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OPTIMAL PUBLIC PROCUREMENT CONTRACTS UNDER A SOFT BUDGET CONSTRAINT

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Tiivistelmä: Tässä tutkimuksessa tarkastellaan julkisia hankintasopimuksia tilanteessa, jossa pehmeä budjettirajoite kannustaa julkisen sektorin hankkijoita tehottomaan investointien taloudellisten riskien hallinnan. Teoreettisessa mallissa kilpailu rahoituksesta julkisen sektorin sisällä kannustaa yksiköitä käyttämään hankintasopimuksissa rahoitusjärjestelyjä, joiden avulla ne voivat uskottavasti sitoutua hallitsemaan riskejä tehokkaammin. Näistä instrumenteista ns. Public-Private Partnership (PPP) sopimus, joka delegoi hankkeiden monitoroinnin yksityiselle rahoituslaitokselle, on tehokkain hankintamalli, jos rahoituslaitoksilla on mahdollisuus monitoroida hankkeita samalla tavoin kuin julkisen sektorin edustajat. Tutkimus osoittaa myös, että vastoin yleisesti käytössä olevia sopimuskäytäntöjä PPP sopimuksen optimaalinen rahoitusrakenne koostuu julkisen sektorin rahoituksesta ja lainasta rahoituslaitoksista.

Asiasanat: Elinkaarimalli, julkiset investoinnit, epätäydellinen informaatio

JEL Luokitus: D8, L3, H54, H57

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Abstract: This paper presents a model where the central government cannot ensure that regional governments manage risks prudentially, due to soft budget constraint. Competition for project funding induces the regional governments use financial instruments as commitment devices as a signal of prudential risk management. A Public-Private Partnership contract, which delegates the monitoring task to a financial institute, is the most efficient commitment device provided that private financiers have an access to the same monitoring technology the regional governments fail to employ. The optimal capital structure of a PPP contract is a combination of public funds and debt from financial institutes.

Keywords: PPP contracts, public investments, moral hazard

JEL Classification: D8, L3, H54, H57

[1] Tämä tutkimus on osittain rahoitettu TEKESin hankkeessa ”Markkinamekanismit julkisten palveluiden tuotannossa”.

Contents

1 Introduction

The usual claim regarding efficiency of public procurement projects is that they exhibit more cost overruns and delays than project managed and funded by private sector.[1] One explanation for the argument is that those responsible for the planning of public procurement projects are not financially liable for the outcomes, which generates a moral hazard problem referred to as soft budget constraint (Kornai 1979 and Dewatripont and Maskin 1995).[2] A soft budget constraint emerges, for instance, when a branch of the government responsible for allocation of public funds cannot establish a credible pre-commitment not to bail out the branch subject to a cost overrun. Since the positive probability of a bail out is common knowledge, the equilibrium of a procurement system often exhibits poor management of risks and - in extreme cases - deliberate underestimation of costs.

The attempts to increase the efficiency of public procurement without giving the property rights of assets perceived socially important to private sector have led to the emergence of so-called Public-Private Partnership (PPP) contracts. These contracts leave the property rights with the public sector, but responsibilities to finance, construct and operate are transferred to private contractors. In return for these tasks the contractor receives operation fees from the public sector and returns the assets to the tax payers at the end of contract period.[3] The contract thus specifies a system of contractual relationships where the contractor and the financiers carry the financial risks of the investment, which should induce prudential project management. The service fees are usually tied to the quality and quantity of the service. The contractor thus has an incentive complete the project in time and invest in technologies which increase service quality and reduce expected operation costs (see Hart et al 1997).

The public debate on the welfare implications of PPPs involves many arguments based on theory and practice. Arguments for PPPs rely mostly on theories on the efficiency gains resulting from the transfer of investment risks from inefficient public entities to private investors, who have higher powered incentives manage projects prudentially (e.g. Grimsey and Lewis 2004). Those who are against PPP contracts justify their views on theories on financial contracting and on the proper scope of the public sector (e.g. Arrow and Lind 1972). The main argument of the critics is that since the governments of developed economies have superior ability to bear the risks inherent to large infrastructure investments, the interest rate payments on publicly funded projects are lower than for those financed with private capital. Therefore, the cost the public sector incurs for economically viable PPP project cannot be lower than that of a conventional project funded with public capital.

