5 On the Financial Structure and the Contractual Length of Public–Private Partnerships

Daniel Danau and Annalisa Vinella

5.1 Introduction

Infrastructure projects have two main characteristics. First, the realization of the infrastructure involves huge investments. Second, the project unfolds essentially in two phases, namely construction and operation, between which synergies are very often present. In projects like transport, hospital, and prisons, building the infrastructure diligently may indeed lead to a reduction in the maintenance and operating costs. The contracts between governments and private firms for infrastructure projects display in turn three core features. To begin with, they have a long duration, especially when a large part of the investment is financed with private capital, namely own funds of the firm and bank loans. In that case the operation must remain private for a sufficiently long period of time so that the private investment can be fairly remunerated "as time goes by." In addition, as the projects are long termed and include two phases, the conditions under which the firm will operate are unknown, when the parties meet at the contracting table. Once the parties become aware of the actual operating conditions, each of them is able to evaluate how convenient it is to honor the contract, as compared to any alternative option faced at that time. As the parties lack the ability to commit to particular actions, in general, the contracts are vulnerable to renege, on the initiative of either one or the other party. Lastly, informational asymmetries arise between governments and firms. Although this is standard in agency relationships, peculiar to the contracts for infrastructure projects is that informational asymmetries are related to the very circumstance that such projects include different activities, between which synergies are present.

Many theoretical articles have recently been published, focusing on the desirability of involving private firms in infrastructure projects, as

well as on the design of suitable contracts for bringing those projects to efficient outcomes. However, little effort has been made to account for all the aspects aforementioned in a comprehensive manner, hence to investigate how the contractual performance is thereby affected. Once those elements are considered altogether, one realizes that for efficiency to be attained, it is essential to adopt contractual instruments, which are not usually thought of. These instruments are the financial structure of the project and the length of the contract. Concerning the latter, a double option is available. The length of the contract can either be fixed or it can be tailored to the specific realization of the operating conditions. The ways in which these two instruments enhance the contractual performance are complex and not easily approachable. Resting on these considerations, the goal of the present work is to offer an intuitive, little technical explanation of the reasons why decision makers should pay much attention to the choice of the financial structure and the contractual length of infrastructure projects.

Before elaborating further on the analysis to be developed in this work, it is useful to say a few more words on the existing studies. A *first stream of literature* looks at the issues that ensue from the presence of informational asymmetries between governments and firms. The focus is on the presence of moral hazard in construction and the consequences it has on the operating conditions. Specifically, studies like Bennett and Iossa (2006), Martimort and Pouyet (2008), Iossa and Martimort (2015), investigate the desirability of delegating both construction and operation to a single private consortium, rather than relying on two distinct firms, each in charge of one activity. The former kind of arrangement, which is identified as a public–private partnership (PPP), is more and more frequently adopted in practice.[1] According to those authors, the PPP attains a more efficient outcome, as compared to traditional procurement, in which the tasks are separated, because the private consortium internalizes the synergies between construction and operation. *Other studies* focus on the opportunity of involving private capital in the realization of public projects. In particular, Engel, Fischer, and Galetovic (2013) argue that by resorting to private capital, governments can save on the administrative and agency costs associated with the disbursement of funds from the public budget. In practice, it is very often the case that politicians justify the reliance on PPPs as a way to develop infrastructure projects without burdening the public budget. As a matter of fact, involvement of private investment in infrastructure projects has first appeared in the United Kingdom in

the form of a private finance initiative (PFI), despite that there was no rationing experienced on the credit market to raise funds for public investment. In Danau and Vinella (2015a, b), we consider the issue of limited commitment, which leads either to the suboptimal renegotiation or to the early termination of PPP contracts. We find that the private investment as well as the contractual length are effective instruments at fostering cooperation between the partners. In this work, we provide a "ready-for-use" description of some of the lessons ensuing from those studies.

The issue of a suboptimal renegotiation of PPP contracts has received much attention in the literature, though not necessarily with regard to frameworks of limited commitment. Engel, Fischer, and Galetovic (1997, 2001) focus on renegotiation resulting from contractual incompleteness, in the tradition of the studies on transaction costs and incomplete contracts. Their preoccupation is that, if the contract is incomplete, then the firm will seek to obtain a better deal, in the event that it faces unfavorable conditions. As a remedy to this problem, they suggest that the contract stipulate a certain return, which the firm will cumulate during the development of the project, regardless of the operating conditions. Hence, the contract would be complete and contractual frictions would not arise. An important implication of this policy is that the termination date, which is not a contracting variable, will be contingent on the actual state of nature. That is, the termination date will be adjusted during the execution of the contract, in such a way that the firm obtains the return stipulated in the contract, regardless of the realized state of nature. Contracts of this kind are known as *flexible-term contracts*.[2]

While the mechanism proposed by Engel, Fischer, and Galetovic (1997, 2001) is appealing in incomplete-contracting frameworks, it is not necessarily the best solution under limited commitment. In the latter perspective, one can think of the flexible-term contract as being motivated by the possibility of the government being "weak," that is, prone to avoid that the firm incurs financial difficulties, when the project generates a poor cash flow. Situations in which the government has a limited ability to enforce the contract with a reticent firm can be associated with one side of the limited-commitment problem, namely *limited enforcement* (see Estache and Wren-Lewis 2009 for this terminology).

In other situations, as represented in Danau and Vinella (2015a, b), the government may not be weak and, yet, it may welcome

renegotiating the contract, after the firm reneges on it, because the breakup of the partnership would be costly. In its turn the firm may want to renege, regardless of the insurance received at the contracting stage, simply because it expects to reach a better deal. Moreover a strong government may itself take the initiative to renege, thus exposing the partnership to early breakup. The possibility that the government will behave opportunistically, during the operation phase of the project, mirrors the second side of the limited-commitment problem, namely *noncommitment*. Considering noncommitment together with limited enforcement is in fact rather natural. In institutional environments where one party is unable to commit to contractual obligations, it is very plausible that the other party will not commit in turn. Once it is recognized that the government is not necessarily weak, so that renegotiation may also result from the government's opportunism, it becomes apparent that offering a flexible-term contract does not need to be the best remedy under limited commitment. As long as there is some extra benefit to extract from the government in a new negotiation, the firm will attempt to return to the contracting table, regardless of the insurance it receives under the initial deal. In addition, as soon as informational issues, which are also pervasive in PPPs, are accounted for, one would expect the firm to be transferred some risk and, hence, to receive different compensations in different states of nature, at odds with the flexible-term approach. Engel, Fischer and Galetovic (1997, 2001) rely on an incomplete contracting approach to model the vulnerability of PPP contracts. In line with the studies following Laffont (2003), the focus is here on situations where the vulnerability of the contract follows from the lack of enforcement mechanisms in the economy.

The findings in Danau and Vinella (2015a) confirm that when the government is not necessarily weak and information issues are present, the firm's profits should be differentiated across states of nature, indeed. Actually, in that framework, not only the compensation scheme, but also the role that the duration plays, in affecting the contractual performance, differs from the role pointed out in Engel, Fischer, and Galetovic (1997, 2001). This reflects, first, the need to tackle information issues and, second, the circumstance that ex post opportunism is not bound to concern the sole firm but can also arise on the government's side. To catch the relationship between the contractual length and the partners' incentives to renege on the contract, it is essential to consider that for either partner, the convenience to renege, at each moment in

time, depends on the residual duration of the partnership and ultimately on the termination date stipulated in the contract. In addition the convenience to renege depends on what is at stake, for either partner, at each moment in time. In turn this is related to the exact kind and amount of funds invested in the project up-front, which determine what the investors can gain or lose, during the development of the project. It follows that not only the duration of the contract but also the financial structure of the project affects the incentives of the two partners to abide by the respective obligations.

