PPP Procurement in Canada: An Analysis of Tendering Periods[1]

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Abstract

Governments around the world are facing growing demands to invest in infrastructure and many have looked to public-private partnerships (PPPs) as an essential procurement solution. PPPs, however, are often prone to lengthy tendering periods, measured as the time between contract notice and financial close. Accounting for a significant portion of total project delivery time, slow tendering periods have the potential to deters bidders, reduce competition for contracts, and eliminate the possibility of achieving value for money under PPP delivery. In the context of these issues, this paper examines the determinants of tendering periods using data on 146 PPP projects in Canada. Employing a duration analysis to isolate the factors influencing tendering period duration, the data shows that larger PPP projects exhibit a weak positive association with longer tendering periods, after controlling for a broad range of project characteristics. The results also illustrate minimal sectoral variation and differences in tendering across various Canadian provinces. However, tendering is significantly affected by both the degree of private participation in a PPP project and the level of competition present in the procurement process. Finally, while a variety of complex factors influence the length of tendering period duration, Canada demonstrates notably faster and more efficient tendering than the UK, the global leader in PPP activity.

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[1] *This research uses data from the Canadian Council for Public-Private Partnerships (CCPPP) Canadian PPP Project Database. Special acknowledgment is given to Steven Hobbs and Christian Bauer for granting special permission to use the CCPPP data. Information on the Canadian PPP Project Database can be obtained on the CCPPP website (http://projects.pppcouncil.ca/ccppp/src/public/search-project).*

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I. Introduction

One of the most pressing challenges governments face around the world today is the provision, renovation, and replacement of physical infrastructure. Investments in public infrastructure (i.e. bridges, roads, seaports, railways, airports, public transit, water and wastewater treatment facilities, power plants, schools, hospitals, prisons, and courthouses) are needed on an immense scale in order to address deferred maintenance, population growth, modernization, and economic development. Recent global predictions from the McKinsey Global Institute (2013) and OECD (2015) estimate that between US$57 trillion and US$71 trillion in infrastructure investment is needed in key sectors such power generation, transmission and distribution, telecommunications, water and transportation by 2030 to keep pace with global economic growth.[3] However, traditional project delivery is insufficient to meet these rising demands. Evidence provided by Flyvbjerg et al. (2002; 2003; 2003b; 2004; 2011) in a series of publications on large infrastructure project procurement suggests traditional project delivery is laden with inefficiencies. Their analysis of data on 258 large-scale infrastructure projects (i.e. those costing $100 million or more) illustrated that traditional infrastructure procurement was characterized by benefit shortfalls, cost overruns and time delays in nine out of ten cases. With governments also facing significant capital constraints and large funding gaps following the 2008 global financial crisis, public authorities are now looking for novel and innovative ways to improve the accountability and efficiency of spending devoted to infrastructure projects.[4]

[3] The International Energy Agency (2013) estimates global expenditures for transportation, reconditioning, upgrading costs, new construction, and annual operations and maintenance will reach approximately $120 trillion by 2050.

[4] McKinsey (2013) claims that costs savings can be generated from simple improvements to infrastructure policy such as project selection and approval, land acquisition, demand management and asset maintenance. For example, the adoption of proven best practice methods in infrastructure management could achieve savings of 40 percent and increase investment productivity. The IMF (2014:105) notes that: “Efficiency entails not only the proper allocation of investment to sectors, but also the production of public assets at the lowest possible cost. When public investment is inefficient, higher levels of spending may simply lead to larger budget deficits, without increasing the quantity or quality of roads, schools, and other public assets that can help support economic growth.”

Increasing the role of private sector participation in infrastructure project delivery via public-private partnerships (PPPs) has become one of the primary policy mechanisms to improve the efficiency of infrastructure project delivery. PPPs, broadly defined, are contracts between a public sector project sponsor and a private partner that allow for enhanced private participation in life cycle of infrastructure projects (i.e. design, construction, financing, operations and maintenance). Concession contracts, build-operate-transfer (BOT) arrangements, and agreements ranging from design-build (DB) to design-build-finance-operate-maintain (DBFOM) are just some of the many PPP approaches that have been utilized to delivery highways, tunnels, airports, road, bridges, seaports, hospitals and schools. The use of PPPs has also expanded to finance projects related to power generation, water and wastewater treatment facilities, dams, irrigation systems, and telecommunications infrastructure (Auriol & Picard, 2013).

Governments claim the use of PPPs leads to faster infrastructure procurement and greater value-for-money (VFM) relative to traditional project delivery. With public authorities routinely expected to delivery projects on-time and on-budget, PPPs have been lauded as an instrumental step in overcoming inefficiencies associated with public infrastructure procurement via traditional methods. However, such assertions remain subject to extensive debate. Hodge and Greve (2007, 552) conclude in their comprehensive international review of PPPs that "the economic and financial benefits of PPPs are still subject to debate – and hence considerable uncertainty." Moreover, a more recent review of PPPs in the United Kingdom by HM Treasury (2012) concludes that neither the public sector nor taxpayers have been getting adequate value for money. Despite these concerns, there is considerable empirical evidence supporting both the time and cost savings of PPPs in infrastructure project procurement. For example, the National Audit Office (2003), Mott MacDonald (2002), Duffield and Raisbeck (2007), and Lammam, MacIntyre, and Berechman,

(2013) all reach similar conclusions that PPPs reduce capital costs (i.e. construction costs) and shorten completion times. These findings are consistent with property rights theory which suggests well-defined property rights – in this case through a PPP – will incentivize superior performance in the form of faster project delivery (Alchian & Demsetz, 1972; Wiseman, 1978).

