

the maximum likelihood optimization of the fractional-response model to obtain parameter estimates within our panel-data setting. This is possible by applying a population-averaged, panel-data model with a within-group correlation structure. We thus estimate:

$$Percentage_{it} = \alpha + \beta_1 D^{PPP\_Act} + \beta_2 Real\_income\_pc_{it} + \beta_3 Fedaid\_pc_{it} + \beta_4 Debt\_pc_{it} + \beta_5 Pop_{it} + \beta_6 Unionm_{it} +$$
$$\beta_7 Year_t + \varepsilon_{it} \tag{1}$$

$$Percentage_{it} = \alpha + \beta_1 D^{PPP\_Index} + \beta_2 Real\_income\_pc_{it} + \beta_3 Fedaid\_pc_{it} + \beta_4 Debt\_pc_{it} + \beta_5 Pop_{it} + \beta_6 Unionm_{it}$$
$$_+ \beta_7 Year_t + \varepsilon_{it} \tag{2}$$

Each variable is defined below. The two equations differ only in the use of the binary *PPP Act* indicator (set to one if the state has a PPP act in effect in that year, zero otherwise) versus the continuous *PPP Index* variable to capture the impact of PPP enabling laws. The dependent variable, *Percentage*, is the percentage of PPP investments in roads and highways divided by total investment in roads and highways in state *i* in year *t*, while *Year* denotes common trend effects, and ε is an error term.[19] Estimates are presented in Table 4 below.

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[19] Year-specific fixed effects are not included because Fractional Response panel data models (xtgee) and 2SLS models (ivreg) do not allow them in STATA. Instead we use a linear common trend variable (YEAR). They are included in count data models where we evaluate the amount of PPP projects.

TABLE 4. Summary Statistics

Variables	Description	Source	Mean	Std. Dev.	Min	Max
Percentage	Percentage of PPP investments over Total State Investments (in roads and highways)	See Sections 3 and 4.	0.0030	0.0174	0	0.3184
Projects	Number of yearly PPP projects reaching financial close	See Sections 3 and 4.	0.1220	0.4344	0	5
PPP Act	Binary variable taking value 1 a PPP enabling law is present; 0 Otherwise.	See Section 3	0.3896	0.4878	0	1
PPP Index	PPP favorability index presented describe in Section 3.	See Section 3.	1.435	2.031	0	7
Real Personal Income_pc	State real income per capita (Constant $2010)	U.S. Census Bureau	36,780	6,970	21,649.5	63,017.8
Real_Federalaid_pc	Federal aid to highways per capita to the state	U.S. Census Bureau	147.23	93.67	13.16	677.91
Real_Gastax_pc	State gasoline tax receipts per capita (Constant $2010)	FHWA Highway Statistics Series	147.759	41.30	0	276.60
Real_Debt_pc	State's only Debt outstanding per capita (Constant $2010)	U.S. Census Bureau	3,161	2,201	206.6	20,829.63
Pop	State population (000s)	U.S. Census Bureau	5,708	6,303	454	39,250
Unionm	Percent of working population in a union in the state	unionstats.com(from CPS)	12.35	5.92	2	31
Year	Variable that denotes the year of the observation.	-	2002	8.369	1988	2016

Count data models are chosen to predict the yearly number of PPP projects that reach financial close. We apply two different models. We first use a standard Conditional Fixed-Effects Negative binomial model which, unlike Poisson models, accounts for dispersion. We then apply a Zero-Inflated Negative-Binomial Model, which accounts for the large proportion of the zero values in our dependent variable (i.e. *Projects*). The estimating equations only differ with the addition of State-specific fixed effects (i.e. s_t).

Our estimates displayed in Table 5 indicate that the *PPP Act* binary variable (model 1) and the favorability index of the state's legislation (model 2) are statistically significant determinants of a state's proportion of PPP investment. Both display a positive, statistically significant impact in the fractional-response model. This is consistent with predictions regarding the positive role of PPP legislation in attracting private investment. Regarding marginal effects, we find that the elasticity for the percentage of PPP investments is 0.52 with respect to *PPP Act* and 0.63 with respect to the *PPP Index*.[20] Indeed, our estimates indicate that PPP laws are the main driver of PPP investment.