As far as the contract duration is concerned, Danau and Vinella (2015b) highlight another important aspect. In situations where either partner may be reticent to honor the contract, it is useful to make the contractual length contingent on the realized operating conditions. Unlike in Engel, Fischer, and Galetovic (1997, 2001), the reason is that some of the incentive problems are relevant in the good state, and the others are relevant in the bad state. Because the state-dependent approach yields additional flexibility in the determination of the contractual length, as compared to the fixed-term approach, it makes it easier to reconcile information problems and commitment problems across states of nature. Hence the desired outcome is more likely to be attained.

5.1.1 Outline

We proceed in two main steps, following the literature review. We first highlight how to address asymmetric information issues under full commitment (section 5.2). We then focus on a limited-commitment framework. After offering a few relevant examples of limited-commitment problems in practice, we move back to the formal analysis, in order to explain why, under limited commitment, the duration of the contract and the financial structure of the project are essential contractual instruments. We show how they should be set, in order to induce the two partners to abide by their contractual obligations (section 5.3). To conclude, we discuss the practical implications of the theoretical predictions (section 5.4).

5.1.2 Literature Review

It is now recognized that the poorness of enforcement mechanisms is a serious issue in the execution of long-term contracts. While this issue has been recently investigated in the literature on relational contracts (see Levin 2003), it is still underexplored with regard to PPP contracts.

Relational contracts are cast on repeated relationships. In PPPs, instead, the relationship is unique and its duration is endogenous to the contract. From the analysis in Danau and Vinella (2015a, b), discussed above, it is apparent that the contractual length is an essential instrument to have PPP contracts executed, in the absence of enforcement mechanisms. The issue of commitment being limited, in the development of public projects, is also considered in the studies of Laffont (2003) and Guasch, Laffont, and Straub (2006, 2008). These authors are mainly concerned with concession contracts and focus on either government-led or firm-led renegotiation. The results presented in this work evidence that making a proper choice of the contractual length is especially important, and poses more challenges, when *both* the firm and the government, not only one of them, lack the ability to commit.

Among the studies in which contractual frictions stem from contractual incompleteness, most related to our analysis are those of Engel, Fischer, and Galetovic (1997, 2001). They show that, by adjusting the contractual length in the different states of nature, it is possible to eliminate the discrepancy between the discounted streams of profits, which the firm will cumulate, during the development of the project, in those states. They argue that this contractual policy, which fully insures the firm, should be adopted in order to avoid ex post renegotiation. In line with this, one of our findings is that under limited commitment, the firm should be exposed to little risk. In particular, for the partners' opportunism to be lessened, the wedge between the discounted streams of profits, which the firm will obtain through the termination date, in the two states, should be set as low as possible. The lower bound to that wedge is such that the firm is just indifferent between exerting effort and shirking when building the infrastructure. However, unlike in Engel, Fischer, and Galetovic (1997), the amount of risk transferred to the firm does not need to change as the contractual length is adjusted in the different states. This is because in our framework the per-period profits of the firm are endogenous. Thus a certain (desirable) risk transfer can be maintained, when inducing changes in the contractual terms, by compensating those changes with variations in the wedge between the per-period (rather than the cumulated) profits. This possibility proves dramatically useful to discipline the partners in environments in which commitment problems coexist with information problems.

Renegotiation issues in principal-agent relationships have been investigated by Dewatripont (1989), Hart and Tirole (1988), and Rey

and Salanié (1996). They consider situations in which the contract is signed at *interim*, that is, when the agent is privately informed, and the contractual parties have an interest in coming back to the contracting table ex post, that is, when information is revealed and the principal no longer needs to incentivize the agent. In those models the contract must be made robust to renegotiation. Similarly in our framework the contract must be made robust to renege. Yet this involves that not only renegotiation but also early breakup be made unattractive to the parties. As we saw, this task is more complex and subtle in that the desirability to the parties of the allocation resulting from the contractual frictions depends on the relative convenience of the two outside options. Here is where ECAs are helpful. Thanks to them, the debt liabilities can be used strategically to eliminate any benefit from renegotiation, thus ruling out one of those options. This facilitates the task of making the contract self-enforcing.

5.2 Information Issues under Full Commitment

We begin by considering a situation in which the two partners to an infrastructure project, namely a government and a private consortium (henceforth, the firm, for the sake of brevity), commit to their contractual obligations. However, the government suffers from an informational gap vis-à-vis the firm. Albeit full commitment is a hypothetical situation, this approach is useful, as a first step, to enucleate information issues and to discuss their implications. Consistent with previous studies, we will show that the government needs to transfer some risk to the private partner, in order to tackle those issues. To assess how much risk should exactly be transferred to the firm, we refer to the simple analytical framework described hereafter.

5.2.1 Analytical Framework

The construction of the infrastructure involves a cost of $I > 0$. The subsequent provision of the service involves an inner marginal cost of $\theta > 0$, linked to the very characteristics of the infrastructure. To capture the real-world circumstance that the operating conditions are unknown when contracts are signed, we take the value of θ to be uncertain initially. It will be revealed after the investment cost is sunk and the infrastructure is built, at the outset of the operation phase. The operating marginal cost can take a value of θ_l or θ_h. We require that $\theta_l < \theta_h$ so that θ_l represents the good state of nature (the service is less costly) and

Se

θ_h represents the bad state of nature (the service is more costly). In addition, to capture the synergies between construction and operation, we assume that the probability of facing the low cost depends on whether or not the firm exerts an effort in construction. If it does, then the probability is v_1, Otherwise, it is v_0, with $0 < v_0 < v_1 < 1$. The firm may not be willing to exert effort because this causes a disutility of $\psi > 0$.

5.2.2 Information Issues and Financial Structure of the Project

Moral Hazard in Construction

Assume that $\tilde{\mathbb{E}}_i[\theta_i] - \mathbb{E}_i[\theta_i] > \psi$, where $\tilde{\mathbb{E}}_i[\theta_i]$ (resp. $\mathbb{E}_i[\theta_i]$) is the expected operating cost without (resp. with) effort provision. It means that the saving in the expected operating cost, which effort provision grants, overcompensates for the disutility of that effort. Thus effort is socially desirable and the government should motivate the firm to exert it. Denote $\Pi_{i,0}$ the present value, at the contracting stage (date 0), of the stream of profits that the firm is supposed to obtain, during the operation phase, when the true cost is θ_i, $i \in \{l, h\}$. Further denote $\Delta v = v_1 - v_0$.

Result 1 *Effort is exerted in construction, if and only if*

$$\Pi_{l,0} - \Pi_{h,0} \geq \frac{\psi}{\Delta v}. \tag{1}$$

Condition (1) expresses a standard prescription in moral-hazard problems. A wedge must be induced between the compensation in the good state of nature and the compensation in the bad state of nature, as expressed in discounted terms. The wedge must be more important the higher the disutility of effort, and the lower the benefit in terms of enhanced probability of facing the good state. When the compensation scheme is structured according to this prescription, any incentive to shirk in construction is eliminated.