However, the aforementioned studies focus only on the portion of the procurement process which spans from contract award through construction completion. The interval between contract notice and contract award (i.e. the tendering period) is largely overlooked, despite the fact that long tendering periods can significantly impact public sector investment efficiency. PPP projects are characteristically prone to have longer tendering periods than other procurement options (Owen and Merma, 1999; Ahadzi & Bowles, 2004; HM Treasury, 2012). This tendency is often attributable to the long term nature of PPP contracts, which usually span twenty or more years as a result of enhanced private participation in facility operations and maintenance. Moreover, the different project life-cycle components covered by PPPs increases the relative complexity of the procurement process, thereby elevating the level of uncertainty surrounding projects. As a whole, longer tendering periods for PPP projects have the potential to delay the completion of projects and impose high social costs on citizens who are unable to access the infrastructure services being provided (HM Treasury, 2010). Additionally, the association between PPP projects and lengthy tendering periods may deter potential bidders, thus decreasing competition for contracts, eliminating the possibility for lower costs, and reducing the prospect of achieving better VFM under PPP delivery (National Audit Office, 2007).

In light of these issues, Reeves, Flannery, and Palcic (2015, n.d.) were the first scholars to use a duration-analysis model to empirically examine, for both Ireland and the UK respectively, the extent to which tendering periods are determined by project size (i.e. capital value), the timing of contract notice, and the geographic location of PPP projects. In Ireland, they initially found tendering periods decreased over time and exhibited a weak positive association with project capital costs (i.e. the construction costs of the project). In the UK, Reeves et al. subsequently found that significantly longer tendering periods were associated with higher project capital values, after controlling for many other factors. While these results are informative, given the UK's position as a world leader in PPP procurement, the determinants of tendering periods still remain largely unexplored. This paper, thus, serves to expand the existing literature by examining tendering periods, their determinants, and the overall ex-ante or pre-contract performance of PPP procurement in Canada, a country with extensive PPP experience. In collaboration with Reeves et al., this paper applies a similar duration analysis framework to isolate the determinants of tendering periods for PPP projects in Canada.

In the next section, I provide a general overview of the theory and mechanics behind the PPP procurement process. In section III, I offer a brief synopsis of PPP procurement in Canada. In section IV, I discuss both the data and empirical methodology used in my analysis of Canadian PPP tendering periods. In section V, the variables included in the models are discussed at length, followed by the estimates reported in section VI. Finally, section VII provides a summary and conclusion of this paper's findings.

II. PPP Procurement: Theory and Practice

Although the history of public and private sector cooperation is extensive, the use of PPP terminology only began to appear in the early 1940s. Since then, PPPs have been used broadly to define a diverse range of public and private sector collaborative arrangements (Bovaird, 2004; Hodge & Greve, 2007). However, the most recent wave of PPPs in physical infrastructure stems from the U.K.'s private finance initiative (PFI) during the early 1990s. This paper focuses on these

PPPs, represented by long-term infrastructure contracts, and specifically discusses the ex-ante or pre-contact procurement phase. NAO (2007) provides a clear illustration of the ex-ante PPP procurement phase. The distinct stages of procurement prior to contract award are: (i) option appraisal and project preparation; (ii) the tendering process; (iii) construction; and (iv) service delivery. For the purpose of this paper, the tendering process is of primary concern. Tendering involves the invitation of bidders, the selection of preferred bidding party, and the negotiation of a final contractual agreement.

Despite the global appeal of the PPPs for infrastructure project delivery, past procurement experience has been laden with issues related to tendering and contract negotiation, leading to time delays and elevated costs from organizing, crafting, and executing infrastructure deals (HM Treasury, 2012; KPMG, 2010; Brown & Potoski, 2003). While additional procurement time may sometimes be necessary and extremely beneficial to a project in order to ensure adequate VFM, lengthy procurement periods can disrupt the competitive bidding process and undermine the ability of PPP projects to achieve greater VFM. Furthermore, higher transaction costs associated with longer tendering periods also destroy the ability to achieve VFM under PPP delivery. Transaction cost economics (Williamson, 1975, 1985) clearly illustrate how the source of these costs can impact overall PPP procurement efficiency.

Transaction costs consist of information, searching, bargaining, negotiation, and monitoring/enforcement costs (Obermann, 2007). These costs affect both the public and private sector and can arise between contracting parties in a PPP agreement when a deal is being finalized. In a PPP agreement, organizing the tendering processing, assessing incoming bids, and negotiating the final contract with the preferred bidder are all sources of transaction costs incurred by the public sector project sponsor. Private consortiums interested in acquiring the contract also incur substantial costs by assembling bids which may or may not be selected. In general, if parties in a PPP agreement are to account for the numerous risks and uncertainties (e.g. changes in government objectives, pre-commitment issues, stakeholder coordination, etc.) in a deal and negotiate a contract that considers both foreseen and unforeseen contingencies, these contracts can take many months, even years to put together (Lammam et al., 2013). Ultimately, the magnitude of transaction costs associated with a particular agreement are determined by transaction-specific characteristics such as project uncertainty, deal complexity, the degree of asset specificity, bidding competitiveness, and the quality of government contract management skills (Vining, Boardman, & Poschmann, 2005; Williamson, 1975, 1985). Infrastructure PPP contracts carry high degrees of uncertainty and are extremely complex in nature. They also consist of specific, sunk investments (i.e. irreversible with little to no alternative use) and attract relatively small numbers of bidders. Furthermore, government contract management skills remain poor despite improvement in some countries (Boardman & Vining, 2012). As a result, the potential for participants in a PPP agreement to engage in opportunistic behavior, whereby parties try to expropriate value from each other, poses a persistent threat to infrastructure contracting with significant implications for transaction costs (Spiller, 2011).[5]