The intuition for the arguments why private capital invested in a PPP project increases the procurement costs is trivial, insofar as the economic risks related to the projects are exogenous. However, if the cost overruns are a consequence of agency problems in the public sector, PPP

[1] Financial Times reported that the cost of 30 most important transport infrastructure projects is about €379bn, which is 11.6 per cent more than the original estimate in 2004 (Financial Times 2008). Flyjberg et al (2003) report similar findings from international procurement projects.

[2] Soft budget constraint emerges in many sectors. One example is the financial sector where large banks are important for the financial system. Therefore, the regulators cannot pre-commit to a policy that allows large banks become insolvent. The banks anticipate they will be bailed out in fianncial distress, and therefore, they have an incentive to engage in excessive risk taking, which increases the fragility of the financial system.

[3] These contracts take several forms depending on the nature of the projects. A typical PPP contract bundles the financial responsibilities and service provision into a single contract. The contract specifies a time period of 20 to 30 years a private concessionaire controls the assets, manages the service and collects user fees paid by the users direclyt or the public sector. The payments are tied to quantity and various quality dimensions. At the end of the contract period the contractor returns the assets to the control of the government.

contracts may be an appropriate instrument to mitigate agency problems in the public sector, as it transfers the risks, and therefore the responsibility to manage them, to the private financiers.

Both arguments can readily be justified on the grounds of economic theory with appropriate assumptions regarding the efficiency of public private sector. It is, however, worth pointing out that the agency problems in, for instance, large infrastructure investments are not just public sector phenomena. In a similar manner as the tax payers, the financiers of a PPP contractor must employ instruments to make prudential risk management incentive compatible for the contractor and other relevant agents. These considerations imply that the key in understanding the welfare implications of choosing a specific contractual form in public investments is whether the private sector financiers can mitigate the agency problems emerging in imperfect contracts at a lower cost than the public sector.

In this paper I examine public procurement contracts the public sector can use to mitigate the agency costs inherent to public investments. To this end I develop a model of public procurement under a soft budget constraint and study the arguments presented in the debate regarding PPP contracts. The results illustrate the conditions where PPP contracts welfare dominate conventional contracts and determine the optimal capital structure for procurement contracts.

The first result shows that conventional procurement contracts under soft budget constraint exhibit welfare loss in the form of higher procurement costs due to inefficiently high number of cost overruns. The result coincides with the usual findings in the literature on soft budget constraint (e.g. Dewatripont and Maskin 1995): When the public sector is decentralized so that a central government responsible for the allocation of the tax payers' money cannot observe regional governments' monitoring activity, the regional governments have limited incentives monitor the private contractor efficiently. This diminishes the contractors' incentives manage the risks prudentially and increases the expected costs the tax payers incur for public procurement.

The second result illustrates that the public sector can mitigate the agency costs. When the contractor is required to hold capital as collateral, regional governments can establish a credible precommitment to prudential project management. Collateralized contracts increase the procurement costs through the opportunity cost the contractor incurs for holding capital in liquid form, but when these costs are lower than the welfare loss resulting from cost overruns, these contracts increase welfare. The result is familiar from the theory of financial contracting, as collateral is known to mitigate moral hazard. In terms of soft budget constraint, the result shows a competition for public funding is a prerequisite for the regional governments to have an incentive to design efficient contracts, as they serves as a commitment device in competition for public funds.

