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A transaction costs-based model to choose PPP procurement procedures

PPP
procurement
procedures

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Abstract

Purpose – The purpose of this paper is to develop a decision model for choosing the tendering procedure in PPP that minimizes the transaction costs borne by the public sector.

Design/methodology/approach – A conceptual model that relates the procurement procedures described in the EU legal framework to launch PPPs and the transaction costs, considering the level of information managed by each procurement procedure has been developed. The authors use this conceptual model to develop propositions about the impact that specific project- and country-related factors have on the choice of the procurement procedure that minimizes the transaction costs.

Findings – The application of the proposed model to the case of the Italian highway “Cispadana” shows its usefulness in orienting the public authority’s choice between the different tendering procedures, taking into account project- and country-related factors.

Research limitations/implications – The present study fills the gap existing in the literature on transaction costs of PPP projects and the procurement procedure used to launch those projects by developing a model that relates the level of transaction costs with a set of key factors, namely the level of information managed during the tendering process, the number of bidders, the project size, the project complexity, and the institutional environment.

Practical implications – As for practitioners, the main contribution of this study lies in offering a tool for supporting the public authority in the decision-making process about the tendering procedures in PPPs without imposing the selection of a specific procedure.

Originality/value – The approach developed provides a new tool to support the contracting authority in the design and choice of the tendering procedures in PPP.

Keywords PPP, Public sector, Transaction costs, EU legal framework, Public procurement procedures, Tendering process

Paper type Research paper

1. Introduction

The tendering processes of PPP reveal more complicated than those of conventional procurement for two main reasons. First, the transaction in PPP involves not only the design and construction of the infrastructure but also the operations and finance, this requires that the evaluation and selection are based on a wide set of parameters. Second, governments should assure competition among private participants, this increases the number of potential bidders to be evaluated.

The structure of the tendering process in PPP results as a combination of two relevant aspects: the phases of tendering process; the awarding methods used to rank candidate partners for PPP and choose the best one (Ahadzi and Bowles, 2001; Zhang, 2004).

As regards the first aspect, the following three main phases can be distinguished in the tendering procedure (Kwak *et al.*, 2009; Tiong and Alum, 1997; To and Ozawa, 2007; Wang and Dai, 2010):

- (1) prequalification of tenderers is aimed at reducing the number of interested tenderers to a shortlist of reputable and experienced tenderers, thus avoiding unnecessary tendering costs of weaker bidders;



- (2) bid evaluation consists in the selection of one or more among qualified bidders based on their proposals evaluated in accordance with a set of predefined evaluation criteria; and
- (3) negotiation with preferred tenderers consists in the negotiation prior to the final awarding with one or a few preferred tenderers.

Studies about awarding methods used to rank candidate partners for PPP distinguish between those used for tenderer prequalification and those for bid evaluation. These methods may adopt simple or complex evaluation criteria for choosing the best among the candidate partners for a PPP project (Zhang, 2004, 2005a; Wang and Dai, 2010).

The higher complicity of the tendering processes in PPP compared to conventional procurement increases tender costs (Liu and Wilkinson, 2014). Birnie (1997) found that tender costs for PFI projects in the UK ranged from 0.48 to 0.62 per cent of the total project costs, which are higher than those for conventional procurement (i.e. design-build projects (0.18-0.32 per cent) and traditional design-bid-build projects (0.04-0.15 per cent)). Other estimates about impact of tendering on total PPP cost are even much higher, until to 10 per cent (Zhang, 2005b).

Therefore, although PPPs can help government to fill the gap between available public finance and needed resources and may offer considerable benefits and significant savings over the entire life cycle of the project, they may increase the cost of procuring, monitoring, and enforcing contracts, i.e. transaction costs, much more than traditional procurement of public investment projects (Soliño and de Santos, 2010; Gerstlberger and Schneider, 2013). Researchers that investigate the role of transaction costs in PPPs have stressed the need for taking into account the amount of transaction costs when take decisions on PPPs, which must be set against any benefits in terms of economic efficiency incentives (Zitron, 2006).

Nevertheless, the literature is short of studies and methodologies that guide public managers in choosing the optimal tendering procedure that minimizes transaction costs.

Filling this gap needs to take into account two main issues. First, PPP tendering procedures manage different levels of information, according to their phases and awarding methods to rank candidate partners, and consequently bears different amount of transaction costs. Second, several project- and country-related factors may affect transaction costs of a PPP project during the procurement.

To the best of our knowledge, only one study aims at analyzing the possible influence that procurement mechanism has over transaction costs in PPP projects (Soliño and de Santos, 2010). In particular, by carrying out a regression analysis on empirical data, they find that the type of project, the capital value of the project, and the procurement procedure are significant variables to explain transaction costs for the public authority in the procurement phase of PPP projects.

Our paper contributes to advance the knowledge on this topic in two directions. First, we develop a conceptual model that relates the procurement procedures described in the EU legal framework to launch PPPs, namely Open procedures, Restricted procedures, Negotiated procedures and Competitive Dialogue, and the transaction costs, considering the level of information managed by each procurement procedure. Second, we use this conceptual model to develop propositions about the impact that specific factors have on the choice of the procurement procedure that minimizes the transaction costs, enriching the list of factors considered in the empirical analysis of Soliño and de Santos (2010) by considering both project- and country-related factors.

The paper is structured as follows. Section 2 discusses the transaction costs associated to PPPs and describes the procurement procedures described in the EU legal framework to launch PPPs in terms of their phases and awarding methods for ranking candidate partners. Section 3 presents the conceptual model that relates the EU procedures and the transaction costs, considering the level of information managed by each procurement procedure.

In Section 4 we use the conceptual model to formulate propositions on the impact that specific project- and country-related factors have on the choice of the procurement procedure that minimizes the transaction costs.

Finally, Section 5 presents the application of the model to the case of the Italian toll highway “Cispadana”. Section 6 discusses the findings. Some final remarks conclude the paper.