Adverse Selection in Operation

In addition to having an exclusive control on the effort to be provided when building the infrastructure, the firm is in a better position, as compared to the government, to assess the true value of the operating cost. Thus the firm will have an incentive to exploit this informational advantage to raise its return from the partnership, unless that incentive

is eliminated by means of a properly designed compensation scheme. Denote T_i and q_i, respectively, the duration of the contract (i.e., the length of the operation phase) and the level of production chosen by the government, in the event that the cost is θ_i, where $i \in \{l, h\}$. Obviously the government prefers to recommend more production in the good state, so that $q_l > q_h$. Also let r be the discount rate and $\Delta\theta = \theta_h - \theta_l$.

Result 2 *Private information is revealed at the outset of the operation phase, if and only if*

$$\Pi_{l,0} - \Pi_{h,0} \geq \Delta\theta \int_0^{T_h} q_h e^{-rx} dx, \tag{2}$$

$$\Pi_{l,0} - \Pi_{h,0} \leq \Delta\theta \int_0^{T_l} q_l e^{-rx} dx. \tag{3}$$

Conditions (2) and (3) embody two additional prescriptions for a suitable design of the compensation scheme. On the one hand, according to (2), the profit in the good state must be large enough, as compared to the profit in the bad state. If it were not so, then the firm would have an interest in pretending a high cost, when the true cost is low. In exchange for receiving a lower compensation, the firm would appropriate the difference between the claimed total cost ($\theta_h q_h$) and the incurred total cost ($\theta_l q_h$), at each instant during the operation phase, through the termination date T_h. On the other hand, according to (3), the profit in the good state must not be excessively larger than the profit in the bad state. Otherwise, the firm would have an incentive to claim a low cost, when the true cost is high. The compensation that the firm would receive, at each instant during the operation phase, through the termination date T_l, would be so high to offset the penalty simultaneously incurred, as given by the difference between the incurred total cost ($\theta_h q_l$) and the claimed total cost ($\theta_l q_l$).

Interpreted together with result 1, result 2 conveys a neat message. Information issues call for transferring risk to the firm. Nonetheless, risk transfer must be limited.

Irrelevance of the Financial Structure of the Project

Inspection of (1), (2), and (3) evidences that the ability of the government to tackle moral hazard and adverse selection is not affected by the magnitude of the cost of investment (I), hence by the specific way in which this is covered. From this standpoint, the financial structure

of the project does not matter. That is, under full commitment, any combination of public funds and private capital (i.e., own funds of the firm and borrowed funds) can be chosen to finance the project.

5.2.3 Information Issues and Contractual Length

From (1), (2), and (3) it is apparent that the way in which the contractual length is set, in the two possible states of nature, is essential to provide desirable incentives to the firm. The shorter the contract duration when the cost is low, the smaller the opportunity cost, for the firm, of pretending θ_l when the cost is high, hence the stronger the incentive to do so. If T_l is set short, then this incentive cannot be eliminated, unless a sufficiently high compensation is granted to the firm for correctly announcing θ_h. However, when this strategy is followed, it becomes difficult, for the government, to tackle the moral-hazard problem. A firm that receives a high compensation when faced with a high operating cost, is little motivated to exert effort in order to increase the likelihood of facing a low cost. Furthermore the longer the contract duration in the bad state, the more important the benefit that the firm obtains by pretending θ_h, when the cost is low, hence the stronger the incentive to do so. Once these elements are considered altogether, the intuitive conclusion is that restrictions will appear on how little the government can set T_l, and, for any given T_l, on how big it can set T_h, in order to solve the two information problems at once. We will state this result in a moment, after making the following assumption on the magnitude of the disutility of effort, which will be maintained all throughout:

$$\psi \leq \Delta v \Delta\theta \frac{q_l}{r}. \tag{4}$$

To see why we impose (4), suppose this condition is violated. The disutility of effort is so big that shirking cannot be prevented, unless the firm is exposed to much risk. This involves making the compensation to the firm substantially higher in the good state, relative to the bad state. However, in that case it is impossible to persuade the firm to release information in state h, even if the contract has an infinitely long duration in state l. Hence (4) must hold. We are now ready to state the result.

Result 3 *Moral hazard and adverse selection are both addressed, only if*

$$T_l \geq \frac{1}{r} \ln \frac{\Delta v \Delta\theta q_l}{\Delta v \Delta\theta q_l - r\psi}, \tag{5}$$

and when

$$T_l \leq \frac{1}{r}\ln\frac{q_l}{q_l - q_h},$$

$$T_h \leq \frac{1}{r}\ln\frac{q_h}{q_h - q_l\left(1-e^{-rT_l}\right)}. \tag{6}$$

We previously explained that when structuring the compensation scheme in order to address the different information issues, the government faces two potential conflicts. We also said that the first conflict, between moral hazard and adverse selection in state h, can be avoided only if (4) holds. We can now further specify that, for that conflict not to arise, T_l must be set large enough to satisfy (5). Additionally, in order to avoid also the second conflict, between preventing cost exaggeration in state l and preventing cost understatement in state h, T_h must be set below the threshold identified in (6).

A Particular Case: The Fixed-Term Contract

There is a very natural question that arises after drawing result 3, namely whether conditioning the duration of the contract on the true cost, as in the analysis developed so far, does deliver any benefit and is thus to be preferred to the fixed-term option. The relevance of this question becomes apparent as soon as it is observed that in practice, most PPP contractual agreements have a fixed term.

Result 4 *Assume that* $T_l = T_h \equiv T$. *Moral hazard and adverse selection are both addressed, only if*

$$T \geq \frac{1}{r}\ln\frac{\Delta v\Delta\theta q_l}{\Delta v\Delta\theta q_l - r\psi}. \tag{7}$$

Result 4 echoes the content of proposition 1 in Danau and Vinella (2015a). It evidences that, when the contract has a fixed term, there is only one possible conflict between information problems, namely that between inducing effort in construction and eliciting information in state h. As from result 3, avoiding this conflict requires choosing a sufficiently long contractual term. The other potential conflict, between preventing cost exaggeration in state l and preventing cost understatement in state h, never arises with a fixed term. The insight that we can retain is that eliciting information in either state is not an issue, as long as the firm cannot pick, with a false cost claim, more convenient a contract duration than the one corresponding to the true cost.

Irrelevance of Whether the Contractual Term Is Fixed or State Dependent

From results 3 and 4, it ensues immediately that under (4), a suitable contractual length can be found to tackle both moral hazard and adverse selection, whether the term is conditioned on the cost realization ($T_l \neq T_h$) or is fixed ($T_l = T_h \equiv T$). In other words, anything the government can achieve, by offering a contract such that (5) and (6) are met, can also be achieved by means of a fixed-term contract, which complies with (7). Thus, as long as the performance of the PPP is challenged by information issues only, there is no loss of generality in sticking to the usual practice of offering a fixed-term contract to the firm.

5.3 Contractual Length and Financial Structure under Limited Commitment

Under limited commitment the issue of identifying the optimal PPP contract is more complex. As will become apparent in the sequel of the analysis, the two "irrelevance" conclusions, which we drew concerning the financial structure of the project and the fixed or state-dependent duration of the contract, no longer hold. To fix ideas, before making further progress with the formal analysis, we provide a few relevant examples of limited-commitment problems in real world.