Overall, PPP tendering periods and transaction costs associated with the ex-ante procurement stage are significantly influenced by PPP transaction-specific characteristics and the threat of contracting parties engaging in opportunistic behavior. Existing literature shows that the transaction costs associated with PPP project delivery are quite substantial.[6] Klein, So, and Shin (1996) claim that transaction costs in well-developed policy environments makeup between 3 and 5 percent of project costs and 10 to 12 percent in pioneering projects. Dudkin and Välilä, (2005),

[5] For a more detailed review, see Spiller (2011).
[6] For a more detailed review, see Obermann, 2007.

using data on 55 UK PPP contracts, also indicate that ex-ante transaction costs represent about 12 percent of a project's capital value, with about 7 percent attributed to the public sector and winning bidder and the remaining 5 percent representing aggregate costs incurred by failed bids. Ultimately, the available evidence indicates the implications of high transaction costs on overall PPP efficiency are large. Therefore, improving procurement efficiency and shortening tendering periods remain important facets of ongoing PPP management.

III. Background: PPP Procurement in Canada

Through the formation of specialized agencies, called PPP units, at both the federal and provincial level, Canada has made a strong commitment to the PPP procurement process, ensuring that public authorities have the necessary capacity to create, deliver and enforce PPP contracts (Istrate and Puentes, 2011). Since the creation of Canada's first specialized provincial PPP unit in British Columbia (Partnerships BC) in 2002, the use of PPP units in Canada has grown. In 2005 and 2006 respectively, Quebec (Infrastructure Québec) and Ontario (Infrastructure Ontario) each established their own PPP units. New Brunswick (Partnership New Brunswick) followed in 2010 along with the government of Saskatchewan (SaskBuilds) in 2012. Alberta similarly formed a P3 unit called Alberta Infrastructure - Alternative Capital Financing which operates within the province's Treasury Board (OECD, 2010) and Nova Scotia recently created its own special division devoted to PPPs as well (Gross et al., 2010). At the national level, the federal government also established a PPP unit and crown corporation (PPP Canada) in 2009 to improve PPP expertise, develop Canada's national PPP market, and manage the federal government's $1.25 billion PPP infrastructure fund (OECD, 2010). Working together, these PPP units at the federal and provincial level have helped standardize Canada's procurement process and improve coordination amongst various government agencies (Istrate and Puentes, 2011).

As a result, commitments by both Canada's federal government and provinces to increase the use of PPPs has yielded substantial economic benefits for the country. Between 2003 and 2012, estimates indicate Canada's use of PPPs to deliver public infrastructure has created 517,000 full-time jobs, $32.2 billion in total income, $48.2 billion in total GDP, and $92.1 billion in total economic output. Representing somewhere between 10% and 20% of Canada's public infrastructure spending, PPPs have also generated $9.9 billion dollars in total cost savings (Iacobacci, 2010; InterVISTAS Consulting, 2014). Additionally, Canada has demonstrated superior PPP procurement efficiency, relative to the UK and its European counterparts.[7] For example, even though limited literature exits on Canadian PPP construction performance, initial results provided by Iacobacci (2010) indicate roughly 90% of projects finished on or ahead of schedule. An evaluation of value-for-money (VFM) assessments for 55 projects in Canada also showed that PPPs generated potential savings between 0.8% and 61.2% of the costs associated with conventional procurement (Iacobacci, 2010). Furthermore, a recent review of PPPs projects in the UK suggested that Canadian PPP units are a model for reducing transaction costs, despite the UK's extensive history and greater use of PPPs (HM Treasury, 2012). Finally, the HM Treasury (2012) noted that the UK's average tendering period of 34.8 months was significantly slower than those realized in Canada. Overall, Canada's successful adoption of PPPs has received international recognition, and Canada remains a global leader in the use of PPPs to deliver physical infrastructure on time and on budget.

IV. Data Collection and Methodology

In the next section, I undertake an empirical examination of the determinants of tendering period length, measured as the number of months between contract notice and contract

[7] A detailed overview of Canada's experience with PPPs is beyond the scope of this paper. See Siemiatycki (2013) for a more detailed review of Canada's PPP experience.

award/financial close, for PPP projects in Canada. Using the Canadian Council for Public-Private Partnerships' (CCPPP) Canadian PPP Project Database, this analysis looks at tendering periods and other relevant project characteristics of PPPs which have reached financial close as of January 31, 2016. Of the 236 PPP projects in Canada, 205 fit the sampling restriction outlined above. However, the absence of information related to contract notice, financial close, and project size resulted in the omission of an additional 59 projects from the sample, leaving a total of 146 PPP projects available for analysis.[8] Overall, the data spans from May 1987 (first contract notice) to July 2014 (latest contract notice for a project reaching financial close by January 31, 2016), and the average tendering period lasts 19 months. Table 1 reports a breakdown of the Canadian PPP sample by economic sector, contract agreement value (i.e. the NPV of the whole life cycle cost of a project) and tendering period length.[9] Table 2 provides a similar breakdown by province.[10]