2. Transaction costs and PPP tendering process

2.1 Transaction costs in PPP

Transaction costs are usually divided into two categories: *ex ante* or front-end transaction costs (EATCs) and *ex-post* or back-end transaction costs (EPTCs) (Williamson, 1985), that in construction projects are referred, respectively as pre-contract transaction costs and post-contract transaction costs (Li *et al.*, 2014).

EATCs refer to the tasks of defining, negotiating, and maintaining an agreement. They include search and information costs, i.e., transaction costs incurred in determining whether the required good is available on the market, its lowest price and so on, and bargaining costs, i.e., costs to reach an agreement and draft an appropriate contract. EPTCs include the monitoring and enforcing costs, due to the need for monitoring that the other party fulfils the terms of the contract and taking an appropriate action if not (Arrow, 1974; Williamson, 1981).

The literature on transaction costs recognizes as crucial the issue of measuring transaction costs, since these are observable only after the fact and their assessment relies on proxies and indirect measures (Lipson, 2004).

Transaction costs related to the various procurement situations vary on the basis of the amount of information to be processed and codified. The higher the customization (i.e. uniqueness and uncertainty) of the supply, the more its transaction needs the exchange and sharing of uncoded (or less codified) knowledge and information. Quantity and level of codification, and therefore transaction costs, vary significantly according to what is transacted (Costantino and Pietroforte, 2005). If we consider standard supplies, their procurement process is characterized by a reduced amount of information with high levels of codification, a decreased risk of contractual hazard, and opportunistic behaviour. If we consider customized supplies, their procurement process is characterized by an increased amount of information with varying extents of codification and an increased risk of contractual hazards and opportunistic behaviour.

Focusing on PPPs, procurement situations are much more uncertain than those associated with conventional procurement, thus increasing the level of information to be managed (Soliño and de Santos, 2010) and causing significant transaction costs (Ho and Tsui, 2009).

In PPPs, several entities with different goals participate to the transaction, so increasing the probability that opportunistic behaviours rise from all sides and making the negotiations more expensive (Jacobson and Choi, 2008). The complexity and uncertainty of trade relationships, together with their long contractual terms, imply that it is impossible to plan for every potential contingency and that, even if every

contingency could be predicted, it would be probably difficult to write down these plans in a contract between two parties that is enforceable by law. In other words, the contracts are incomplete and therefore must constantly be revised or renegotiated as time goes on (de Bettignies and Ross, 2004).

Dudkin and Väilä (2005), focusing on PPPs in UK, find that the costs related to the only process of procurement will amount on average to well over 10 per cent of the capital value of the project.

2.2 PPP tendering procedures within the EU

The EU legal framework on public procurement, Directive 2004/18/EC of the European Parliament and Council, on the coordination of procedures for the award of public works contracts, public supply contracts, and public service contracts (European Union, 2004), outlines four different procurement procedures for the award of public contracts, namely: Open procedures, Restricted procedures, Negotiated procedures, and Competitive Dialogue.

Open procedures are defined as those whereby any interested economic operator may submit a tender. This procedure enhances competition in the tendering process since it does not reduce the number of participants through the prequalification. It also requires that the contracting authority has a clear understanding of its own objectives to provide advanced bidding documentation in which the main features of the project are well defined, since tenderers are binding and cannot be changed or negotiated during the procedure. The contract is awarded on the basis of the “most economically advantageous tender”. Accordingly, in terms of phases and methods adopted, the Open procedure requires only the bid evaluation phase carried out by using simple methods.

Restricted procedures are those in which only economic operators invited by the contracting authority after a prequalification phase may submit a tender. The awarding process is similar to that of the Open procedure. Thus, Restricted procedures include two phases, the prequalification of tenderers and the bid evaluation, and may use simple or complex evaluation criteria for ranking candidate partners.

Negotiated procedures are those where the contracting authorities select bidders after a prequalification phase and negotiate the terms of contract with one or more of these. In each phase of the procedure, the number of participants is reduced until the preferred bidder is finally chosen, although negotiations continue in this last stage.

The Competitive Dialogue is a procedure in which any economic operator may request to participate and whereby the contracting authority conducts a dialogue with the candidates admitted to the procedure, with the aim of developing one or more suitable alternatives capable of meeting its requirements, on the basis of which the chosen candidates are invited to tender. Even though the Competitive Dialogue is more structured and regulated than the Negotiated procedure, both the procedures include all the three phases: the prequalification of tenderers; the bid evaluation; and negotiation with preferred tenderers.

3. Transaction costs in PPP tendering process: the conceptual model

Tendering procedures handle different level of information (Lingard *et al.*, 1998), due to the different phases to be implemented in the tendering process and the awarding methods for ranking candidate partners.

Such information (*I*) can be defined as the information to be gathered and processed by the public authority during the tendering process in order to qualify the bidders and evaluate bids. It varies according to the phases, the methods, and criteria adopted by the procedure.

More simple procedures, such as Open procedures, deal with a low level of information before the partner selection. In absence of the prequalification phase, there is no need for reviewing the competences of all prospective bidders, thus causing the likelihood of having *ex post* adaptation and changes to be an important feature of the transaction, and the need to manage *ex post* a great amount of information. It is in fact widely recognized that the prequalification helps in narrowing the bidders to those with a wider experience in similar projects and stronger financial reliability, which in turns reduces the risk of incompliance with the contract requirements (Al-Reshaid and Kartam, 2005).

More complex procedures, such as the Restricted procedure, the Negotiated procedure, and the Competitive Dialogue, deal with a greater amount of *ex ante* information since the prequalification phase requires the collection and evaluation of prospective bidders' performance. In addition, for the Negotiated procedure and the Competitive Dialogue the negotiation with preferred tenderers brings to a more detailed contract that supports efficiency and effectiveness through the life of the transaction. The greater *ex ante* information to be managed reduces the ambiguity on expected performance thus reducing the amount of *ex post* information requirements and the probability of *ex post* adaptation and changes (Hensher and Houghton, 2004).

Figure 1 shows the amount of information characterizing each type of EU tendering procedure.

Therefore, as highlighted in Subsection 2.1 on the relationships between TC and *I*, each tendering procedure will be characterized by different levels of transaction costs since it manages different amount of information.