The third result of the paper derives an optimal PPP contract and a ranking between the contract types. PPP contracts maximize the welfare of the taxpayers when financiers of a PPP contract have an access to the same monitoring technology the public sector fails to use. In this case, the regional government can efficiently delegate the monitoring tasks to financial institutes, which have an incentive to employ the monitoring technology. Insofar as the financial institutes can collect funds from the capital markets at a sufficiently low interest rate, the contracts welfare dominate conventional procurement contracts. The final result of this paper derives an optimal capital structure for PPP contracts, which is a combination of public funds and bank credit. This contradicts the current practice where private equity constitutes a significant proportion in the capital structure of a PPP project.

The economic literature on PPPs can be divided into two branches. The first branch looks at public procurement and public services in a similar manner as in the case of private sector decisions regarding the optimal degree of vertical integration. Here, the procurement and private sector involvement are determined by efficiency considerations when there are agency costs (e.g. Williamson 1985; Hart et al 1997; Hart 2003; Qian and Roland 1998). In line with, for instance Qian

and Roland (1998), I assume inefficient decentralized public sector where the soft budget constraint mitigates efficient procurement. Unlike the results in the existing literature I show that the public sector has, in addition to full privatization, several contractual arrangements between public and private sector agents with limited private participation to be used as commitment device, which mitigates moral hazard within the government.

The second branch of literature emphasizes the political process and the political economy reasons for inefficient public sector. For instance, Boycko et al (1996) show that privatization makes it harder for firms to pursue inefficient management strategies preferred by politicians. Maskin and Tirole (2008) show that PPP contracts can be used to promote inefficient projects and evade budget constraints by taking liabilities off the balance sheet. Maskin and Tirole also emphasize the role of financial institutes as delegated monitors for the tax payers. The results of this paper entail qualifications to this result, as they illustrate that in addition to financial institutes' ability to monitor the contractor, the risk of a cost overrun must also be transferred to the financial institute efficiently. More specifically, I show that the capital structure of optimal PPP contracts entails private debt only the amount needed to induce monitoring and the remaining funds should originate from the public sector. This result provides goes against the view that private equity capital is an important part of the financial structure of a PPP contract.

The remainder of the paper is organized as follows. The next section describes an economy where the soft budget constraint mitigates the efficiency of public procurement. The third section derives socially optimal conventional procurement contracts. The fourth section examines PPP contracts. Section six concludes.

2 Model

I consider an economy where a central government (CG) collects taxes and allocates funds to investment projects, which after completion produce public goods. The public sector is decentralized so that the CG finances regional governments (RGs). The RGs are responsible for the management of the investment projects.[4]

The CG decides which projects receive funding on the basis of applications prepared by the RGs. The applications specify the financial structure and the payment in a contract the RG makes with a contractor. The contractors are chosen in a competitive bidding for the procurement projects. The assumptions regarding the projects and the contracts are the following.

A1: Moral hazard problem between the contractor and RG. At the first period, a project $x_i$requires an initial investment equal to $c_1 + e(x_i)$ where c_1 is the investment cost and $e(x_i)$ is a nonverifiable investment that mitigates the risk that the project becomes a subject of an incremental cost C_2 at the second period of the project. The cost C_2 equals $c_2 > 0$ and 0 with probability $1 - \pi[e(x_i)]$ and $\pi[e(x_i)]$, respectively. An investment in prudential management $e(x_i) = \varepsilon > 0$ mitigates the probability of cost overrun. Formally, the probabilities are such that $\pi(0) = \underline{\pi}$ and $\pi(\varepsilon) = \bar{\pi}$ where $\underline{\pi} < \bar{\pi}$. The expected cost of a project x_i is thus given by

$$E[C(x_i)] = \begin{cases} c_1 + (1 - \bar{\pi})c_2 + \varepsilon & for \quad e(x_i) = \varepsilon \\ c_1 + (1 - \underline{\pi})c_2 & for \quad e(x_i) = 0 \end{cases}$$

where $\varepsilon < (\bar{\pi} - \underline{\pi})c_2$, which ensures that choosing $e(x_i) = \varepsilon$ is socially efficient.