Our binary variables may potentially suffer from endogeneity, however.[21] This could occur if PPP laws are passed in response to a previously agreed-upon PPP project, or if the state has recently signed a PPP contract that created public concern and engendered legislative action. We use a two-pronged approach to address this issue. We first report estimates using a two-stage procedure employing instrumental variables **(2SLS).** Second, because PPPs are often large and controversial events covered by the state's media we report findings from an exhaustive investigation into news reports around the time of law adoption. State legislators adopting a PPP law *in response to* an impending transaction (perhaps due to pressure from investors) is newsworthy and would likely be reported widely.

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[20] Results are robust to different treatments of standard errors and different correlation structures. They are also robust to time-and-year fixed effects.
[21] Geddes and Wagner (2013) examine the drivers of a state's decision to adopt a PPP enabling law. They find that states with higher levels of traffic congestion as measured by the travel-time index (TTI) are more likely to pass a PPP enabling law. We are aware of the possibility that the laws may be endogenous to the amount of investment. However, we were unable to detect an effect of completed private infrastructure investment on the travel-time index.

TABLE 5. Estimates of PPP Investment

Covariates	Fixed Effects FR model PPP Percentage (1)	Fixed Effect FR model PPP Percentage (2)	IV 2SLS model PPP percentage (3)
PPP Act	**1.632*****	-	**0.01032*****
	(0.3843)		**(0.0028)**
PPP Index	-	**0.3622*****	-
		(0.0687)	
Real_Income_pc	0.00001	0.00001	**0.00007****
	(0.00005)	(0.00004)	**(0.00003)**
Real_Fedaid_pc	-0.0023	-0.0015	3.17e-06
	(0.0026)	(0.0032)	(0.00001)
Real_Gastax_pc	-0.0067*	-0.0050	0.00004
	(0.0040)	(0.0043)	(0.00003)
Debtpc	0.00004	0.00001	7.29e-07
	(0.00014)	(0.0001)	(7.39e-07)
Pop	9.53e-06	0.00001	**-2.80e-06****
	(0.00002)	(0.00001)	**(1.25e-06)**
Unionm	0.0135	2.436	**0.00047***
	(3.276)	(3.344)	**(0.00028)**
Year	0.00516	-0.00239	**-0.0010****
	(0.0266)	(0.0253)	**(0.0005)**
N. Observations	1450	1450	1450
Wald-Chi2	**49.47*****	**1343.00*****	**13.65***

Notes: ***, **, * significance levels at 1%, 5% and 10% respectively. Errors are clustered allowing for arbitrary correlation by State in models (1) and (2). They are robust to heteroscedasticity in models (3) and (4).

Regarding 2SLS, we chose first-stage instruments to determine the adoption of a PPP enabling law. We use *the annual number of laws* enacted by State legislature in order to proxy the legislative intensity of the State, which is considered to be positively correlated with the probability of PPP enactment laws but uncorrelated with PPP investments. Other instruments included come from the statistically significant variables reported in Geddes and Wagner (2013), who estimate the determinants of *PPP law passage*. Instruments include *the annual number of vehicle registrations* and the *travel-time index,* as well as various political variables. We include three political instruments to account for PPP enactment: the ideology of the constituency proxied by the percentage of votes for democratic candidates in the last presidential election, the percent of democrat representatives in the State legislature and a dummy variable indicating the political party of the Governor (zero democrat, one otherwise).

Estimates using this method are presented in model (3) of Table 5 for the *percentage of PPP expenditures relative to total expenditures*. The positive and statistically significant impacts

of *PPP Act* remain after correcting for possible endogeneity.[22] 2SLS models rely on the quality of instruments employed. On the one hand, the Hansen J-Test checks whether the restrictions implied by the existence of more instruments than endogenous regressors are valid (exogeneity requirement). Results of this test support our over-identifying restrictions strategy (Chi-sq= 4.30 P-value =0.51). On the other, the Kleibergen-Paap test checks whether instruments are relevant (the relevance requirement), which is also satisfied (Chi-sq = 186.15*** P-val=0.0004).[23]

Our second strategy to address potential law endogeneity was to search for media reports of a law being passed in response to an impending agreement. That task would be onerous for all **thirty-five** states with PPP laws. We instead focus on five states that have exhibited high PPP activity: California, Florida, Texas, Virginia, and North Carolina. An exhaustive search into events surrounding *PPP law passage* in each state was conducted.[24] It revealed lobbying by numerous stakeholders prior to the passage of an enabling law, including by state Departments of Transportation, Associated Builders and Contractors, and construction companies, among others. Regarding the laws' importance for investors (i.e. our maintained hypothesis), there were several instances where private groups lobbied for a stronger PPP law lest they move investment to a more accommodating state. That is consistent with our hypothesis.[25] In no case did our investigation reveal that a PPP agreement was concluded prior to the law's passage, offering further comfort regarding possible law endogeneity.