Specifically, on one extreme the Negotiated procedure and the Competitive Dialogue are characterized by high costs for collecting and evaluating information on all prospective tenderers for the purpose of making a decision on the partner to be selected (high level of EATCs), thus increasing bargaining costs (costs to reach an agreement and draft an appropriate contract). Contrarily, the EPTCs for monitoring and eventually enforcing the contract will be reduced, since the incompleteness of the contracts is reduced and the selected partner would be less likely to engage in opportunistic behaviour. On the other extreme, the Open procedure manages little information about prospective tenderers prior to the award of the contract causing a low level of EATCs. However, it is likely that EPTCs will be high, due to the need for close monitoring of private party activities and the increased possibility of costly legal disputes and claims. To sum up, the procedures that manage a few amount of information *ex ante*, i.e., low EATCs, are likely to cause a high degree of contract incompleteness, this in turn causes high EPTCs.

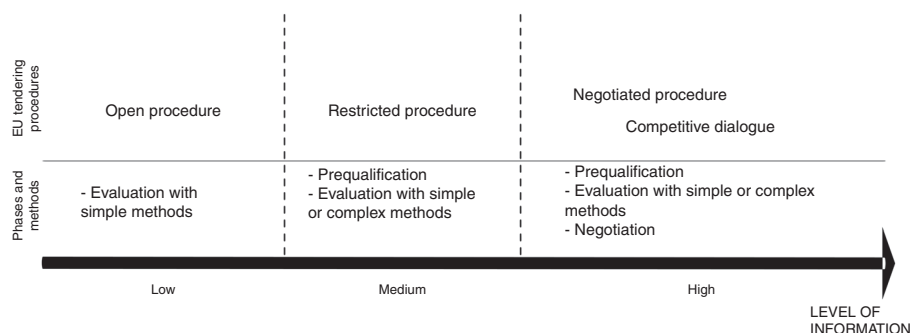


Figure 1.
Information level
characterizing
tendering procedures

Therefore, if I is the level of information to be managed in the tendering procedure, EATCs are increasing with I , while the EPTCs are decreasing with I . According to the theoretical model of the relationship between EATCs and EPTCs, information, and total transaction costs proposed by Lingard *et al.* (1998), EATCs and EPTCs are plotted vs the level information as increasing and decreasing concave up curves, respectively.

The curve of total transaction costs is derived as the sum of the two components and assumes a concave up shape characterized by a decreasing slope in the first part, a minimum, and an increasing slope in the last part.

Based on the above discussed constructs on the relationship between the EU procurement procedures and the information, as well as on the relationship between the information and transaction costs, we develop the conceptual model that relates the EU procurement procedures and transaction costs. According to the model, shown in Figure 2, the tendering procedure that minimizes the transaction costs is the Restricted procedure.

4. Impact of project- and country-related factors on PPP tendering process

The transaction costs of a PPP project during procurement phase are affected by several factors, such as project country, economic sector, project size, project complexity, procurement time, number of bidders (Dudkin and Vålilä, 2005; Farajian and Cui, 2010). Factors influencing transaction costs can be grouped in two categories: project-related factors, such as project scale, project complexity, and project structure; country-related factors, such as the institutional environment in which the project is developed (Ho and Tsui, 2009).

We analyze how these factors affect transaction costs in the PPP tendering procedure, by modelling the transaction costs as a function of five variables: the level of information (I), the size of the project (PS), the number of bidders (NB), the level of complexity of the project (PC), and the institutional environment (IE):

$$\text{Transaction costs} = f(I, PS, NB, PC, IE) \tag{1}$$

Notice that the variable I , defined as the level of information (I) to be gathered and processed during the tendering process, is not a function of all the other four

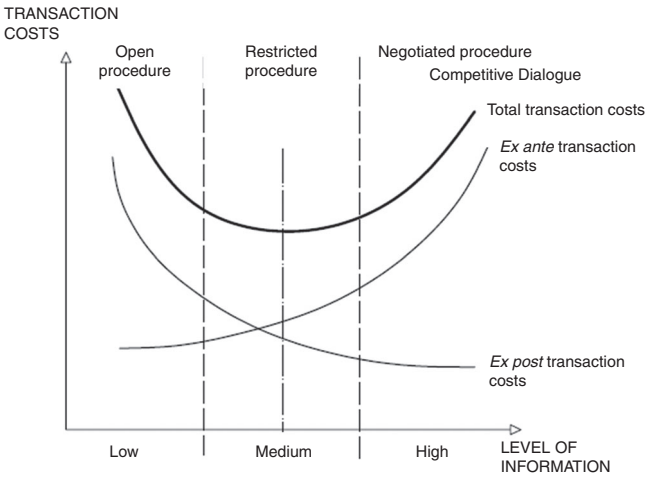


Figure 2.
Conceptual model

Source: Adapted from Lingard *et al.* (1998)

independent variables (PS, NB, PC, IE) and its amount is determined by the inner characteristics of the Open procedure, the Restricted procedure, the Negotiated procedure, and the Competitive Dialogue (Figure 1). To put it differently, if one of the four factors changes, the phases, the methods and the criteria adopted by the specific tendering procedure do not change, but the procedure itself has to deal with a different number of bidders, or a different project size, or issues with a different complexity, or different institutional environments, thus causing a variation of the transaction costs.

4.1 The project size

The project size can be measured in terms of financial investment required by the project. According to the European Investment Bank, the level of transaction costs in the procurement of infrastructure in PPP projects are, on average, about 10 per cent of the capital value of the project, while for the public sector it is about 2-3 per cent. Empirical studies reveal that the EATCs borne by the public sector for small size projects (capital value below £25 million) are significantly higher than those for bigger projects in terms of the percentage of the total capital value of the project (Dudkin and Väilä, 2005). Such an inverse relationship occurs because many of the transaction activities included in the tendering procedure stay the same, no matter what the size of the project (Farajian and Cui, 2010). Therefore, changes in the project size cause small changes in EATCs, so that these variations can be considered less important than in other cases.