[4] In addition to geographical dimension, the inerpretations of the RGs also include offices of public administration in control provision of public goods and services (eg. military, education, hospitals and transport infrastructure).

The RG cannot induce socially efficient effort level without monitoring or incentive compatible contracts, because choosing $e(x_i) = \varepsilon$ fails to satisfy the individual rationality constraint of the contractor, regardless of the value of the contract payment P_i^t :

$$P_i^t - \varepsilon > P_i^t.$$

This constraint illustrates that a moral hazard problem inhibits efficient public procurement.

A2: Soft budget constraint in the public sector: The RGs have an access to monitoring technology that mitigates moral hazard in the procurement contract with the contractor.[5] Monitoring, however, involves a cost for the CG. From this it follows that when the monitoring effort cannot be verified, another moral hazard problem emerges. The RG observes that value a completed project is higher for the CG than the incremental cost, $v_i > c_2$. Since the RG has no liquid capital to cover the cost overrun, the funds for the bail out must originate from the CG. This means that although the RG has the same valuation for the completed project, it has limited incentives monitor the contractor.

Letting m denote the cost of monitoring, a formal illustration of the soft budget constraint can be written as:

$$\bar{\pi} v_i + (1 - \bar{\pi}) \left[(1 - \beta_i) v_i + \beta_i v_i \right] - m < \underline{\pi} v_i + (1 - \underline{\pi}) \left[(1 - \beta_i) v_i + \beta_i v_i \right]$$

where v is the value of project x_i and β_i is the probability the project becomes a subject of a bail out on behalf of the CG. Observe that when $v_i > c_2$ and the investment to the project is funded with public funds, the CG always bails out the RG, $\beta_i = 1$. This implies that it is not individually rational for the RG monitor the contractor, because $v_i - m < v_1$. I also assume that monitoring is socially efficient: $m < (\bar{\pi} - \underline{\pi}) c_2 - \varepsilon$.

A3: Procurement contracts: A procurement contract $\Gamma_i(P_i^t, K_i)$ specifies a payment $P_i^t \geq c_1$ the RG pays for a contractor at time t, provided that the CG has granted the funds. The capital structure of the contract is $K_i = k_i + d_i + g_i$ where k_i is the amount of collateralizable equity capital invested in the project, d_i denotes the debt borrowed from a financial institute and g is the amount of public capital invested in the project. The interest rates for public funds and equity capital are fixed in the money markets. The interest rate for public funds is 1 reflecting the CGs superior ability to carry financial risks.[6] The interest rate for equity capital is $r_k > 1$. The financial institutes operate in perfectly competitive markets and choose the interest rate subject to a constraint $r_b \geq r_g$ where $r_g \in (1, r_k)$ is the rate for which they borrow from the financial markets. This constraint illustrates the property that institutes specialized financing large infrastructure investments usually have highest credit ratings.

In a *conventional procurement contract* the CG provides direct ex-ante funding for the RG to complete a project. The conventional contract is denoted by $\Gamma_i(P_i^{t=1}, g)$ where $g = c_1$. After receiving the funds from the CG, the RG arranges a bidding competition for the contract that is specified in the application.[7] The funding received from the CG is based on the investment costs that the contractor incurs with certainty. In the case of a cost overrun, the RG must apply additional funds to the contractor from the CG to cover the cost or the value of the investment is zero.

[5] The technology can be interpreted as reforms in the administration of public procurement practices, which have positive effects on project management.

[6] This appllies to most countries.

[7] For simplicity, I assume that the contract design is transparent and the RG receives the funds only if the CG knows the structure of the contract subject to the bidding competition.

In a conventional contract with collateral the contractor pledges to hold excess capital in liquid form until the end of period two. Collateralized contracts are denoted by $\Gamma_i(P_i^{t=1}, k_i + g)$ where k_i is the amount collateralized capital and $g \geq c_1$.