Table 1: PPP Projects by Sector, Contract Value, and Tendering Period

Sector	# of Projects	% of Total	Contract Value ($Millions)				Tendering Period (Months)		
			Total	Average	Min	Max	Average	Min	Max
Hospitals & Healthcare	65	44.50%	23,052.30	354.7	32	1,973.00	18.6	8.3	48.1
Transportation	36	24.70%	41,140.10	1,142.80	16	9,100.00	20.5	6.4	78
Justice/Corrections & Government Services	18	12.30%	5,798.00	322.1	93	966	21	13.4	38.1
Other Sectors	27	18.50%	11,338.30	419.9	2	4,250.00	16.7	1.6	36.5
Total	146	100.00%	81,328.70	557	2	9,100.00	19	1.6	78

Source: Calculations from CCPPP (2015) data. Notes: (1) 'Hospitals & Healthcare' includes 61 hospitals, 3 long term care centers, and 1 children and youth services project; (2) 'Transportation' includes 26 road and bridge projects, 6 public transit projects, 2 airport & civil navigation projects, and 2 other transportation facilities; (3) 'Justice/Corrections & Government Services' includes 9 corrections facilities, 6 courthouses, 2 license testing centers, and 1 archives project; (4) 'Other Sectors' includes projects in the following sectors: Defense (1 project), Education (7 Projects), Energy (2 projects), Environmental (7 projects), Real Estate (2 projects), Recreation & Culture (8 projects).

[8] A risk-adjusted contract agreement value was used for projects lacking information on the contract agreement size
[9] See Table A1 (see Appendix) for a breakdown by economic sector, capital value, and tendering period length.
[10] See Table A2 (see Appendix) for a breakdown by province, capital value, and tendering period length.

Table 2: PPP Projects by Province, Contract Value, and Tendering Period

Province	# Projects	% of Total	Contract Value ($Millions)				Tendering Period (Months)		
			Total	Average	Min	Max	Average	Min	Max
Ontario	86	58.90%	45,611.20	530.4	2	9,100.00	17.9	1.6	34
British Columbia	22	15.10%	7,760.40	352.7	24	1,117.00	19.5	11.9	36.5
Alberta & Quebec	22	15.10%	18,151.00	825	60	3,431.00	22.1	10.5	48.1
Other Provinces	16	11.00%	9,806.10	612.9	16	1,832.00	20	9.2	78
Total	146	100.00%	81,328.70	557	2	9,100.00	19	1.6	78

Source: Calculations from CCPPP (2015) data. Notes: 'Other Provinces' includes the following provinces: Saskatchewan (5 projects), Nunavut (1 project), Nova Scotia (1 project), New Brunswick (5 projects), Manitoba (3 project), Multiple (1 project).

In order to first determine the relationship between tendering length (measured in months) and project size for PPP projects in Canada (measured in $ millions), I run a short set of models regressing tendering duration on proxy variables for project size (i.e. capital value and contract agreement value respectively). Equation 1 below represents a basic linear regression of tendering period length on project size for the *i*th observation. Tendering duration is denoted by T_i while x_1 represents a continuous variable of project size with a coefficient β_1. Equation 2 includes a secondary quadratic term of project size with a coefficient β_2 to test whether the relationship between these two variables is indeed linear. Both models have an intercept parameter μ and an error term, ε_I, which denotes the residual or unexplained variation in the estimates.

$$T_i = \mu + \beta_1 x_1 + \varepsilon_i \qquad (1)$$

$$T_i = \mu + \beta_1 x_{1_i} + \beta_2 x_{1_i}{}^2 + \varepsilon_i \qquad (2)$$

While these initial regressions help reveal the nature of the relationship between tendering period length and project size, I use a Duration Analysis (DA) model to more precisely identify the factors which significantly affect tendering period duration. DA models encompass a select group of analytical methods which are used to model data focusing on end-of-duration occurrences, assuming the duration has persisted for some period of time (Hensher & Mannering, 1994). DA has been previously applied to empirical models of urban housing duration (Kim & Horner, 2003), unemployment duration (Arulampalam & Stewart, 1995), local government tenure length (Castro & Martins, 2013), self-employment duration (Taylor, 1999), and the adoption by U.S. states of PPP enabling legislation (Geddes & Wagner, 2013). Reeves et al. (2015, n.d.) were the first to apply DA methodology to tendering period duration in their analyses of Ireland and the U.K. This paper reapplies their DA model to the tendering period duration of PPP projects in Canada, allowing for analysis of the time (measured in months) between contract notice and financial close.