On the contrary, EPTCs increase when the project size increases, due to a greater effort posed by the public sector in the monitoring process (Torres and Pina, 2001), and – of course – to the related enforcement costs. Consequently, when the project size increases, EPTCs increase more for simple procedures (i.e. the Open procedure) rather than for complex ones (i.e. the Negotiated procedure and the Competitive Dialogue); since the monitoring process will be more complex and will require a greater effort when the information managed in the tendering process is low:

$$EPTCs \propto \frac{PS}{I} \quad (2)$$

- P1.* The higher the project size, more complex will be the tendering procedure (i.e. the Negotiated procedure and the Competitive Dialogue) that minimizes transaction costs.

4.2 The number of bidders

EATCs could be expected to increase when the number of bidders increases because of a higher amount of information to be managed during the project initiation and procurement process. In particular, when the number of bidders increases, EATCs increase more for complex procedures (i.e. the Negotiated procedure and the Competitive Dialogue) rather than for simple ones (i.e. the Open procedure). The information managed both in the Negotiated procedure and in the Competitive Dialogue is, in fact, higher due to the higher number of phases characterizing the procedure itself that should be replicated for each bidder see the following equation:

$$EATCs \propto NB \cdot I \quad (3)$$

EPTCs are generally higher when the number of bidders is particularly low, because the consequent absence of competition is likely to result in a higher probability of

opportunistic behaviours and subsequent contract renegotiation during the project life cycle. At the same time, EPTCs increase with the number of bidders, because the high level of competition reduces the effort of the participants in preparing the bid as they perceive a low probability of winning the tender (Dudkin and Vålilä, 2005). Consequently, it is possible to assume a *U*-relationship between the EPTCs and the number of bidders, as shown in Figure 3.

Empirical studies on real PPP projects show that the average number of participants in a bidding process ranges mostly from two to four (Estache *et al.*, 2009), accordingly we do not consider the rising part of *U*-relationship.

Furthermore, when the number of bidders increases, EPTCs decrease less for complex procedures (i.e. the Negotiated procedure and the Competitive Dialogue) rather than for simple ones (i.e. the Open procedure). In fact, the greater level of information managed both in the Negotiated procedure and in the Competitive Dialogue reduces the probability of renegotiation and, at the same time, the higher number of bidders improves competition among them, resulting in a lower probability of contract renegotiation during the project life cycle:

$$EPTCs \propto \frac{1}{NB \cdot I} \quad (4)$$

- P2. The higher is the number of bidders, more simple will be the tendering procedure (i.e. the Open procedure) that minimizes the transaction costs.

4.3 The project complexity

The project complexity depends on a wide range of factors, namely technical, legal, political, and economic, embedded into the entire PPP project life cycle

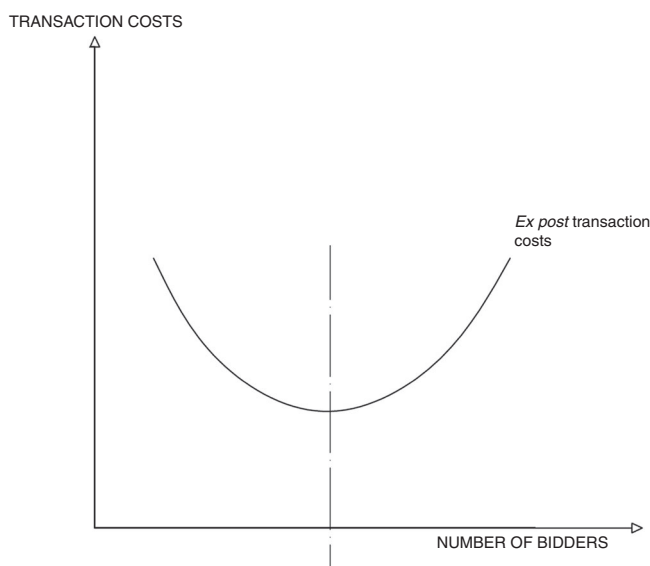


Figure 3.
The U-relationship
between the EPTCs
and the number
of bidders

(De Meyer *et al.*, 2002). However, it is possible to identify two primary sources of complexity (Boushaala, 2010; Gidado, 1996):

- (1) design and technological complexity of the construction process; and
- (2) managerial complexity of the operating phase.

The complexity of the construction process will require a great amount of information to be managed in the first phase of the procurement process (*ex ante* information). The complexity of the operating phase will increase the effort in the monitoring process and the likelihood of having *ex post* adaptation and changes (i.e. renegotiation). These increase the need to manage *ex post* a great amount of information.

As a result, the project complexity increases transaction costs.

In general terms, EATCs increase more for complex procedures due to the greater level of information to be managed in each phase of the procedure:

$$EATCs \propto PC \cdot I \quad (5)$$

On the contrary, EPTCs increase more for simple procedures: lower the level of information managed in the tendering process, greater the effort in the monitoring process and the likelihood of having *ex post* adaptation and changes (i.e. renegotiation):

$$EPTCs \propto \frac{PC}{I} \quad (6)$$

In particular, three situations can be hypothesized:

- (1) EATCs and EPTCs increase in the same manner assuming a same level of complexity in the construction process and operating phase (Equations (5) and (6)):
- P3. When the complexity in the construction process and operating phase is the same, the project complexity does not affect the choice of tendering procedures.
- (2) EATCs increase more than EPTCs (Equations (7) and (8)), assuming that the complexity of the construction process is higher than the complexity of the operating phase:

$$EATCs \propto j \cdot PC \cdot I \quad (7)$$

$$EPTCs \propto \frac{PC}{I} \quad (8)$$

Where the factor j is greater than 1: the higher the complexity of the construction process compared to the complexity of the operating phase, the higher the value of j :

- P4. The higher the complexity in the construction process compared to the complexity of the operating phase, more simple will be the tendering procedure (i.e. the Open procedure) that minimizes the transaction costs.
- (3) EPTCs increase more than EATCs (Equations (9) and (10)), assuming that the complexity of the operating phase is higher than the complexity of the construction process:

$$EATCs \propto PC \cdot I \quad (9)$$

$$EPTCs \propto k \cdot \frac{PC}{I} \quad (10)$$

where the factor k is greater than 1: the higher the complexity of the operating phase compared to the complexity of the construction process, the higher the value of k :

- P5. The higher the complexity of the operating phase compared to the complexity of the construction process, more complex will be the tendering procedure (i.e. the Negotiated procedure and the Competitive Dialogue) that minimizes the transaction costs.