A PPP contract specifies a service payment the contractor receives after completion of the project. The contractor collects the funds for the initial investment from financial markets as a combination of loans and private equity. The contract has the following form $\Gamma_i(P_i^{t=2}, k_i + d)$. In section 4 I also consider PPP contracts where the financial structure of the project entails public funding.

A5: Funding decision: The RGs have projects in line waiting for funds from the CG, which makes the funding decision based on the applications (e.g. contracts) it receives. The net social utility of a project x_i administrated by RG i is denoted by $w = v - P_i^t - \beta_i[1 - \pi(e)](c_2 - k_i)$ where $\beta_i[1 - \pi(e)](c_2 - k_i)$ is the expected cost the CG incurs due to the soft budget constraint.

For a given tax rate T and tax base normalized to unity, the optimal procurement schedule (number of projects that receive funding) of a welfare maximizing CG is given by

$$N^* = \arg\max \sum_{i=1}^{N} w_i = Nv - \sum_{i=1}^{N}[P_i^t + \beta_i[1 - \pi(e)](c_2 - k_i)]$$
$$st. \quad \sum_{i=1}^{N}\left[P_i^t + \beta_i[1 - \pi(e)](c_2 - k_i)\right] \leq T.$$

where the constraint determines the maximum number of projects N^* the CG can implement given the applications and tax income T.

Timing of the model is the following. At period zero, the CG makes the funding decisions of the basis of the applications. The RGs arranges a bidding competition at period one after the CG has granted the funds for the project. The winning contractors make the required financial arrangements and start the project with an initial investment c_1. At the second period the cost C_2 materializes. The financiers of the projects decide whether to continue with the project, providing additional finance for the contractor. After the completion of the project, the RG or a PPP contractor begin the production of the public goods. If the procurement is organized as a PPP contract, the contractor receives the payment at the end of the second period after the delivery of the public good. In a conventional contract, the contractor receives the payment in period one.

3 Conventional procurement contracts

The CG is indifferent between projects with identical financial structures and risk profiles. RGs have therefore strictly positive probability receive funding for a contract $\Gamma_i(P_i^t, K_i)$, if the expected cost of the project is (weakly) lower than that of the contracts presented to the CG in other applications. Formally, suppose that there exist at least $N - 1$ applications ranked so that

$$w_1[\Gamma_1(P_1^t, K_1)] \geq w_2[\cdot] \geq ... \geq w_{N-1}[\Gamma_{N-1}(P_{N-1}^t, K_{N-1})]$$
$$st. \quad \sum_{i=1}^{N-1}[P_i^t + \beta_i[1 - \pi(e)](c_2 - k_i)] < T$$

Then a contract $\Gamma_j(P_j^t, K_j)$ where $j > N-1$ receives funding with a positive probability if

$$w_{N-1}[\Gamma_{N-1}(P_{N-1}^t, K_{N-1})] \geq w_j[\Gamma_j(P_j^t, K_j)] \geq w_h[\Gamma_h(P_h^t, K_h)]$$
$$st. \quad \sum_{i=1}^{N-1} \left[P_i^t + \beta_i[1-\pi(e)](c_2 - k_i)\right] + P_j^t + \beta_j[1-\pi(e)](c_2 - k_j) \leq T.$$

where $h \neq j$. These properties imply that when there are $\bar{N} > N^*$ identical applications, the probability that x_j receives funding from the CG equals $\frac{N^*}{\bar{N}}$.

3.1 Conventional procurement contracts

When the RG has a conventional contract with the contractor, the initial investment is sunk. Therefore, the CG always bails out the contractor, because the cost of a bail out is lower than the value of a completed project $c_2 < v$. This implies that the probability the CG must bail out the contractor equals the probability of a cost overrun $\beta_i[1-\pi(e)] = [1-\pi(e)]$.