Within the DA methodology, I employ an accelerated time failure (AFT) specification to generate estimates for my model. Using this framework, the logarithm of duration represents the dependent variable and the error term assumes a particular distribution. Equation (3) below represents the log-linear specification of the AFT model for the *i*th observation. The log-transformed duration is represented by $\log T_i$ while $x_1 \ldots x_p$ are explanatory variables with coefficients $\beta_1 \ldots \beta_p$. The intercept and scale parameters are μ and σ respectively and the residual or unexplained variation in the model is denoted as ε_i.

$$LogT_i = \mu + \beta_1 x_{1_i} + \ldots . \beta_p x_{p_i} + \sigma\varepsilon_i \qquad (3)$$

Using the AFT model parameterization, the first step in this analysis is to specify the distribution for the duration times T_i. The distribution for T_i ultimately determines the error term, ε_i, distribution. For example, log-logistic, log-normal or generalized gamma distribution models assume ε_i to be logistic, normal or log gamma respectively. When choosing the most appropriate distribution, standard practice recommends using either the exponential, Weibull, Gamma, log-

logistic and log-normal distributions in an AFT model. In this study, the decision to use a Gamma distribution for the duration models was based on the Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC).

V. Choice of Variables

The dependent variable in the DA models is the tendering period, measured by the number of months between contract notice and financial close.[11] Contract agreement value (separated into quintile ranges), time period dummy variables, provincial dummies accounting for location, sector dummies, PPP delivery model dummies, and the number of shortlisted bidders make up the main explanatory variables (see Table 3).[12] These independent variables were chosen based on theoretical perspectives and the existing literature on PPP procurement discussed below.

Table 3: Variable Descriptions (Main DA Models - Contract Value)

Variable	Type	Description
Contract Value 1	Indicator	Project value is less than or equal to $92 million
Contract Value 2	Indicator	Project value is between $93 and $189 million
Contract Value 3	Indicator	Project value is between $198 and $354 million
Contract Value 4	Indicator	Project value is between $355 and $769 million
Contract Value 5	Indicator	Project value is greater than or equal to $789.8 million
Time Period: 1987 - 2006	Indicator	1= Tendered during the period 1987-2006; 0 = Not tendered during the period 1987-2006
Time Period: 2007 - 2010	Indicator	1= Tendered during the period 2007-2010; 0 = Not tendered during the period 2007-2010
Time Period: 2011 -	Indicator	1= Tendered in or post 2011; 0 = Not tendered in or post 2011
Provincial Dummies	Indicator	Provincial dummies: Ontario; British Columbia; Alberta & Quebec; Other Provinces

[11] Typically, tendering begins when a government issues a request for qualifications (RFQ) to firms interested in a project. However, governments occasionally issue a request for expressions of interest (RFEI) prior to an RFQ to gauge market demand for a project. In these circumstances, the REFI stage can reasonably be considered the start of the tendering process. While the majority of tendering periods for PPP projects in Canada began with an RFQ, RFEIs were used as the starting point of tendering periods for applicable projects. Based on these assumptions, the average tendering period in Canada lasts 19 months. If only the RFQ is considered to be the starting point of the tendering process, the average tendering period lasts 18.5 months.

[12] Table A3 (see Appendix) contains the explanatory variables used in the preliminary DA model. This includes project capital cost (separated into quintile ranges), time period dummy variables, provincial dummies, and sector dummies.

Sector Dummies	Indicator	Sectoral dummies: Hospitals & Healthcare; Transportation; Justice/Corrections & Government Services; Other Sectors
P3 Model Dummies	Indicator	PPP model dummies: BFM/DBFM/DBFO/DBFOM; BF/DBF
Shortlisted Bids: 1 to 2	Indicator	Number of shortlisted bids is between 1 and 2
Shortlisted Bids: 3	Indicator	Number of shortlisted bids is 3
Shortlisted Bids: 4 or More	Indicator	Number of shortlisted bids is 4 or more

The development of major private infrastructure projects is extremely complex. By nature, PPP contracts usually bundle the construction, operation and financing components of a project, necessitating the procurement process account for these factors in the tendering process (HM Treasury, 2012; Klein et al., 1996). While Duffield and Raisbeck (2007) say the advantage of PPPs increases (in absolute terms) with project size and complexity, Yescombe (2011) asserts higher bidding and increased development costs stem from the enhanced complexity of large infrastructure projects. In order to examine the association between PPP procurement complexity and tendering period length, Reeves et al. initially used capital cost, segmented into quintile ranges, as a proxy for project size and complexity in their previous work. While this paper uses capital cost in a preliminary DA model, PPP contract agreement value serves as an alternative proxy for project size and complexity in the main DA models of this paper.

Transaction cost economics also illustrates how specific components of infrastructure project transactions can impact procurement times as well as costs. The DA model therefore incudes sectoral and provincial dummy variables to account for differences across sectors (e.g. healthcare, transportation, justice/corrections, etc.) and variation in the tendering periods associated with various provincial procuring authorities across Canada (e.g. Ontario, British Columbia, Alberta & Quebec, etc.). Additionally, pooled categories of PPP model type (e.g. BFM/DBFM/DBFO/DBFMO, BF/DBF) are included in a secondary analysis to control for variability in contract structure, the degree of private participation in the PPP contract, and risk transfers from the procuring authority to private partner.

In order to account for improvements in the procurement process overtime, time period dummy variables are also incorporated into the DA models. Because PPP procurement is relatively novel in practice, public authorities engaged in PPP procurement face a "learning curve" in implementing effective procurement practices. As governments gain more experience and more PPP projects are procured, a set of baseline standards and best practices are reinforced (Barrios, 2012). As a result, tendering periods and transaction costs are expected to decrease over time as PPP procurement improves (Iacobacci, 2010; Istrate & Puentes, 2011).