4.4 PPP administration practice and policies

The institutional environment characterizing the country or state in which the PPP project is constructed affects many elements that determine the maturity level of the PPP programmes, including the legal system, PPP administration practices, PPP policies (Farajian and Cui, 2010). Having a good legislation base, having enough experience in terms of previous PPP contracts, having enough resources in-house in terms of experienced staff and consultants make PPP programmes mature and effective (Ho and Tsui, 2009), this, in turn, impacts on transaction costs in PPPs.

EATCs could be expected to decrease when the institutional environment determines a higher maturity level of the PPP programme, because of having a legal support for PPPs, having experience with other projects using PPP as delivering method, having codified procedures and well-defined practices make more effective and efficient the information management process during the project initiation and procurement. The resulting efficiency gain is higher when the level of information to be managed is higher. Therefore, when the maturity level of the PPP programme increases, EATCs decrease more for complex procedures (i.e. the Negotiated procedure and the Competitive Dialogue) rather than for the simple ones (i.e. the Open procedure):

$$EATCs \propto \frac{I}{IE} \quad (11)$$

EPTCs could be expected to decrease when the institutional environment determines a higher maturity level of the PPP programme. The higher the maturity level of the PPP programme, more effective are the mechanisms in discouraging or preventing opportunistic behaviours and consequent contract renegotiation during the project life cycle. Such effect is boosted for simple procedures (i.e. the Open procedure) where greater is the effort in monitoring process and higher is the likelihood of having renegotiation:

$$EPTCs \propto \frac{1}{I \times IE} \quad (12)$$

- P6. An institutional environment with a higher maturity level of the PPP programme reduces the transaction costs of the tendering process, thus fostering the use of complex procedures (i.e. the Negotiated procedure and the Competitive Dialogue).

5. The empirical study: the case of Italian toll highway “Cispadana”

The developed model was applied to a PPP project for the construction and operation of the Italian toll highway “Cispadana”, a 67 Km highway which links Reggio to Ferrara in Emilia Romagna (a Northern Italy region), in order to support the public decision maker in choosing the procedure that should be used to procure the project to minimize the transaction costs.

The regional government wants to deliver this facility as a build-operate-transfer concession for 49 years and six months, following the Italian regulation for PPP formulated by the Code of Public Contracts (Law 163/2006) that implements the Directives 2004/17-18/CE.

As for the technical characteristics of the project, two different options are considered: building a small part of the project, i.e., a few number of lines and a small length, and deferring the decision of expanding the road in the future; building the whole project of the highway at once.

The tolling system for the highway “Cispadana” has been designed according to the solution traditionally used in Italy, this is a mix of manual collection, automatic machines reading Viacard magnetic cards, and Telepass Automatic Vehicle Identification (AVI). This technological option for tolling, called here Scenario 1, is compared with two different tolling solutions. The first is based on the use of both manual and automatic collection by means of GPRS technology (Scenario 2). The second is based on completely automated tolling (Telepass AVI system), and an enforcement system (cameras) to impose tolls (plus an extra fee) to cars without a transponder (Scenario 3).

To find a private PPP partner the regional government has made a request for bidders, expecting a number of eligible candidates ranging from two to four.

The project characteristics can be associated to the project- and country-related factors presented in Section 4. Specifically, the technical characteristics, namely the length and number of lines of the road, define the project size factor (PS); the tolling system defines the project complexity factor (PC); the expected number of eligible candidates determines the number of bidders (NB); the Italian legal and regulatory framework for PPP defines the Institutional environment factor (IE).

The different project options can be framed into different cases, differing each other only for one factor:

- A base case where only a small part of the project, i.e., a few number of lines and a small length, is built (PS1), two bidders are involved in the tendering process (NB2), the tolling system is that one described in Scenario 1 (PC1).
- Case A, where the whole project of the highway is built at once (PS2) and it is assumed that $PS2 = 2 \times PS1$.
- Case B, where the expected number of bidders is 4 ($NB4 = 2 \times NB2$).
- Case C where the tolling system is that one described in Scenario 2. It is assumed that the complexity of this scenario (PC2) is double than the Scenario 1 ($PC2 = 2 \times PC1$) and that the toll collecting technology has an higher complexity of the operating phase compared to the complexity of the construction process ($k = 2.5$).
- Case D where the tolling system is that one described in Scenario 3. It is assumed that the complexity of this scenario (PC3) is double than the Scenario 1 ($PC3 = 2 \times PC1$) and that the complexity of the construction process is higher than the complexity of the operating phase ($j = 2$).

Being the project developed in Italy, where the legal and regulatory framework for PPP is still weak (Soecipto *et al.*, 2015), all the cases share the same institutional environment factor (IE1). In order to understand the effect of a stronger regulatory framework and an increasing political support to PPP, we consider an additional case (Case E) where we assume $IE2 = 2 \times IE1$, *ceteris paribus*.

Table I synthesizes the characteristics of the considered cases in terms of *PS*, *NB*, *PC*, and *IE* values.

In order to apply the developed model, we start with the operationalization of the conceptual model that relates the EU procurement procedures and transaction costs, in the base case. Data have been collected through semi-structured interviews[1] conducted with five key experts with an engineering background, at least five years of experience in PPPs, and in charge of the procurement procedures for public works in local government offices.

Specifically, for the base case, the key informants were asked to express their opinion, at a ten-point Likert scale, on the level of EATCs and EPTCs for some given levels of information (low, medium, and high) characterizing the tendering procedures. This numbering system is the most intuitive and easy to conceptualize since it offers a form of rating (one to ten) which lies within common experience (Cummins and Gullone, 2000). Figure 4 plots the average of the values given by the key informants, i.e. the level of transaction costs for given level of information. In the base case, the tendering procedure that minimizes transaction costs is the Restricted procedure.