An optimal contract from the viewpoint of CG implements a risk profile $\bar{\pi}$. Such contract must satisfy the following individual rationality constraint of the contractor

$$P_i^{t=1} - c_1 - \varepsilon \geq 0.$$

This implies that an application on behalf of the RG, which internalizes the monitoring cost involves a transfer of funds from the CG to RG that equals $P_i^{t=1} + m$, where $P_i^{t=1} = c_1 + \varepsilon$ is the payment the RG pays for the contractor and m is a side payment to the RG that covers the cost of monitoring.

The contractor invests in prudential risk management, if the RG can establish a precommitment to monitor the contractor. The soft budget constraint, however, indicates that once the RG has received the funds it has limited incentives to engage in monitoring. This is common knowledge and the contractor capitalizes on the inefficiency of the public sector choosing $e = 0$, because $P_i^{t=1} - c_1 - \varepsilon < P_i^{t=1} - c_1$.

The following Lemma examines the properties of the conventional contract in more detail.

Lemma 1 *The optimal conventional contract involves a payment* $\underline{P}_j^{t=1} = c_1$ *and a capital structure* $K_i = g = c_1$. *The social utility with conventional procurement contracts is*

$$W[\Gamma_i(\underline{P}_i^{t=1}, g)] = N_0^*(v - c_1 - \underline{\pi} c_2)$$

where $N_0^* = \frac{T}{c_1 + \underline{\pi} c_2}$. *The welfare loss due to soft budget constraint is*

$$(N_0^* - \bar{N})v < 0$$

where $\bar{N} = \frac{T}{c_1 + \overline{\pi} c_2 + m + \varepsilon}$ *denotes the number of projects that would receive funding, if the CG could make the funding conditional on monitoring.*

Proof. The proof of the first part is trivial and therefore omitted. As for the second part, observe that if the CG could make the funding conditional on monitoring and enforce the RG monitor the contractor, the cost for the CG for each project would be $E[C(x_i)] = c_1 + \overline{\pi} c_2 + m$. Thus, the number of applications, which receive funding is $\frac{T}{c_1 + \overline{\pi} c_2 + m + \varepsilon} = \bar{N}$. Substituting $\bar{N}$ and N^* into $W[\Gamma_i(\underline{P}_i^{t=1}, g)]$ gives $(N^* - \bar{N})v$ which is negative, provided that monitoring is socially efficient activity, $m < (\bar{\pi} - \underline{\pi})c_2$. ■

The RG has limited incentives monitor the contractors due to the soft budget constraint. Lemma 1 illustrates that the friction between the public sector agents induces a welfare loss. A funding arrangement that covers all the costs an investment to prudential risk management requires does not have the desired effect, because the RGs cannot establish a credible precommitment to engage in monitoring after receiving the funds. It is therefore optimal for the CG to finance projects where no funds are directed to investments on risk management.

3.2 Conventional contracts with collateral

Excessive risk taking can be mitigated transferring part of the risk to the counter party using collateral requirements. This instrument is also available for the public sector. An optimal contract with collateral must be incentive compatible in a following sense. The payment for the contractor should cover the investment cost and the opportunity cost for holding excess capital in liquid form. Formally, the individual rationality constraint satisfies

$$P^{t=1} - c_1 - \varepsilon - (1 - \bar{\pi})k_i \geq k_i r_k$$

which implies that a cost minimizing contract implements an action $e = \varepsilon$ with minimal level of private capital k_i.

The optimal capital level k^* can be derived from the following incentive compatibility constraint

$$P_i^{t=1} - c_1 - \varepsilon - (1 - \bar{\pi})k^* = P_i^{t=1} - c_1 - (1 - \underline{\pi})k^*.$$

where the LHS of the equation is the payoff the contractor receives of a prudentially managed contract for a given $P_i^{t=1}$. The RHS of the equation is the payoff the contractor receives from a project with a risk profile $\underline{\pi}$. Solving for k^* gives

$$k^* = \frac{\varepsilon}{\bar{\pi} - \underline{\pi}}$$

This expression illustrates that the optimal collateral requirement is independent of the ex-post value of the incremental cost c_2.[8] Substituting k^* into the individual rationality constraint of the contractor, gives the optimal payment that minimizes the expected procurement costs

$$\bar{P}_i^{t=1} = c_1 + \varepsilon \frac{1 - \underline{\pi} + r_k}{\bar{\pi} - \underline{\pi}}$$

where $\varepsilon \frac{1-\underline{\pi}+r_k}{\bar{\pi}-\underline{\pi}}$ is the information rent the public sector must pay for the contractor to induce prudential project management.