Finally, competition in the tendering process is a crucial component of PPP procurement. Grimsey and Lewis (2004, 135) note that "competition creates an environment that encourages bidders to be innovative in their design and efficient in service delivery." While only one party ultimately prevails, competitive tendering and contracting creates "competition for the market" which encourages private firms to reduce costs, improve quality, and provide both creative and innovative solutions in the bidding process (Domberger & Rimmer, 1994; Domberger, Hall & Li, 1995; De Bettignies & Ross, 2004). In order to account for different levels of competition in the tendering process, the number of shortlisted bidders vying for a contract are included in an iteration of the DA models as well.

VI. Empirical Results

Table 4 contains the preliminary regression results which report the relationship between tendering period duration and measures of project size (i.e. capital cost and contract agreement value) for PPP projects in Canada. In the first column, the coefficient indicates that a $100 million increase in the capital cost of a PPP project is associated with an increase in tendering of roughly

0.3 months. Likewise, results reported in the third column indicate a $100 million increase in the contract agreement value of a PPP project is associated with an increase in tendering of roughly 0.2 months. Quadratic terms of capital cost and contract agreement value are included in the second and fourth columns respectively in order to determine whether the relationship between project size and tendering duration is linear. Since the coefficients associated with these quadratic terms approximate zero and are not significant, the relationship between tendering period length and project size for PPP projects in Canada appears to be linear in nature.

Moving to the examination of specific factors with potential influence on tendering period duration, the first column in Table 5 (see Appendix) shows the preliminary DA estimates for tendering duration when capital cost, time period dummies, sector dummies, and provincial dummies are used as the main explanatory variables. Drawing on a limited sample of 72 PPP projects, this initial examination of tendering mirrors the analysis conducted by Reeves et al. for the UK. Estimates of overall tendering period duration are reported in the form of time ratios in order to clarify the interpretation of model coefficients (Jenkins, 2005). The results in this particular analysis indicate that tendering periods differ significantly across various sectors and provinces. For example, the tendering process for hospitals and healthcare projects took 31.5% longer to complete compared to those in the transportation sector after controlling for province location, project capital value, and the time period of procurement. Additionally, across provinces, while the tendering period for projects in Ontario were not significantly different in length than those in British Columbia after controlling for time period, sector, and project capital value, projects procured in smaller provinces throughout Canada took, on average, 31.5% longer to reach financial close than those in British Columbia. Given British Columbia and Ontario have extensive experience with PPP procurement and have the highest volume of PPP projects, these latter findings are not surprising.

The preliminary DA model also suggests that the capital value of a PPP project plays a significant role in determining the length of the tendering process. While projects in the intermediary quintiles (i.e. $69.6 - $132 million, $142.2 - 249.4 million, $252.6 - 543.8 million) all reported significantly longer tendering (60.3%, 38.8%, and 42.1% respectively) relative to projects valued at less than $63.1 million, projects in the highest capital value quintile, valued at $550 million of more, experienced the longest time to completion. These projects took, on average, 145.7% longer than those in the bottom quintile after controlling for time period, sector, and province.

Lastly, the estimates of this model specify that the time period corresponding to the advertisement of a project affects the length of the tendering period in a significant way. The coefficients on the time period dummies demonstrate reductions in tendering across time and highlight a 39.4% decrease in tendering for projects procured from 2011 to the present, relative to those tendered between 1987 and 2006.

While these results are informative and significant, the relatively small sample size (N =72) and omission of a large number of projects due to missing information raises questions about the robustness of these findings. Because the missing data is likely non-random, the resulting estimates are expected to be biased. With this in mind, the second column in Table 5 (see Appendix) contains a similar analysis to the first column but uses contract agreement value in place of capital value as a proxy for project size and complexity. Dummies for sector, province, and time periods are included in this model as well. Drawing on the full sample of 146 PPP projects, much of the significance seen in the preliminary DA model disappears in this analysis. While no significance differences in tendering duration appear across the Canadian provinces or over time, only justice/corrections and government services projects took 23.0% longer to reach financial close than those in the transportation sector, after controlling for contract agreement value, time period, and sector. This estimate, however, only maintains significance at the 10% level.

Additionally, when it comes to contract agreement value, only projects in the highest quintile (i.e. those with contract values greater than or equal to $789.8 million) reported a significant difference in tendering duration relative to projects with contract values equal to or less than $92 million. These larger projects took, on average, 29.2% longer to complete the tendering process and their prolonged procurement support the hypothesis that relatively large, complex infrastructure projects, normally characterized by considerable uncertainty, lead to significantly longer tendering periods.

However, when indicator variables corresponding to PPP model type and the number of shortlisted bidders are introduced into the DA model to account for both competition and the degree of private participation involved in the procurement process, the significant association between high contract agreement values and prolonged tendering disappears yet remains positive. Alternatively, estimates reported in the third column of Table 5 (see Appendix) indicate that significant variation exists in tendering duration across PPP model type and that PPP tendering period length is partially dependent on the number of bidders vying to secure the contract. For instance, after controlling for factors such as project sector, provincial location, contract agreement value, time period, and PPP model type, the time from contract notice to financial close for projects with only 1 or 2 bidders took, on average, 34.3% longer than projects with 3 shortlisted bidders involved in the procurement process. Likewise, projects containing enhanced private involvement in operations and maintenance (i.e. BFM/DBFM/DBFO/DBFOM projects) experienced tendering which lasted, on average, 37.3% longer than the tendering periods associated with projects containing less private involvement (i.e. BF/DBF projects). With the DA estimates also indicating relatively few differences in tendering period length across both sectors and provinces and weak positive improvements in tendering duration overtime, these findings, on a whole, support some of the theoretical perspectives previously outlined in this paper.