Afterwards, we have investigated how the project- and country-related factors impact on the choice of the procedure that should be used to procure the project to minimize the transaction costs, by analyzing first the impact of each single factor, in a *ceteris paribus* context, and then the joint effect of all the factors.

In the Case A, project size doubles compared to the base case ($PS2 = 2PS1$). As explained in Section 5.1, this change causes a negligible variation in EATCs, while according to Equation (2) increases EPTCs as follows:

$$\begin{aligned} \text{Ex post transaction costs (Case A)} &\propto \frac{PS2}{I} = \frac{2PS1}{I} \\ &= 2 \times \text{ex post transaction costs (base case)} \end{aligned}$$

Case B is characterized by a number of bidders double respect to the base case, this implies an increase of EATCs according to Equation (3) and a decrease of EPTCs that are down by half respect to the base case (Equation (4)).

	Project size (PS)	Number of bidders (NB)	Project complexity (PC)	Institutional environment (IE)
Base case	PS1	NB2	PC1	IE1
Case A	PS2	NB2	PC1	IE1
Case B	PS1	NB4	PC1	IE1
Case C	PS1	NB2	PC2	IE1
Case D	PS1	NB2	PC3	IE1
Case E	PS1	NB2	PC1	IE2

Table I.

Characteristics of the analyzed cases

Note: Notice that the project of the highway “Cispadana” does not have a project option where the project complexity of the construction phase and that of the operating phase increase in the same manner

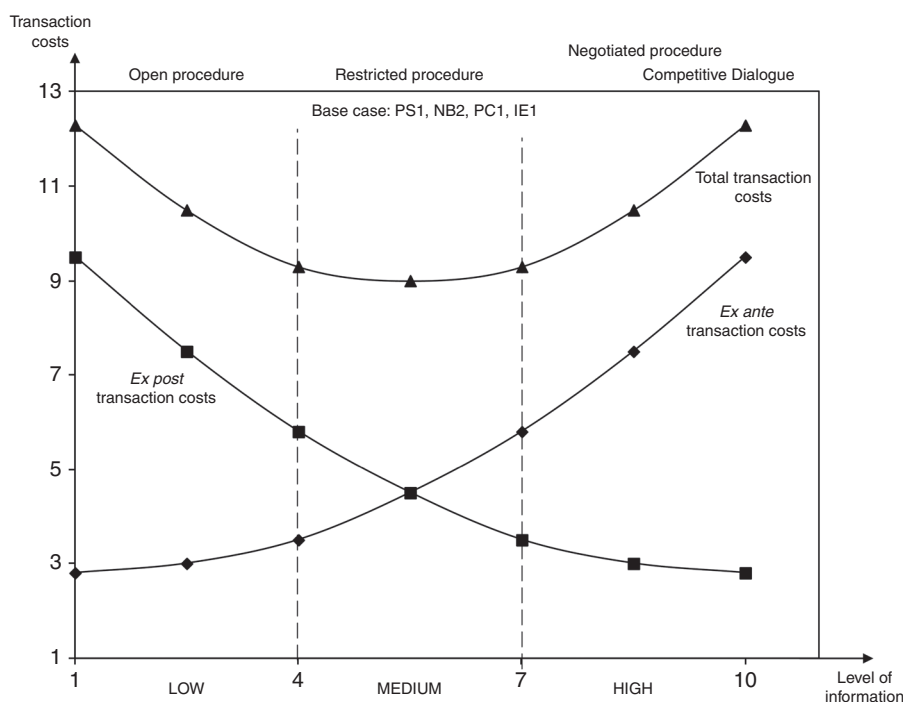


Figure 4.
Trend of transaction
costs for the base
case (*PS1, NB2,*
PC1, IE1)

Cases C and D differ from the base case for the value of PC. In particular, in Case C the increase of project complexity (double respect to the base case) is due to a greater complexity of the operating phase ($k = 2.5$); in Case D the increase of project complexity (double respect to the base case) is due to a greater complexity of the construction process ($j = 2$). Therefore, as described in Section 5.3, the variation of transaction costs can be calculated by Equations (7) and (8) for Case D, and by Equations (9) and (10) for Case C.

Case E assumes that the project is developed in a context where the PPP regulatory framework is stronger and the PPP programme is more mature, we set $IE2 = 2 \times IE1$. As a result, both EATCs and EPTCs decrease according to Equations (11) and (12).

Figure 5 depicts the effect of the variation of the four factors on the EATCs and EPTCs and, consequently, on the selection of the tendering procedure. In the Case A, where the project size increases, the optimal tendering procedure moves towards more complex procedures (i.e. the Negotiated procedure and the Competitive Dialogue) as stated by *P1*. In the Case B, where the number of bidders increases, the tendering procedure that should be chosen to minimize transaction costs moves towards more simple procedures (i.e. the Open procedure), consistent with *P2*. In the Case C, where the project complexity increases and the operating phase is more complex than the construction phase ($k = 2.5$), the optimal tendering procedure moves towards more complex procedures (i.e. the Negotiated procedure and the Competitive Dialogue), as stated by *P5*. In the case D, where the increase of project complexity is due to a greater complexity of the construction process ($j = 2$), the optimal tendering procedure moves towards more simple procedures (i.e. the Open procedure), as settled by *P4*.

In the Case E, where the maturity level of PPP programmes increases, transaction costs decrease and the optimal tendering procedure moves towards more