The incentive compatible contract just derived is, essentially, a commitment device the RG can use to maximize the probability it receives funding in the competition for public funds. The commitment device is efficient when the CG understands that the reduction in expected cost of a project is higher than the information rent that increases the contract payment. The following Lemma examines the welfare implications of collateralized conventional contracts

[8] It is worth noting that a complete transfer of risk from the public sector to the contractor occurs when $k_i^* \geq c_2$. The cost of capital $r_k > 1$ implies that a contract where the risk is transferred fully to private sector is sub-optimal ex-ante, because $(1 - \bar{\pi})c_2 < r_k k_i$ for $k_i \geq c_2$. Collateral should therefore be used only to induce prudential risk management. See also Chan and Thakor (1987).

Lemma 2 *The CG prefers conventional procurement contracts with (without) collateral if the information rent is lower (higher) than the expected cost savings. Formally, the CG accepts only applications with* $\Gamma_i(\bar{P}_i^{t=1}, k^* + g)$ *iff*

$$\varepsilon \frac{1 - \underline{\pi} + r_k}{\bar{\pi} - \underline{\pi}} < c_2(\bar{\pi} - \underline{\pi}).$$

The welfare loss resulting from using collateral is given by $(N_k^* - \bar{N})v < 0$ *where* $N_k^* = \frac{T}{P_i^{t=1} + \bar{\pi} c_2}$.

Proof. The proof of the first part follows directly from

$$w[\Gamma_i(\bar{P}_i^{t=1}, k^* + g)] - w[\Gamma_i(\underline{P}_i^{t=1}, g)] = -\varepsilon \frac{1 - \underline{\pi} + r_k}{\bar{\pi} - \underline{\pi}} + c_2(\bar{\pi} - \underline{\pi})$$

. The second part argues that collateralized contract involves a welfare loss if the cost of monitoring is higher than the information rent the RG must pay for the contractor. The proof is similar to that in Lemma 1 and therefore omitted. ■

The result is driven by the role of precommitment in competition for public funds. It is common knowledge that the RGs have limited incentives monitor projects after receiving funding for the investment. In bidding for state funding the RGs are less likely to receive funding from the CG, unless they propose a contract that specifies a capital structure, which conducive with prudential risk management. In equilibrium, CG accepts only collateralized contracts when the reduction in expected costs of the projects is higher than the cost the public sector incurs for implementing incentive compatible conventional procurement contracts. The commitment device thus increases welfare, because prudential risk management increases the number of public projects for a given tax income.

4 PPP procurement contracts

The main difference between PPP and conventional procurement contracts is the timing of the payment. When the payment is tied to the delivery of the service the contractor is induced collect the funds for the initial investment from private sources. Private funding thus makes the project highly leveraged, which has the following implications on the moral hazard problems in procurement projects.

First, the private equity capital used to finance the investment has the same effect on the risk management as collateral requirements in conventional procurement. That is, the contractor has an incentive to manage the risks prudentially when he has own capital invested in the project. Second, the financial institutes, which lend the funds for the contractor, may have an incentive to bail out a project subject to cost overrun to secure the repayment of the loans. This property effectively insulates the public sector against cost overruns. Finally, since private financiers operate under hard budget constraint, the agency problem that inhibits efficient project management in public sector might be less severe in PPP procurement contracts.[9]

I begin the analysis of the PPP contracts assuming that the financial institutes do not have an access to a monitoring technology. In this framework I derive the capital structure of optimal contracts that induce prudential risk management and private investors carry the risk of a cost overrun. Second, I derive the optimal PPP contract for the CG under the assumption that

[9] This feature is discussed and presented briefly in Maskin and Tirole (2008).

financial institutes have an access to the monitoring technology. Finally, I compare the optimal PPP contracts to those derived in the previous section and illustrate the circumstance where PPP contracts welfare dominate conventional ones.