5.3.1 Limited Commitment in Practice

Limited Enforcement

Examples of limited enforcement and firm-led renegotiation are pervasive in PPPs. In institutionally weak contexts (developing countries, in general), strong rules of law seldom exist and renegotiation is frequent. Estache and Wren-Lewis (2009) recall that in Ghana the incumbent monopoly for fixed telephony entered the mobile business despite the explicit interdiction to do so. In Tanzania the regulator failed to enforce regional mobile license, and the dominant operator began to expand at the national level. Guasch (2004) and Guasch, Laffont, and Straub (2006, 2008) provide further examples in Latin America and in the Caribbean regions. Although less often, firms renege on contracts also in frameworks where institutions are solid (typically, developed countries) and contracts should be, in principle, more easily enforced, say, by fining firms reluctant to produce. Gagnepain, Ivaldi, and Martimort (2009) detect a progressive increase in the subsidies paid to French

urban transport concessionaires through the contract execution. In the controversial London underground project, the service was taken in house, when Metronet, the consortium in charge of the project, filed for bankruptcy (House of Lords 2010a, b). This suggests that governments are not prone to engage in costly and time-consuming litigations to enforce contracts.

Noncommitment

In developing countries government failure to honor contractual terms is even bigger a concern, as compared to limited enforcement. In those countries, large-scale investments are desperately needed, especially in utilities. However, they are unlikely to take place at all if governments cannot warrant investors' remuneration.[3] In Central and Eastern Europe repeated changes in the political attitude toward partnerships with private firms have challenged and slowed down the development of various infrastructure projects over the last decades. As an illustration, Brench et al. (2005) document the case of transportation projects in Hungary.

5.3.2 Governmental Guarantees under Limited Commitment

Under limited commitment the contract between the government and the firm is vulnerable to the risk of not being executed. Additionally, if the firm takes out a loan to fund (a part of) the initial investment, then also the credit contract is exposed to the risk of not being executed, provided that the firm cannot be compelled to return money to the lender. In turn the firm may be unable to borrow on the credit market. To circumvent this difficulty, the lender should receive a guarantee that the debt will be paid back. We will now explain which kind of guarantees can actually be provided in a PPP. Given the relevance that the participation of external financiers is attached in PPP projects, this aspect has very important practical implications, and yet it is still little explored in the economic literature.

5.3.2 Collateralized and Unprotected Debt

It is sometimes argued that either the assets of the firm or those created through the PPP project should be used to pledge debt collateral (see, for instance, Engel, Fischer, and Galetovic (2013) and Guasch, Laffont, and Straub (2006). However, the effectiveness of collateralizing debt in PPP projects is questionable. To clarify this point, let us first consider a private firm that takes a loan to run a private project. The assets

pertaining to the new project are used to collateralize the debt. If the debt is not paid, then the creditor has the right to either liquidate the assets or use them to reorganize the activity. When a private firm takes out a loan to run a public project, rather than a private one, things are quite different. In the event of default, the activity is undertaken by the government and, possibly, delegated to a new firm. Because most of the assets are sunk in the project, they cannot be liquidated in favor of the creditor. However, even if there are assets that could be liquidated, without compromising the continuation of the project under the new management, the collateral is likely to be ineffective. Under limited commitment any claim by the government that it would not expropriate the creditor is indeed little credible.[4]

5.3.2 Governmental Guarantees and Their Limits in Practice

The government can use "external" means to commit to abide by the obligations acquired with the firm's lender. For instance, one could think of the government as depositing resources with a reliable third party. Such resources should then be released to the lender, in case the firm stops making repayments and the government does not step in to complete the repayments in the firm's place. In practice, a strategy of the kind just described is adopted when a government mandates an export credit agency (ECA) to act as an intermediary, providing cover in the event of any default in payment by a borrower (or its guarantor) under some loan agreement. Originally created as government entities to promote, facilitate, and support the exports of goods and services, starting from the 1990s, ECAs have begun to operate in project financing as well. This practice is now widespread.[5] Moreover in developing countries the World Bank and other multilateral development banks (e.g., the Inter-American Development Bank) provide guarantees that are less subject to project and country limits, as compared to insurance, and are intended to cover debt up to 100 percent of principal and interest. Irwin et al. (1997) stress that if properly managed, these guarantees are crucial at reinforcing governments' resolve to abide by their commitments.

Once it is clear that there is a way, for governments, to tie their hands and honor the guarantees provided to the firms' lenders, it is still to be clarified which practical effect governmental guarantees will have. When a firm defaults and the government intervenes to bail out the activity, debt responsibilities are passed onto taxpayers, with nonnegligible consequences. A particularly good example is the 2002 to 2003

London underground maintaining-and-upgrading project, which we recalled above. At the time when the project was launched, the public sector was uncertain over whether Metronet could raise enough funds to cover the investment. To boost the banks' appetite, during the bidding stage, Transport for London guaranteed 95 percent of Metronet's debt obligations. Eventually Metronet failed and the Department for Transport had to make a £1.7 billion payment to help Transport for London meet the guarantee (House of Lords 2010a, b). The National Audit Office (2008–2009) reports that in addition to facing the failure of the partnership, taxpayers incurred a direct loss of between £170 million and £410 million. Something similar occurred in Mexico in 1990s, when the government embarked on an ambitious road building program, awarding more than fifty concessions for 5,500 km of toll roads. The concessions were highly leveraged. Debt financing for the projects was provided by local banks. Several such banks were government owned and faced government pressure to sponsor the concessionaires. Thus the government acquired a substantial amount of implicit liabilities. Eventually the government had to bail out twenty-five financially distressed concessions in order to avoid a disastrous bank collapse. This involved assuming $7.7 billion in debt, to the detriment of taxpayers (Ehrhardt and Irwin 2004).

5.3.2 A Remedy: Conditional Guarantees

The tales described above highlight one main weakness in the practical use of governmental guarantees. The latter come into force, despite that the partnership breaks down, following to the firm's default. There is thus an obvious way to avoid the double damage of the PPP failing and the debt burden relapsing onto the collectivity. That is, the provision of governmental guarantees should be conditioned on the continuation of the partnership. It should be contractually stipulated that governmental guarantees will assist external financiers, only in the event that the private partner does remain in the project, whether the original contract is honored until the termination date or it is, at some point, renegotiated. Importantly, the reliance on *conditional* guarantees of this kind is coherent with the project finance technique, which requires making the project legally and economically self-contained. This task is accomplished in two ways. First, a stand-alone firm (the special purpose vehicle) is created to undertake no other business than building and operating within the concerned project. Besides, the firm is endowed with the sole assets pertaining to the project, which are

Se

kept separated from the assets of the parent firm. Second, lenders are provided no guarantees beyond the right to be paid out of the resources generated within the project (i.e., user fees and, possibly, governmental transfers). This involves forgoing any repayment guarantee, in the event that the firm abandons the activity.

5.3.3 Private Investment: Loan Guaranteed by the Government and Own Funds of the Firm

We now move back to the formal analysis in order to explain why involving private funds in the project, in the double form of funds belonging to the firm and funds borrowed by the firm on the credit market, plays an essential role in the execution of the contract under limited commitment. To this end, we need to describe what may motivate the partners to renege on the contract, foreseeing either renegotiation or break-up of the partnership.