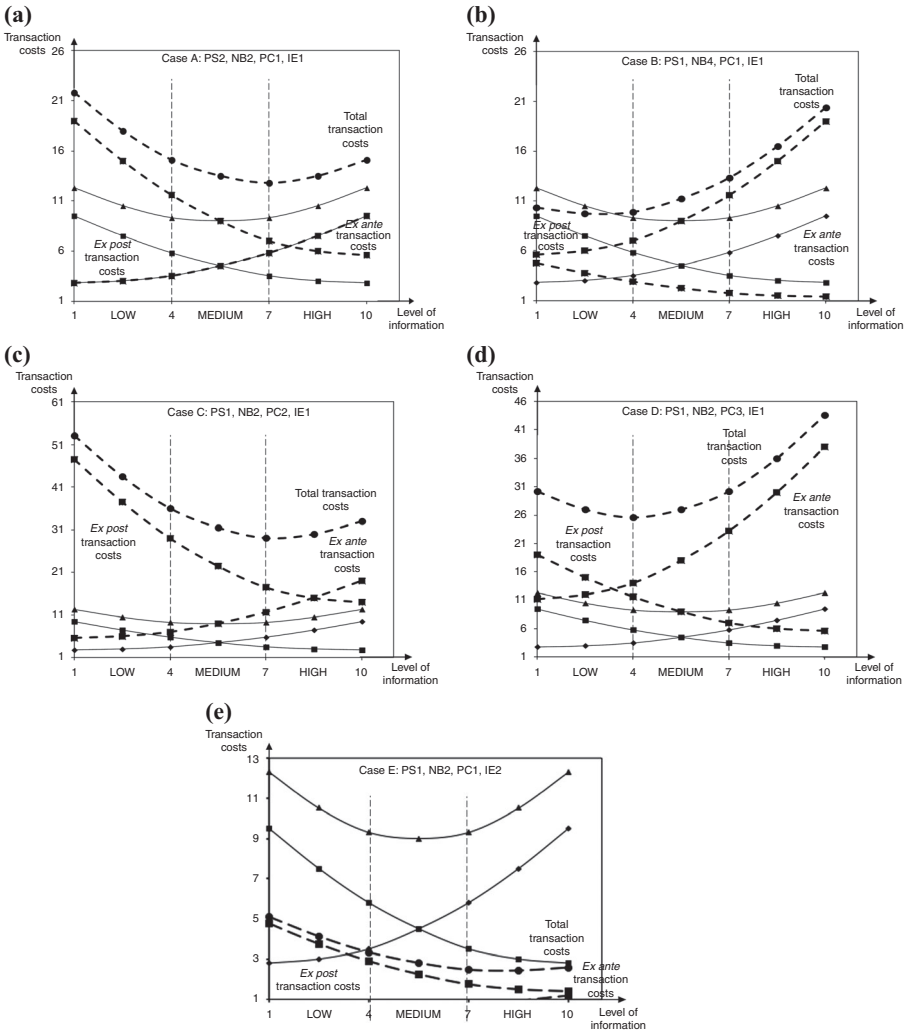


Figure 5.
Effect of the
variation of the
four factors on the
EATCs and EPTCs

complex procedures (i.e. the Negotiated procedure and the Competitive Dialogue), coherent with *P6*.

Finally, the joint effect that the three factors have on the selection of the tendering procedure was analyzed. In particular, the model was applied in order to find the best tendering procedure when the project has the following characteristics: PS2, NB4, PC3, and IE2. To do this, we first calculate the delta values (increase or decrease) of the EATCs and EPTCs caused by changing each factor, in a ceteris paribus context. Then we sum these delta values to the value of EATCs and EPTCs in the base case. Table II shows the results of the analysis.

When the project is characterized by PS2, NB4, PC3, and IE2, the tendering procedure minimizing the total transaction costs moves towards low information-intensive procedures (i.e. the Open procedure) (Figure 6).

Table II.
Results of the
analysis of the joint
effects on EATCs
and EPTCs

	Info	Base case	Δ NB	Δ PC	Δ PS	Δ IE	Joint effects
<i>Ex ante TC</i>							
	1	2.8	2.8	8.4	0	-2.5	11.6
Low (1-4)	2.5	3	3	9	0	-2.6	12.4
	4	3.5	3.5	10.5	0	-3.1	14.4
Medium (4-7)	5.5	4.5	4.5	13.5	0	-3.9	18.6
	7	5.8	5.8	17.4	0	-5.1	23.9
High (7-10)	8.5	7.5	7.5	22.5	0	-6.6	30.9
	10	9.5	9.5	28.5	0	-8.3	39.2
<i>Ex post TC</i>							
	1	9.5	-4.75	9.5	9.5	-4.8	9.5
Low (1-4)	2.5	7.5	-3.75	7.5	7.5	-3.8	7.5
	4	5.8	-2.9	5.8	5.8	-2.9	5.8
Medium (4-7)	5.5	4.5	-2.25	4.5	4.5	-2.3	4.5
	7	3.5	-1.75	3.5	3.5	-1.8	3.5
High (7-10)	8.5	3	-1.5	3	3	-1.5	3
	10	2.8	-1.4	2.8	2.8	-1.4	2.8

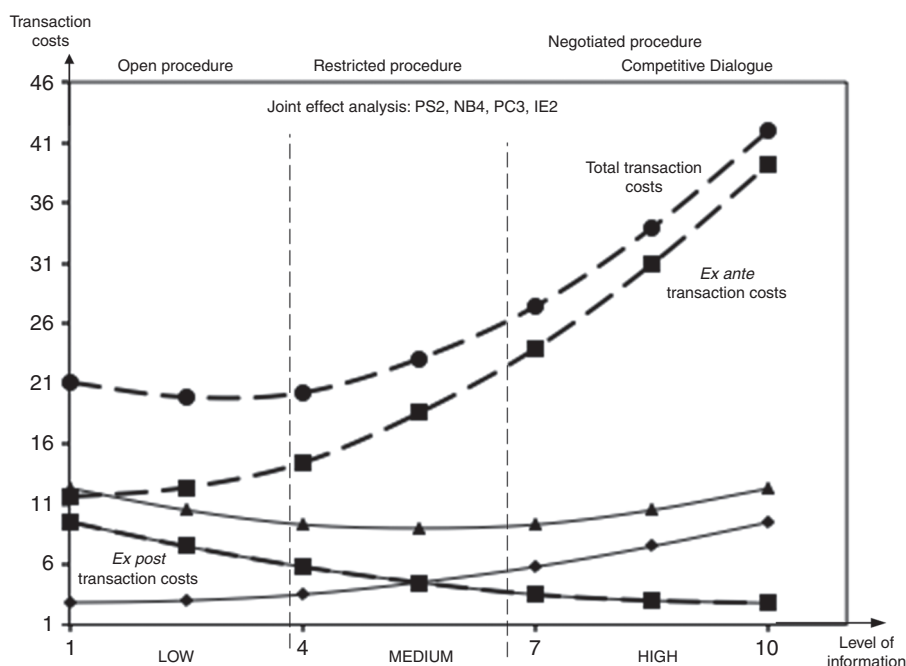


Figure 6.
Joint effect of the
four factors on
transaction costs

6. Discussion

In this paper we found how specific factors, namely project- and country-related factors, influence the transaction costs in PPP and then the choice of the tendering procedure that minimizes transaction costs.