We have thus far shown that PPP laws encourage a larger presence of PPP investments in the composition of total state and local road and highways expenditure. However, this could happen due to a substitution effect if State and Local road expenditure decreases. In order to evaluate if PPP expenditure is just substituting public sector expenditure rather than promoting additional investment, we perform an additional estimation using a panel-fixed-effect model to

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[22] We do not replicate the analysis with the PPP index variable because of collinearity.

[23] The null hypothesis of this test is that the matrix of reduced form coefficients has rank=K1-1 (i.e. under-identified). The Kleibergen-Paap Wald rk F can also be used to check whether the equation is weakly identified. This is rejected at 5% in our model.

[24] We are grateful for Priya Mukherjee for thorough research assistance on this issue. Details of her investigation are available upon request.

[25] Using California's PPP enabling law as an example, Skanska noted that, "The danger for California is that many of its neighbor states not only have legislation in place to allow for PPPs, but have established processes that make these efforts easier for all stakeholders. Should California lag behind these states, private money will go elsewhere."

(see "To enable its growing economy, California needs to renew its design-build and PPP legislation," September 4, 2013, available at: http://blog.usa.skanska.com/to-enable-its-growing-economy-california-needs-to-renew-its-design-build-and-ppp-legislation/ (accessed October 18, 2015).

estimate the impact of *PPP laws* on total per-capita state and local road expenditure – excluding PPPs- in constant terms (US$ of 2010). Rising expenditure on infrastructure via PPP in those states with laws did not crowd out government infrastructure spending.

Results for this test are summarized in Table 6. We report estimates of coefficients of the key PPP variables only, although the models presented in equations (4), (5) and (6) include the same regressors used in previous models displayed in Table 5.[26] The coefficient associated with *PPP act* in the first column of Table 6 is not statistically significant. The same result is obtained when *PPP index* is used. Nonetheless, these variables capture the role of laws and their indirect effect on public-sector expenditure by attracting private investment. In order to test whether private expenditure substitutes for public-sector expenditure, we use the total amount of PPP expenditures directly. Estimates for this analysis are presented in the third column of Table 6. Again, we find no statistical significance in its attached coefficient. Therefore, our estimates indicate that neither PPP legislation nor PPP expenditure in roads and highways negatively affect public-sector expenditure. Therefore we do not find evidence of a substitution effect.

TABLE 6. Summary of Selected Least-squares Estimate Results for Total Public-Sector Investment

Covariates	Fixed Effects Total State and Local expenditures without PPP investments (4)	Fixed Effects Total State and Local expenditures without PPP investments (5)	Fixed Effects Total State and Local expenditures without PPP investments (6)
PPP Act	14.42 (19.29)	-	-
PPP Index	-	3.562 (3.731)	-
PPP investments	-	-	-61.90 (40.324)
N. Observations	1.450	1.450	1.450
R2	0.26	0.26	0.23
F-test	5.97***	5.79***	5.48***

Notes: ***, **, * significance levels at 1%, 5% and 10% respectively. Standard errors are presented in parentheses. Errors are clustered allowing for arbitrary correlation by State.

Our results for count data models predicting the number of annual PPP projects are displayed in columns 7-10 of Table 7. Both fixed-effects negative binomial and zero-inflated negative binomial models consistently show that *PPP laws* and *PPP Index* are positively correlated with the number of projects reaching financial close.

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[26] We did this analysis for federal expenditure on roads and highways in per capita and constant terms. We find the same result that we find in the case of State and Local government expenditure.