5.3.3 Incentives to Renege Anticipating Renegotiation: The Role of the Governmental Guarantees

Suppose that in some state $i \in (l, h)$, at some date $\tau \in (0, T_i)$, either the firm or the government reneges on the contract. If the two partners are unable to reach a new agreement, then the government replaces the firm with a new operator. This occasions a "cost of replacement" of R_{δ_i}, where $\delta_i \equiv T_i - \tau$ is the residual contractual period. The replacement cost is basically a loss of reputation or credibility for the government. It is thus reasonable that it is bigger the longer the residual period, through the termination date initially stipulated. To capture this circumstance, we assume that $R'_{\delta_i} > 0$. However, when replacing the firm, the government enjoys a benefit. This is measured by the value of the guarantee $D^{rn}_{i,\tau}$, which the government provides to the firm's lender at the contracting stage, with the agreement that it will come into force in case of renegotiation. The guarantee being conditioned on the continuation of the partnership, the government saves that money when the PPP is broken up. Therefore the net opportunity benefit of the government from continuing the partnership is $R_{\delta_i} - D^{rn}_{i,\tau}$.[6] Anticipating the government's convenience to appropriate that benefit, the firm might renege opportunistically. Its goal would be to induce the government to renegotiate and share the benefit. Recalling that $D^{rn}_{i,\tau}$ is one of the variables that the government chooses when the initial contract is drawn up, we can state the following result.

Se

Result 5 *The firm's incentives to renege on the contract opportunistically, anticipating renegotiation, are eliminated, if the governmental guarantees, provided for the renegotiated contract, are set as*

$$D_{i,\tau}^{rn} \geq R_{\delta_i}, \qquad \forall \tau \in (0, T_i), i \in \{l, h\}. \tag{8}$$

According to (8), the government should provide so high a guarantee, for the renegotiated contract, that any benefit from renegotiation would be eliminated. Then there would be nothing to share with the firm. Consequently the firm would have no interest in reneging on the contract, in the prospect of reaching a new profitable agreement. Nor would the government attempt to renegotiate. Indeed replacing the firm would be less costly for the government than paying the amount guaranteed to the lender. Therefore the guarantees represent a powerful tool to eliminate the partners' incentives to renege on the contract.

5.3.3 Incentives to Renege Anticipating Breakup

Assume that (8) is satisfied. Then the only remaining concern is to ensure that under the initial contract, each partner attains a higher payoff than would be obtained if the partnership were to break up. To illustrate how this concern can be addressed, we need to formalize the partners' payoffs under the initial contract and in the event of breakup.

When the partnership is terminated, the firm obtains its best outside opportunity, which we take to be zero: $\Pi_{i,\tau}^{rp} = 0$. A new firm steps in and runs the activity. Denote $S_{i,\tau}$ the social benefit from the activity from date τ to date T_i, regardless of who runs it. Thus, when the partnership is terminated, the government obtains $V_{i,\tau}^{rp} = S_{i,\tau} - R_{\delta_i}$. Next let $\Pi_{i,\tau}$ and $V_{i,\tau}$ the values, at date τ, of the partners' payoffs under the initial contract. To eliminate the incentives to renege on the contract, anticipating breakup, it is necessary and sufficient that for all $i \in \{l, h\}$,

$$\Pi_{i,\tau} \geq 0, \tag{9a}$$

$$V_{i,\tau} \geq S_{i,\tau} - R_{\delta_i}. \tag{9b}$$

In what follows, we show that any temptation to renege on the contract, anticipating breakup of the partnership, is eliminated by making a suitable choice of the financial structure of the project. The latter includes the loan to be taken out by the firm and guaranteed by the government, as well as the funds to be provided by the firm.

Se

Governmental Guarantees and Size of the Loan

Let us begin with the government. When the contract is executed, its payoff in state i, at date τ, is given by the gross social benefit generated by the activity from date τ to date T_i, namely $S_{i,\tau}$, net of the compensation that the government owes to the firm, namely $\Pi_{i,\tau}$, and net of the debt guaranteed to the lender, denoted $D_{i,\tau}$. Thus

$$V_{i,\tau} = S_{i,\tau} - (\Pi_{i,\tau} + D_{i,\tau}).$$

Recalling (10), we deduce that the government has no incentive to renege, with the purpose of terminating the partnership, if and only if the amount of debt, which is induced and guaranteed by the government in the initial contract, is not too large. That is,

$$D_{i,\tau} \leq R_{\delta_i} - \Pi_{i,\tau}, \quad \forall i \in \{l, h\}, \tau \in (0, T_i). \tag{10}$$

Setting $D_{i,\tau}$ as low as (11) requires is not an issue because any amount of debt, which is suitable to make the contract self-enforcing, can freely be chosen.

Once it is clear how $D_{i,\tau}$ should be set, one can deduce how much money the government should instruct the firm to borrow up-front and to use in the project, in order to make the contract self-enforcing. For the sake of simplicity, we assume that the credit market is competitive. Hence, the loan conceded to the firm, denoted C, is such that $C = \mathbb{E}_i[D_{i,0}]$. This means that the expected repayment, for the lender, is exactly equal to the loan taken out by the firm. Moreover, from the expected payoff of the government at the contracting stage, which is given by $\mathbb{E}_i[V_{i,0}] = \mathbb{E}_i[S_{i,0}] - \mathbb{E}_i[\Pi_{i,0}] - C$, where $\mathbb{E}_i[\Pi_{i,0}]$ is the expected stream of future operating profits, we see that giving up a rent to the firm is socially costly. Thus the government attempts to retain as much surplus as possible from the firm. The best outside opportunity of the firm being zero, this amounts to saturating its *ex-ante* participation constraint. That is, the compensation scheme is such that $\mathbb{E}_i[\Pi_{i,0}] = M + \psi$, where $M \in [0, I]$ is the monetary contribution made by the firm up-front. Taking all this into account, we find an upper bound to the admissible size of the loan:

$$C \leq \mathbb{E}_i[R_{T_i}] - (M + \psi). \tag{11}$$

Result 6 *To eliminate the government's incentive to renege on the contract opportunistically, anticipating breakup, the governmental guarantees* ($D_{i,\tau}$) *provided to the lender, in the event that the initial contract is honored, must*

Se

be small enough to satisfy ***(10).*** *Moreover the firm should take out a loan (C) small enough to satisfy* ***(10).***

To ensure that results 5 and 6 are completely clear, we make the following remark.