Our findings are coherent with the existing public authorities' practices in PPP infrastructure projects. In fact, the Negotiated procedure and the Competitive Dialogue

are recommended for particularly complex contracts where Open and Restricted procedures cannot ensure the award of the contract. Coherently, we find that, when the project size increases and the project complexity increases with an operational complexity higher than the construction one, the Negotiated procedure and the Competitive Dialogue are preferred since they allow to specify all the aspects of the contract so avoiding costly renegotiation.

Furthermore, the experience reveals that, in the majority of countries, the Negotiated procedure and the Competitive Dialogue are always used for PPP, regardless of the level of maturity of their PPP programmes. This seems counterintuitive since the existence of structured guidelines and codified practices, shaped by the public authorities for the tendering of contracts, should reduce the need for specifying all the elements of the contract and hence reduce the use of the Negotiated procedure and the Competitive Dialogue. Our results explain this apparently counterintuitive behaviour. In fact, we find that an institutional environment with a higher maturity level of the PPP programme reduces the transaction costs of the tendering process, thus allowing the use of the Negotiated procedure and the Competitive Dialogue at lower transaction costs.

Finally, we find that when the number of bidders increases the tendering procedure that minimizes transaction costs is the Open procedure. This result matches the top priority of the public sector that is reaching Value for Money (VfM). Since one of the best ways to ensure VfM is encouraging strong competition among the private actors, longer and more complicated procedures (such as Negotiated procedure and the Competitive Dialogue) make the project less attractive to the private sector and undermine competition. Thus they are replaced by more simple procedure (i.e. the Open procedure).

Our results are partially in line with those provided by Soliño and de Santos (2010). In fact, in analogy with our results, the authors empirically observe a positive relationship among transaction costs and the type of the project, the capital value of the project, and the procurement procedure. They conclude that the principal reason for high transaction costs in PPPs is the use of the Negotiated procedure and only under an Open procedure there is room for savings in the tendering process, regardless of the project- and country-related factors. Doing a step forward, we analyze the mutual relationship among transaction costs, procurement procedures, and all the other factors, thus finding which is the impact of these factors on the choice of the procurement procedure that minimizes the transaction costs. Based on this, we are able to provide indications for the use of the different procurement procedures for the award of public contracts under different circumstances sketched by the different factors.

7. Conclusions

This paper provides a conceptual tool to support the contracting authority in the design and choice of the tendering procedures in PPPs. The driver of such decision process is the level of transaction costs borne by the public sector and its aim is the minimization of the transaction costs. The implications of our study are relevant to both the practitioners and researchers in the field of public procurement.

As for practitioners, the main contribution of this study lies in offering a tool for supporting the public authority in the decision-making process about the tendering procedures in PPPs without imposing the selection of a specific tendering.

At present, governments generally select the tendering procedure guided almost solely by the public procurement regulation that outlines the circumstances for the use of the different procurement procedures for the award of public contracts. Such a regulation suggests the use of specific procedures with the main aim of reducing uncertainty and risks and avoiding the project failure, however, it does not deal with the procurement process costs that can undermine efficiency gains and erode VfM. Above all, it doesn't offer a methodological approach to the choice between the different procedures allowed by the laws. That choice is left to the subjective preferences of the managers in charge.

Public authority can easily adopt the proposed tool in conjunction with the public procurement regulation guidelines to have a qualitative (and, in the best cases, quantitative) support to designing and choosing the tendering procedure, thus being compliant with the regulation while obtaining considerable benefits and significant cost savings.

As for researchers, existing studies offer some empirical evidence on transaction costs in PPP projects and investigate principal elements causing transaction costs, proving that there is room for significant cost savings in the tendering of PPP projects. Very few works have analyzed the relationship between transaction costs of PPP projects and the procurement procedure used to launch those projects. Yet, they do not provide any instruments able to support the design and the choice of the tendering procedure to minimize transaction costs. The present study fills this gap by developing a conceptual model that relates the level of transaction costs with a set of key factors, namely the level of information managed during the tendering process, the number of bidders, the project size, the project complexity, and the institutional environment, and that can be easily applied as a supporting tool in the decision-making process.

The main limitation of this study is that, although transaction costs are highly relevant for both parties involved in the transaction, public sector and bidding companies, we focus on the transaction costs borne by the public sector who is responsible of choosing the tendering procedures. In a win-win condition and in order to gain efficiency for both parties, further researches will be devoted to extend the model by including the private perspective with the aim of minimizing transaction costs borne by the private.

Finally, the approach we used in the empirical study for relating transaction costs with the level of information based on subjective judgements may be considered a limitation of the proposed model. However, this derives from the inner characteristics of transaction costs that do not allow for accurate estimation, as widely recognized by the literature. Nevertheless, the proposed model – without attempting to measure the amount of transaction costs – can be usefully adopted by the public authority to orient its choice between the different tendering procedures.

Note

1. Semi-structured interviews were adopted as a way of investigation since they are preceded by unstructured dialogues that allow the parties to collect information and instructions useful to develop a keen understanding of the topic of interest. In particular, before asking expert's opinion about the level of EATCs and EPTCs for some given levels of information characterizing the tendering procedures, we have discussed the case study, the definition of *ex ante* and *ex post* transaction costs in PPPs, and the EU procedures in terms of their phases and awarding methods.

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Further reading

Wang, W.-X., Li, Q.-M., Deng, X.-P., Li, L.-H. and Cai, Y. (2007), "Selecting optimal private-sector partner in infrastructure projects under PPP model", *Proceedings of International Conference on Management Science and Engineering (ICMSE 2007)*, Harbin, 20-22 August.

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