Overall, these results shed light on a variety of factors influencing PPP procurement efficiency. Firstly, after controlling for a variety of factors, this paper fails to confirm the findings by Reeves et al. in the UK that tendering periods exhibit a significant positive association with PPP project size (represented in this paper by contract agreement value). Contrarily, this paper supports the findings by Reeves et al. (2015) in Ireland of a weak positive association between contract size and tendering period duration. Additionally, this paper finds most of the differences in tendering period length can be explained by levels of competition in the procurement process and the degree of private involvement in a PPP contract. While these findings support the conclusion put forward by NAO (2007) that no significant relationship exists between project size and tendering length, the results offer an alternative explanation for tendering period variability. More importantly, this paper underscores substantial differences in tendering period length between Canada and the UK. While the duration of tendering periods for PPP projects in Canada has been remarkably efficient, averaging 19 months, tendering periods in the UK, the world leader in PPP adoption, have been lengthy, averaging 34.8 months. The HM Treasury (2012) previously noted this stark difference in procurement efficiency, characterizing UK tendering as slow relative to its other European comparators and significantly slower than Canada. This paper confirms this finding and ultimately highlights the success of Canada in producing an efficient procurement process.

VII. Summary and Conclusions

As demands for infrastructure investment continue to increase worldwide, governments face increasing pressure to improve infrastructure procurement efficiency. While many public authorities claim the adoption of PPPs improves investment efficiency and helps address the global infrastructure deficit, a growing body of evidence suggests PPPs may not be sufficient to improve procurement and achieve government objectives.

In order to accelerate infrastructure project delivery, one of the many challenges procurement practitioners continue to grapple with is increasing the efficiency of the PPP tendering process. Although PPPs have been shown to produce shorter construction times and significant cost savings, the complexity and uncertainty often associated with the PPP tendering process hinders the ability of procuring authorities to expedite the delivery of infrastructure projects. Resulting inefficiencies in procurement may ultimately deter bidders, undermine competition for contracts, increase overall project costs, and reduce the potential value for money under PPP delivery. It is therefore critical that best practices in the tendering process are employed by governments around the world.

While HM Treasury (2003), NAO (2007), and HM Treasury (2012) have all emphasized the importance of governments improving the tendering process and strengthening overall procurement practices, Canada has successfully demonstrated its ability to efficiently procure infrastructure projects on time and on budget. Through a combination of good procurement process management skills, fair and transparent evaluation, well-defined government objectives, and clear technical requirements for financeable contracts, Canada has improved upon the UK model and dramatically shortened the time between contract notice and financial close (Barros, 2012; Romoff, 2014).

In this paper, focused analysis of tendering periods for PPP projects in Canada show that tendering periods in Canada have been remarkably short, averaging 19 months to date. The results of the duration analysis models also tenuously indicate that tendering periods may be getting shorter over time and that some variation in the tendering processes exists across provinces and sectors. More importantly, this papers demonstrates that prolonged tendering duration associated with higher PPP contract agreement values may ultimately be explained by the degree of private participation and risk transfer in a PPP contract, measured by the PPP model type, as well as the level of competition for a PPP contract, measured by the number of shortlisted bidders.

While this analysis ultimately sheds light on the determinates of PPP projects in Canada, these results face considerable limitations and more research is need on tendering processes. A global comparative analysis of tendering outcomes would help uncover and isolate the predominate factors which affect tendering around the world. Likewise, while this paper does not compare tendering periods between PPP and traditional procurement methods, a comparative analysis along these lines would also offer useful insight into the effectiveness of PPP delivery and help build off the contributions of this paper.

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Appendix

Table A1: PPP Projects by Sector, Capital Cost, and Tendering Period

Sector	# Projects	% of Total	Capital Cost ($Millions)				Tendering Period (Months)		
			Total	Average	Min	Max	Average	Min	Max
Hospitals & Healthcare	23	31.90%	8,271.20	359.6	22	1,973.30	19.2	7.4	48.1
Transportation	24	33.30%	14,664.20	611	10	2,130.00	19.1	6.4	78
Other Sectors	25	34.70%	6,859.20	274.4	12	4,250.00	18.7	1.6	38.1
Total	72	100.00%	29,794.60	413.8	10	4,250.00	19	1.6	78

Source: Calculations from CCPPP (2015) data. Notes: 'Other Sectors' includes projects in the following sectors: Justice/Corrections (7 projects), Education (3 projects), Energy (1 project), Environmental (4 projects), Real Estate (1 project), Recreation & Culture (9 projects).

Table A2: PPP Projects by Province, Capital Cost, and Tendering Period

Province	# Projects	% of Total	Capital Cost ($Millions)				Tendering Period (Months)		
			Total	Average	Min	Max	Average	Min	Max
Ontario	22	30.60%	11,384.70	517.5	22	4,250.00	16.9	1.6	32.8
British Columbia	28	38.90%	8,617.70	307.8	12	2,050.00	18.6	7.4	36.5
Other Provinces	22	30.60%	9,792.20	445.1	10	1,973.30	21.6	9.2	78
Total	72	100.00%	29,794.60	413.8	10	4,250.00	19	1.6	78

Source: Calculations from CCPPP (2015) data. Notes: 'Other Provinces' includes the following provinces: Alberta (2 projects), Quebec (4 projects), Saskatchewan (4 projects), Nunavut (1 project), Nova Scotia (1 project), New Brunswick (6 projects), Northwest Territories (1 project), Manitoba (2 projects), Multiple (1 project).