Remark 1 *The governmental guarantees* $(D^{rn}_{i,\tau})$ *provided to the lender, in the event that the initial contract is renegotiated, are only relevant off equilibrium, in the renegotiation game between the government and the firm, given that the contract is never actually renegotiated, in equilibrium. Consequently it is not an issue to set those guarantees as large as* **(8)** *requires, regardless of the magnitude of the loan. By contrast, the governmental guarantees* $(D_{i,\tau})$ *provided to the lender, in the event that the initial contract is honored, do reflect the amount of money that the firm is to borrow on the credit market, in order to enter the PPP. This is why, for* $D_{i,\tau}$ *to be set small enough to satisfy* **(10),** *the loan of the firm must comply with* **(11).**

Own Funds of the Firm

To determinate the appropriate amount of own funds (M) that the firm should invest in the project, it is first necessary to complete the analysis of the government's incentives to renege on the contract. To this end we notice that there exists no value of the guarantee $D_{i,\tau}$, such that those incentives are eliminated, unless the cost of replacing the firm at date τ is at least as large as the present value, at that date, of the stream of future operating profits of the firm, that is, $R_{\delta_i} \geq \Pi_{i,\tau}$. It turns out that this is more a concern in the good state, in which the firm is assigned a higher compensation. Thus we only need to consider the case of $i = l$, hence the condition $R_{\delta_l} \geq \Pi_{l,\tau}$. Recalling that the ex ante participation constraint of the firm is saturated, it must be the case that $\Pi_{l,0} = M + \psi + (1 - v_1)(\Pi_{l,0} - \Pi_{h,0})$. Thus the value, at date $\tau \in (0, T_l)$, of the stream of future profits is given by

$$\Pi_{l,\tau} = [M + \psi + (1 - v_1)(\Pi_{l,0} - \Pi_{h,0})]\frac{1 - e^{-\delta_l}}{1 - e^{-rT_l}}.$$

This yields an upper bound to the admissible magnitude of M:

$$M \leq R_{\delta_l}\frac{1 - e^{-rT_l}}{1 - e^{-\delta_l}} - \psi - (1 - v_1)(\Pi_{l,0} - \Pi_{h,0}). \tag{12}$$

For the government not to be willing to renege on the contract, anticipating breakup of the partnership, the firm should not be required to invest more own funds than is necessary to satisfy (12). A larger

contribution would boost the appetite of the government, which would then terminate the relationship and appropriate the firm's investment. Under (12), for the government to honor the contract, it is necessary and sufficient that the guarantee it provides satisfies (10), as result 6 states.

We can now turn to consider the firm. Recall, from results 1 and 2, that $\Pi_{l,0} > \Pi_{h,0}$. It is thus immediate to deduce that the firm is more prone to abandon the partnership when it faces unfavorable operating conditions. That is, (9a) is relevant in state h only: $\Pi_{h,\tau} \geq 0$. Provided that the contract is such that the firm breaks even in expectation, we can write its profit in state h as

$$\Pi_{h,0} = M + \psi - \nu_1 (\Pi_{l,0} - \Pi_{h,0}). \tag{13}$$

Therefore the firm has no incentive to renege, as soon as it starts operating (i.e., when τ is very close to 0), if and only if it is required to invest a sufficiently high amount of money:

$$M \geq \nu_1 (\Pi_{l,0} - \Pi_{h,0}) - \psi. \tag{14}$$

Inspection of (14) prompts us to make two interesting points. First, the minimum admissible size of M is smaller the higher the disutility of effort. This is intuitive. The firm's monetary contribution (M) plays the same committing role as the nonmonetary contribution (ψ). They act as substitutes, from this standpoint. The more costly effort is for the firm, the more prone the firm is to honor the contract, in order to recover that cost "as time goes by," hence the less necessary it is to use the funds of the firm as a commitment device. Second, the minimum admissible size of M is bigger the higher the profit wedge at date 0. This is also very plausible. The more the firm is exposed to risk, the less motivated it is to remain in the contract when the operating conditions are unfavorable. As those conditions are unchanged through the termination date, the firm is assigned the same profit in every operating period. Hence, once it is ensured that the firm is motivated to honor the contract at the outset of the operation phase, as is the case when (14) holds, it is ensured that it is also motivated to do so at any other instant through the termination date.

Result 7 *The incentives of the government to renege, anticipating breakup, are eliminated (i.e.,* **condition 10** *holds), only if the investment of the firm* **(***M***)** *is large enough to satisfy* **(12).** *The incentives of the firm to renege, anticipating breakup, are eliminated, if and only if its own investment is small enough to satisfy* **(14).**

We explained that, for the firm to be willing to honor the contract, it must put on the table a sufficiently large amount of own funds, and that this amount must be higher the bigger the profit wedge is set. Clearly, this requirement cannot be met, unless the firm is wealthy enough, to begin with. Recall that the profit wedge cannot be narrower than required in (1). Together with (14), it follows that the firm must hold a minimum admissible amount of funds, in order to participate in the PPP project. Letting $E \geq 0$ denote the endowment of the firm, and knowing that $M \leq E$, the following result can be stated.

Result 8 *The firm's incentives to renege on the contract can be eliminated, together with the firm's incentives to shirk in construction, only if the amount of own funds that the firm can invest in the project is such that*

$$E \geq v_0 \frac{\psi}{\Delta v}. \tag{15}$$

The need to motivate the firm to exert effort in construction is somewhat at odds with the need to eliminate the firm's incentives to renege on the contract. As we know, the former task is accomplished by transferring enough risk to the firm, which is done by differentiating the profits sufficiently between states of nature. The desire to extract all surplus from the firm, in expectation, involves that the profit must be low in the bad state and high in the good state. However, the lower the profit in the bad state, the more difficult it is to induce the firm to abide by the contractual obligations during the operation phase. To ensure that the state-h profit is high enough for the firm to honor the contract, the initial investment of the firm, hence its wealth, must be sufficiently important.

5.3.4 Contractual Length

General Case: State-Dependent Duration

Based on results 5 to 7, one may deduce that, once the financial structure of the project and the guarantees are properly set, neither the firm nor the government will have any incentive to renege on the contract and to terminate the partnership. One may, thus, conclude that having the contract honored is no longer an issue. However, the picture is not yet complete. To see this, from result 7, notice that it might be impossible to find a value of M, which is little enough to make renege

unattractive for the government, and, at the same time, big enough to make renege unattractive for the firm. The temptation of the government can be eliminated, together with that of the firm, only if the replacement cost, which the government faces in state l, is sufficiently high and/or the profit wedge $\Pi_{l,0} - \Pi_{h,0}$ is sufficiently small, that is,

$$R_{\delta_l} \geq (\Pi_{l,0} - \Pi_{h,0}) \frac{1 - e^{-\delta_l}}{1 - e^{-rT_l}}, \forall \delta_l \in (0, T_l). \tag{16}$$

Let us first focus on the cost of replacement. When this is large, the government is unwilling to break up the partnership, even if the monetary contribution of the firm is important. Therefore the firm can be required to invest as much as necessary to be discouraged from reneging, in turn, on the contract. Let us next consider the profit wedge. To see why, under limited commitment it is helpful to keep it small—recall that the incentive of the government to renege is stronger in the good state—when the compensation of the firm is high. By contrast, the incentive of the firm is stronger in the bad state when its compensation is low. Setting the profit wedge small involves that the compensation to the firm is not very different in the two states. That is, neither the state-l compensation is high nor the state-h compensation is low to the point that renege is convenient, respectively, for the government and for the firm.

Once the logic behind (16) is well understood, knowing that R_{δ_l} depends on the residual contractual period, from date τ to date T_l, and that, given the need to address the information issues, the profit wedge depends on T_l and T_h (results 1 to 3), one further deduces that it might be possible to eliminate the temptations to renege with an appropriate choice of the two termination dates. We hereafter explore this aspect.