TABLE 7. Estimates of the Amount of PPP Projects among Treated States

Covariates	Negative Binomial Fixed Effects PPP projects (7)	Zero inflated Negative Binomial PPP projects (8)	Negative Binomial Fixed Effects PPP projects (9)	Zero inflated Negative Binomial PPP projects (10)
PPP Act	**1.809***	**1.876***	-	-
	(0.4453)	**(0.3124)**		
PPP Index	-	-	**0.3601***	**0.1650***
			(0.0910)	**(0.0627)**
Real_Income_pc	1.02e-06	**0.00005***	**0.00002**	**0.00005**
	(.00004)	**(0.00002)**	**(0.00005)**	**(0.00002)**
Real_Fedaid_pc	0.00471	**-0.0035***	0.0040	**-0.0037***
	(0.0046)	**(0.0021)**	(0.0043)	**(0.0021)**
Real_Gastax_pc	-.00056	**-0.0043***	0.0004	-0.0034
	(0.0057)	**(0.0026)**	(0.0054)	(0.0026)
Debtpc	-0.0001	-0.00003	-0.0002	-0.00003
	(0.0003)	(0.00006)	(0.0002)	(0.00006)
Pop	**0.0002***	**0.00006***	0.00012	**0.00006***
	(0.00008)	**(9.21e-06)**	(0.00008)	**(9.07e-06)**
Unionm	-11.007	**-6.273***	-11.410	**-4.4039***
	(7.384)	**(1.999)**	(7.372)	**(2.148)**
Year	0.01596	0.0149	0.0084	0.0071
	(0.0413)	(0.0149)	(0.0368)	(0.0152)
N. Observations	841	1450	841	1450
loglikelihood	**-313.55**	**-417.85**	**-315.14**	**-416.13**
Wald-Chi2	**68.59***	-	**72.47***	-
LR Chi2	**-**	**110.65***	**-**	**113.62***

4.b) The role of PPP law provisions on PPP outcomes.

The above analysis suggests that PPP laws and their favorability index impact PPP investment. Specific provisions included in the legislation determined favorability. We now examine the role of PPP law provisions on the percentage of PPP investments relative to total roads and highways spending in the same 50 States between 1988 and 2016. We replicate our generalized linear model using fractional-response variables but now substitute our PPP law key variables (*PPP Act* and *PPP Index*) with specific binary variables that indicate whether a provision is included in the law or not. The 13 provisions considered are those presented and described in Table 1.

Model (11) of Table 8 includes all observations, while regression (12) only considers data from States that enacted a PPP law between 1988 and 2016. Finally, regression (14) uses information only of States in years with PPP laws available. For this reason, the number of observation decreases with these models.

Model (11) suggests mixed results regarding the role of provisions on the percentage of PPP investments in roads. Some provisions favor PPP investment, while others hamper their realization. On one hand, we find that allowing existing transportation facilities as well as new transportation facilities to be eligible for PPPs (*Brown*), exemptions from state's procurement laws (*Exemptpro*) and from property taxes on the land required (*Proptax*), as well as the protection of confidentiality of proprietary information in the proposal (*Confident*), all do seem to favor PPP investments. On the other hand, PPP investments in roads are hampered by forbidding eligibility of roads and highways for PPPs (*Elegibility*), by allowing revenue sharing in agreements (*Revenue*) and by allowing both solicited and unsolicited PPP proposals (*Unsolic*). Unlike the opinion declared by experts to construct the favorability index, the latter two have a negative correlation instead of a positive correlation.

We obtain similar results when we restrict our sample to States that enacted a law within our time frame (1988-2016), or when we consider observations of States in years with PPP laws only. There are however some remarkable differences. Allowing revenue sharing loses statistical significance in models (12) and (13) – avoiding the conflict with experts opinion - and allowing for both greenfield and brownfield projects loses statistical significance in model (13). The reduction of the sample also generates new statistically significant results. Allowing both public and private sector funds to be combined in the financing (i.e. *Fundmix*) gains statistical significance (at 10%) in model (13). The positive coefficient indicates that allowing for this

financing option increases PPP investments in States and years with a PPP law. We find the same result for laws not limiting the number of PPPs to pilot projects (i.e. *Unlimitedpro*), and the contrary for the provision that explicitly grants authority to entities other than the state DOT to enter into PPP agreements (i.e. *Others*).