Table A3: Variable Descriptions (Preliminary DA Model - Capital Cost)

Variable	Type	Description
Capital Cost 1	Indicator	Project capital cost is less than or equal to $63.1 million
Capital Cost 2	Indicator	Project capital cost is between $69.9 and $132 million
Capital Cost 3	Indicator	Project capital cost is between $142.8 and $249.4 million
Capital Cost 4	Indicator	Project capital cost is between $252.6 and $543.8 million
Capital Cost 5	Indicator	Project capital cost is greater than or equal to $550 million
Time Period: 1987 - 2006	Indicator	1= Tendered during 1987-2006; 0 = Not tendered during 1987-2006
Time Period: 2007 - 2010	Indicator	1= Tendered during 2007-2010; 0 = Not tendered during 2007-2010
Time Period: 2011 -	Indicator	1= Tendered in or post 2011; 0 = Not tendered in or post 2011
Provincial Dummies	Indicator	Provincial dummies: Ontario; British Columbia; Other Provinces
Sector Dummies	Indicator	Sectoral dummies: Hospitals & Healthcare; Transportation; Other Sectors

Table 4: Relationship Between Tendering Duration and Project Size

	Tendering Duration (Months)			
Explanatory Variables: Project Size ($100 million)	**(1)**	**(2)**	**(3)**	**(4)**
Capital Cost	0.3064*	0.9223**		
	(0.1835)	(0.4391)		
Capital Cost Squared		-0.0002		
		(0.0001)		
Contract Agreement Value			0.1608**	0.3055**
			(0.0728)	(0.1548)
Contract Agreement Value Squared				-0.0000
				(0.0000)
Constant	17.7225***	16.3710***	18.0980***	17.5667***
	(1.4303)	(1.6661)	(0.8085)	(0.9512)
R^2	0.04	0.07	0.03	0.04
Observations (N)	72	72	146	146

Notes: (1) The dependent variable (months) is a count variable indicting the number of months from the time a PPP project was advertised to the date the contract was finalized; (2) Robust standard errors are reported below the coefficients in parentheses; (3) *** denotes significance at 1%, ** denotes significance at 5%, and * denotes significance at 10%.

Table 5: DA Results for Tendering Periods

Explanatory Variables	Tendering Duration (Time Ratios) (1)	(2)	(3)
Quintile 2	1.603***	0.911	0.974
	(0.234)	(0.098)	(0.084)
Quintile 3	1.388**	1.063	1.064
	(0.222)	(0.110)	(0.082)
Quintile 4	1.421*	1.000	0.928
	(0.258)	(0.101)	(0.087)
Quintile 5	2.457***	1.292**	1.210
	(0.635)	(0.166)	(0.144)
Time Period: 2007 - 2010	0.732*	0.954	0.879*
	(0.130)	(0.078)	(0.068)
Time Period: 2011 -	0.606***	0.935	0.848
	(0.102)	(0.097)	(0.093)
Shortlisted Bids: 1 to 2			1.343**
			(0.174)
Shortlisted Bids: 4 or More			0.939
			(0.124)
Ontario	0.935	0.904	1.165**
	(0.100)	(0.071)	(0.078)
Alberta & Quebec		1.081	1.175
		(0.136)	(0.142)
Other Provinces*	1.315**	1.009	1.229
	(0.160)	(0.183)	(0.334)
Hospitals & Healthcare	1.315***	1.076	1.036
	(0.115)	(0.109)	(0.096)
Justice/Corrections & Government Services		1.230*	1.035
		(0.146)	(0.110)
Other Sectors*	1.646***	0.920	0.796**
	(0.201)	(0.110)	(0.087)
BFM/DBFM/DBFO/DBFOM			1.373**
			(0.200)
Ln/Sigma:	-1.053***	-0.989***	-1.172***
	(0.136)	(0.080)	(0.087)
Observations (N):	72	142	130

Notes: (1) The dependent variable (months) is a count variable indicting the number of months from the time a PPP project was advertised to the date the contract was finalized; (2) Robust standard errors are reported below time ratio coefficients in parentheses; (3) *** denotes significance at 1%, ** denotes significance at 5%, and * denotes significance at 10%; (4) Capital cost is used as a proxy for project size in the DA model reported in Column 1; (5) Contract agreement value is used as a proxy for project size in the DA models reported in Columns 2 and 3; (6) Alberta & Quebec are included with Other Provinces in the first DA model reported in Column 1; (7) Justice/Corrections & Government Services are included with Other Sectors in the first DA model reported in Column 1; (8) The base category for capital cost dummies used in Column 1 represent projects which are less than or equal to $63.1 million; (9) The base category for the contract agreement value dummies used in Columns 2 and 3 represent projects which are less than or equal to $92 million; (10) The base category for the time period dummies is 1987 - 2006; (11) The base category for the shortlisted bid categories is 3; (12) The base category for provincial dummies is British Columbia; (13) The base category for the sector dummies is the Transportation sector; (14) The base category for the PPP model categories is BF/DBO.