Let us begin by checking how small the profit wedge can be set, consistently with (1) to (3), in order to relax (16). Hinging on results 1 to 3, the wedge is smallest when, for any pair of termination dates $\{T_l, T_h\}$ satisfying (2) and (3), (1) is saturated. Accordingly, we can rewrite (16) as

$$R_{\delta_l} \geq \frac{\psi}{\Delta\nu} \frac{1 - e^{-r\delta_l}}{1 - e^{-rT_l}}, \forall \delta_l \in (0, T_l). \tag{17}$$

Then, for (2) and (3) to be satisfied, T_l must be set according to (5). In addition, whenever $\psi \leq \Delta\nu\Delta\theta \frac{q_h}{r}$, T_h must be set such that

Se

$$T_h \leq \frac{1}{r}\ln\frac{\Delta v\Delta\theta q_h}{\Delta v\Delta\theta q_h - r\psi}. \tag{18}$$

Result 9 *The information issues are addressed, together with the commitment issues, only if T_l can be chosen in such a way that* **(5)** *and* **(17)** *are simultaneously satisfied and, whenever $\psi \leq \Delta v\Delta\theta\frac{q_h}{r}$, T_h is set to satisfy* **(18).**

From (5), we learned that the duration of the contract cannot be too short in the good state. If the firm were not allowed to enjoy the benefits of the effort exerted in construction, in the state in which they appear, for a sufficiently long period of time, then the firm would not be motivated to try and make that state more likely. The smaller the disutility of effort, the lower is the profit wedge for which shirking is avoided, and hence the harsher the adverse-selection problem in state h, relative to the moral-hazard problem. The former problem is tackled, together with the latter, by ensuring that the contract has a sufficiently long duration in state l. From (6), we also know that the contract cannot have too long a duration in the bad state. Otherwise, it would be impossible to elicit information in the good state, as the firm would be able to obtain an important benefit, through date T_h, by pretending a high cost. The requirement on T_h stated in (18) is a particular case of the requirement stated in (6). It arises because the profit wedge is downsized to saturate (1). With (1) saturated, the profit wedge is smaller the lower the disutility of effort. This makes it more difficult to eliminate the incentive of the firm to release information, when the cost is low, relative to preventing the firm from shirking. Condition (6) mirrors this circumstance. On the opposite, when exerting effort is costly for the firm

$$\left(\psi > \Delta v\Delta\theta\frac{q_h}{r}\right),$$

the moral-hazard problem remains important, relative to the adverse-selection problem in state h. It is, thus, unnecessary to set T_h in compliance with (18).

Fixed versus State-Dependent Duration: Which Approach Should Be Taken?

Result 9 does not evidence any necessity of choosing a different termination date in the two states of nature. This raises, again, the same question that was asked in the full-commitment framework, that is,

whether conditioning the duration of the contract on the true cost delivers any benefit, as compared to the usual practice of designing fixed-term contracts. We investigate this issue referring to a specific replacement-cost function, namely

$$R_{\delta_l} = 1 - be^{-r\delta_l},$$

where $0 < b < \min\{1;\ \psi/\Delta v\}$. Notice that for all positive values of T_l, we have

$$R'_{\delta_l} = rbe^{-r\delta_l} < \frac{\psi}{\Delta v}\frac{re^{-r\delta_l}}{1-e^{-rT_l}}.$$

Thus all over the range of possible values of δ_l, (17) is tightest as δ_l approaches T_l. Provided that $\psi \le \Delta v/r$, (17) is rewritten as

$$T_l \ge \frac{1}{r}\ln\frac{b\Delta v}{\Delta v - r\psi}. \tag{19}$$

Recall that T_l must satisfy (5). In addition, if $\psi \le \Delta v\Delta\theta(q_h/r)$, then T_h must satisfy (18). Thus, combining (5) with (19), it is clear that there is no upper bound to the choice of T_l. Noticeably (5) might not hold jointly with (18), if the contract had a fixed term ($T_l = T_h \equiv T$). The following result can be drawn.

Result 10 *Suppose that* $\Delta\theta q_h > \mathbf{1}$ *and that*

$$b > \frac{\Delta v - r\psi}{\Delta v - (r\psi/\Delta\theta q_h)}.$$

Then (18) *is satisfied, together with* (17) *(rewritten as* condition 19), *only if* $T_l > T_h$.

There is an important practical implication to result 10. In environments where, in addition to the firm holding private information, either contractual party lacks the ability to commit, the usual practice of setting a fixed contractual term may be inappropriate. It may fail to ensure that the contract is, indeed, executed. Decision makers should regard, as a useful tool, the possibility of modulating the duration of the contract according to the specific operating conditions. This rests on the circumstance, previously illustrated, that some incentive issues are relevant in the good state (i.e., the incentive of the government to renege and that of the firm to pretend a high cost), others are relevant in the bad state (i.e., the incentives of the firm to renege and to pretend a low cost). When the state-dependent approach is preferred to the

fixed-term approach, the extra flexibility, which the government enjoys in the determination of the contractual length, can be exploited in the attempt to reconcile the different incentive issues across states of nature. Hence making the duration state-dependent facilitates the task of addressing all those issues at once.

5.4 Conclusion

We now conclude our work, discussing the practical implications of the theoretical predictions and relating our findings to the existing literature.

5.4.1 Discussion

Taking together the bunch of results presented in this work, one can see that there are various instruments, which can be used to attain efficient contractual outcomes, in PPP arrangements, and that ultimately they all involve a proper choice of the contractual length (results 9 and 10). Without the latter, it would be impossible to set the debt guarantees and the firm's investment in such a way to satisfy the conditions in results 6 and 7. Consequently the contract would not be enforceable. Therefore an important practical lesson to retain is that when designing the contract, it is essential to account for the financial structure of the project and the contractual length altogether, rather than considering each of them separately. In fact this looks intuitive, if it is considered that the compensation to the firm, which drives the incentives of either partner to honor or to abjure the contract, does depend on the size of the debt, the firm's own contribution to the project and the contractual length, all at once.

We found that the best strategy to deal with the opportunistic behavior of the partners is to let the contract have a longer duration in the good state of nature, a result that is at odds with the literature on flexible-term contracts. Although, to facilitate the exposition, we only provided an illustrative example, result 10 is general, in fact, as the analysis in Danau and Vinella (2015b) shows. For practical use, setting a longer duration in the good state comes as a novel proposal. Indeed PPP contracts have, in large majority, a fixed term and, in some cases, a flexible term. However, looking closely at real-world experiences, such as the Metronet case in London, it is evident that early terminations of PPPs follow often a default by the firm. By contrast, when contractual renege occurs on the initiative of the government, a new

deal is usually reached, as was the case in Argentina, where many PPP contracts, signed during the 1990s, were subject to government-led renegotiations, even repeatedly (Guasch 2004). What result 9 suggests is that these issues, particularly the different incentives that the partners would display in the different states, should be accounted for in contractual design, and be addressed by choosing a longer duration in good states than in bad states.

We identified an important role for financial institutions such as the ECAs. One may wonder whether, without such institutions, the intended outcome could still be attained and, if so, which benefit could be obtained, in that case, by setting a longer contractual term in the good state. As from result 6 and the subsequent remark, the reason why it is useful to involve a credible financial institution in the government–firm relationship, is that the payment from the government to the lender, to be enforced in the event of a renegotiation, is perceived by the government as a penalty, to be borne if deviating from the original contract to a new deal. Therefore institutions like ECAs are helpful when renegotiation is an attractive option. Their intervention is precisely meant to reduce the attractiveness of that option, thus lessening opportunism. Without that intervention, the commitment problem would be more difficult to tackle (formally, the conditions in result 9 would be tighter). Then, a fortiori, a longer duration in the good state would be useful, making a better job than a fixed duration.