TABLE 8. Estimates of the Effect of State PPP Law Provisions on PPP Investment

Provisions	FR Model Percentage of PPP investments over Total Investments (12)	FR Model Percentage of PPP investments over Total Investments (only treated States) (13)	FR Model Percentage of PPP investments over Total Investments (if PPP Act Available) (14)
Eligibility	-1.703***	-1.575***	-1.194***
	(0.5800)	(0.5074)	(0.4666)
Brown	0.7457**	0.7047**	0.2368
	(0.3308)	(0.3625)	(0.3047)
Unsolic	-0.7718***	-0.8275***	-0.8535***
	(0.2930)	(0.3007)	(.3044)
Exemptpro	1.229***	0.9306**	1.0749***
	(0.4496)	(0.4679)	(0.4129)
Revenue	-1.533*	-1.377	-0.7984
	(0.8141)	(0.9023)	(0.8031)
Avail	-0.1128	0.0689	0.2892
	(0.4860)	(0.4904)	(0.5111)
Proptax	0.6386*	0.6980**	0.6172*
	(0.3829)	(0.3531)	(0.3632)
Noncomp	0.0243	0.0896	0.4006
	(0.5041)	(0.5582)	(0.6998)
Fundmix	-0.1225	0.2029	1.081*
	(0.5580)	(0.5742)	(0.6033)
Confident	0.5806*	0.6930**	0.4734**
	(0.3212)	(0.3362)	(0.2373)
Priorleg	-0.0619	-0.1370	0.1856
	(0.5604)	(0.5386)	(0.4586)
Unlimitedpro	0.6119	0.3674	0.6689*
	(0.4741)	(0.4509)	(0.3713)
Others	-0.3599	-0.7161**	-0.7688**
	(0.4024)	(0.3366)	(0.3397)
Observations	1450	1044	567
Wald-Chi2	283.38***	291.52***	660.21***

Notes: ***, **, * Significance levels at 1%, 5% and 10% respectively. Errors clustered by State.

5. Summary and Conclusions

Many U.S. states and localities are facing challenges in financing, maintaining, expanding and renovating their transportation infrastructure. There is high demand for transportation infrastructure, particularly in urban areas, but it is often poorly maintained and well past its original design life. One approach that is common globally and used increasingly in the United States is to increase private participation through PPPs. Thirty-five states plus Puerto Rico had modern PPP enabling laws in force as of late 2016. Those laws provide the institutional setting within which PPPs can be undertaken, thus lowering transaction costs. Enabling laws clarify important issues including whether or not PPPs can be used on both new and existing facilities, whether the state allows the mixing of public- and private-sector financing, whether or not the government can share toll revenue, and whether or not state legislative approval is needed after the PPP agreement is concluded.

In addition to collecting and analyzing data on PPP enabling laws, we surveyed experts from a range of backgrounds to create an expert-weighted index of PPP enabling law favorability. We then assigned weights to thirteen critical elements of PPP enabling laws and studied state laws to determine which contain those various provisions. We then generated an index of enabling law favorability. More states passing PPP enabling laws while the average favorability of a U.S. PPP enabling law is rising over time. Our estimates indicate that better legal frameworks attract private capital to transport infrastructure projects. We find a strong, positive elasticity of 0.5 for the percentage of PPP investments in roads and highways with respect to PPP Act and of 0.6 to our PPP index variable. We also find a positive association between PPP laws and their favorability with the annual number of PPP projects reaching financial close. Moreover, the higher percentage of PPP investment relative to total state and local investment does not occur due to a crowding-out effect: PPP laws and PPP investments are not associated with lower levels of government investment in highways.

Our estimates suggest several key conclusions regarding the proper structure of PPP enabling laws. Specific-provision estimates reveal that some provisions favor PPP investment in roads and highways while others hamper that investment. The most favorable and consistent results are associated with exemptions on from extant procurement laws and property taxes, and with confidentiality protection. The most problematic are those limiting PPPs to other sectors (excluding roads and highways) and those allowing for unsolicited proposals. Other provisions

show different results depending whether we include the whole sample, the sample of States with PPP laws, and the sample in years with existing PPP laws.

Our findings are invariant to the method of measuring private infrastructure investment via PPPs, and are significant at standard levels of confidence. We believe that, in addition to extending the current literature, our analysis provides useful guidance to the remaining states and localities wishing to craft PPP enabling laws that effectively encourage additional private investment in infrastructure. It also offers guidance to those States wishing to revise their enabling laws in the hope of increasing private investment in infrastructure.

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