Notes

We gratefully acknowledge comments from participants at the CESifo Summer Institute Workshop on The Economics of Infrastructure Provisioning: The (Changing) Role of the State (Venice).

1. In Europe, between 1990 and 2005/2006, PPPs experienced a sixfold increase, on an annual basis, being used in defense, government buildings, hospitals, ICTs, municipal services, schools, tourism, water, and, above all, transportation. Many such initiatives display local dimensions, as municipalities are responsible for infrastructure provision in many countries (Allain-Dupré 2011). In the United States, PPPs became very popular a bit later, in the immediate aftermath of the recession (Engel, Fischer, and Galetovic 2011).

2. Although arguments are, sometimes, provided in favor of a more systematic adoption in toll-road concessions (e.g., see Albalate and Bel 2009), so far flexible-term contracts have received a limited support in practice.

3. From a cross-country analysis, Banarjee, Oetzel, and Ranganathan (2006) conclude that governments' opportunistic behavior does not propitiate private investment (see also Estache and Wren-Lewis 2009).

4. According to The EPEC PPP Guide (2012), in the event of PPP company default, the lenders should be allowed to step in to rescue the project. The PPP contract should be terminated and the government should appropriate the assets, only if the lenders renounce to this possibility. In fact this is a likely option, particularly in complex projects. However, even if the lenders were eager to undertake the activity, providing for their right to step in would require entering into a direct agreement with the government and the firm. Under limited commitment, the government would not commit to this agreement, just as it does not commit to the PPP contract.

5. Most European governments have set up ECAs for the purposes described in the text. All countries, which have official ECAs are now party to the "Arrangement on Guidelines for Officially Supported Export Credits," which provides specific rules for project finance. Examples of European ECAs are Compagnie Française d'Assurance pour le Commerce Extérieur (Coface), Euler Hermes Kreditversicherungs (Hermes), Istituto per i Servizi Assicurativi del Credito all'Esportazione (SACE), and Office National du Ducroire (ONDD).

6. To be more rigorous, spending one unit of public funds requires collecting more than one unit of money from taxpayers. To capture this circumstance formally, we would need to introduce some parameter $\lambda > 0$, expressing the shadow cost of public funds. Then the net benefit of the government would amount to $R_{\delta_i} - (1+\lambda)D^m_{i,\tau}$. However, because this would have no qualitative impact on results, we prefer to keep the formulation simpler and to neglect the shadow cost of public funds.

References

Albalate, Daniel, and Germà Bel. 2009. Regulating concessions of toll motorways: An empirical study on fixed vs. variable term contracts. *Transportation Research Part A, Policy and Practice* 43: 219–29.

Allain-Dupré, Dorothee. 2011. Multi-level governance of public investment: Lessons from the crisis. Regional Development working paper 2011/05. OECD.

Banerjee, Sudeshna G., Jennifer M. Oetzel, and Rupa Ranganathan. 2006. Private provision of infrastructure in emerging markets: Do institutions matter? *Development Policy Review* 24 (2): 175–202.

Bennett, John, and Elisabetta Iossa. 2006. Building and managing facilities for public services. *Journal of Public Economics* 90: 2143–60.

Brench, Andreas, Thorsten Beckers, Maria Heinrich, and Christian von Hirschhausen. 2005. Public–private partnerships in new EU member countries of Central and Eastern Europe. European Investment Bank 10, no. 2.

Dewatripont, Mathias. 1989. Renegotiation and information revelation over time: the case of optimal labor contracts. *Quarterly Journal of Economics* 104: 589–619.

Danau, Daniel, and Annalisa Vinella. 2015a. Public–private contracting under limited commitment. *Journal of Public Economic Theory 17 (1): 78–110*.

Danau, Daniel, and Annalisa Vinella. 2015b. From fixed to state-dependent duration in public–private contracts. Working paper 201504 CREM.

Se

Ehrhardt, David, and Timothy Irwin. 2004. Avoiding customer and taxpayer bailouts in private infrastructure projects: Policy toward leverage, risk allocation, and bankruptcy. Policy Research working paper 3274. World Bank.

Engel, Eduardo, Ronald Fischer, and Alexander Galetovic. 2013. The basic public finance of public–private partnerships. *Journal of the European Economic Association* 11 (1): 83–111.

Engel, Eduardo, Ronald Fischer, and Alexander Galetovic. 2011. Public–private partnerships to revamp U.S. infrastructures. Discussion paper 2011–02. The Hamilton Project, Brookings Institute.

Engel, Eduardo, Ronald Fischer, and Alexander Galetovic. 2001. Least-present-value-of-revenue auctions and highway franchising. *Journal of Political Economy* 109 (5): 993–1020.

Engel, Eduardo, Ronald Fischer, and Alexander Galetovic. 1997. Highway franchising: Pitfalls and opportunities. *American Economic Review* 87 (2): 68–72.

EPEC. 2012. *The Guide to Guidance: How to Prepare, Procure and Deliver PPP Projects*. Luxembourg: European Investment Bank.

Estache, Antonio, and Liam Wren-Lewis. 2009. Towards a theory of regulation for developing countries: Following Laffont's lead. *Journal of Economic Literature* 47 (3): 729–70.

Gagnepain, Philippe, Marc Ivaldi, and David Martimort. 2009. Renégociation de contrats dans l'industrie du transport urbain en France. *Revue Economique* 60 (4): 927–47.

Guasch, Jose L. 2004. *Granting and Renegotiating Infrastructure Concessions: Doing It Right*.Washington, DC: World Bank Institute.

Guasch, Jose L., Jean-Jacques Laffont, and Stéphane Straub. 2006. Renegotiation of concession contracts: A theoretical approach. *Review of Industrial Organization* 29: 55–73.

Guasch, Jose L., Jean-Jacques Laffont, and Stéphane Straub. 2008. Renegotiation of concession contracts in Latin America: Evidence from the water and transport sectors. *International Journal of Industrial Organization* 26 (2): 421–42.

Hart, Oliver, and Jean Tirole. 1988. Contract renegotiation and Coasian dynamics. *Review of Economic Studies* 55: 509–40.

House of Lords. 2010a. Private finance projects and off-balance sheet debt. First Report of Session 2009–10, vol. I: Report, HL paper 63-I.

House of Lords. 2010b. Private finance projects and off-balance sheet debt. First Report of Session 2009–10, vol. II: Evidence, HL paper 63-II.

Levin, Jonathan. 2003. Relational incentive contracts. *American Economic Review* 93: 835–57.

Iossa, Elisabetta, and David Martimort. 2015. . The simple micro-economics of public–private partnerships. *Journal of Public Economic Theory 17 (1): 4–48*.

Irwin, Timothy, Michael Klein, Guillermo E. Perry, and Mateen Thobani. 1997. *Dealing with Public Risk in Private Infrastructure*. Washington, DC: World Bank Latin American and Caribbean Studies.

Se

Laffont, Jean-Jacques. 2003. Enforcement, regulation and development. *Journal of African Economies* 12: 193–211.

Martimort, David, and Jérôme Pouyet. 2008. To build or not to build: Normative and positive theories of public–private partnerships. *International Journal of Industrial Organization* 26 (2): 393–411.

National Audit Office. 2008–2009. The failure of Metronet. HC512. London.

Rey, Patrick, and Bernard Salanié. 1996. On the value of commitment with asymmetric information. *Econometrica* 64: 1395–1414.

Se

Se