4.1 Optimal PPP contracts without public capital

An optimal PPP contract transfers the risk that the financier must bail out the project to the private sector. If the risk of a cost overrun remained with the public sector, a PPP contract is welfare inferior than conventional contracts, because the interest rate on the capital invested to the initial investment is higher than in conventional contracts. Therefore, I begin the derivation of the optimal PPP contract examining the conditions where a PPP contract induces a market solution for the cost overrun.

Observe first that when additional funding is needed, the initial investment is sunk. Since the CG has not paid to the contractor, it bails out the contractor with a project x_i if $P_i^{t=2} + c_2 < v_i$. Otherwise, the CG refuses to pay. If we assume that the projects subject to cost overrun are ex-post inefficient: $c_1 + c_2 > v_i$, the CG obviously refuses bail out a PPP project with $C_2 = c_2$ and the funds to cover the cost overrun must be found from the capital markets.

The private investors bail out the project, if the net present value of the project is sufficiently high so that it covers the opportunity cost:

$$c_2 \left(\frac{P_i^{t=2} - d_i r_b}{k_i + c_2} - r_k \right) > 0,$$

where the first term inside the brackets is the return for the investment net of the repayment of the loan the contractor owes to the bank $d_i r_b = (c_1 - k_i) r_b$ divided between the shareholders. The minimum payment $P_i^{t=2}(K_i)$ which transfers the risk of a cost overrun to the investors is therefore

$$\bar{P}_i^{t=2}(k + d_i) = c_2 r_k + c_1 r_b - k_i (r_b - r_k).$$

A financial institute has an incentive to renegotiate the loan or bail out the contractor when the value of the loan repayment is sufficiently high. Should the value exceed the cost collecting the amount c_2 from capital markets or depositors at a rate r_g, the bank will bail out the contractor. A formal expression of this condition is

$$(c_1 - k_i) r_b > r_g c_2. \tag{4.1}$$

For a given k_i we can derive a minimum interest rate that transfers the risk of a cost overrun to the bank. The interest rate satisfies the following condition

$$(c_1 - k_i)[\pi(e) r_b - 1)] + [1 - \pi(e)][(c_1 - k_i) r_b - c_2] \geq (r_g - 1)(c_1 - k_i).$$

The individual rationality constraint illustrates that if the bank lends to a contractor with a risk profile $\pi(e)$ at a rate r_b, it will bail out the contractor when[10]

$$r_b \geq r_g + \frac{[1 - \pi(e)] c_2}{c_1 - k_i} \equiv r_b^*,$$

Substituting r_b^* to (4.1) implies that the bank always bails out the contractor if $\frac{c_2}{c_1 - k} < 1$.

[10] The risk profile satisfies $\pi(\varepsilon) = \bar{\pi}$ and $\pi(0) = \underline{\pi}$,

The following Lemma summarizes the properties of PPP contracts and shows that they are welfare inferior to conventional contracts, unless the financiers have an access to a monitoring technology

Lemma 3 *A PPP contract insulates the CG against the risk of a bail out if* $r_b \geq r_b^*$ *and* $\frac{c_2}{c_1-k} < 1$ *or* $P_i^{t=2} \geq \bar{P}_i^{t=2}$*. The optimal PPP contract without bank monitoring is financed fully with bank credit and the interest rate equals* r_b^**. Such contracts are, however, welfare inferior to conventional procurement contracts.*

Proof. The proof of the first part follows immediately from (4.1) and the closed form expression for $\bar{P}_i^{t=2}(k+d_i)$ and r_b^*.

To show that PPP contracts should be financed fully with bank credit, observe first that a financier can implement prudential risk management with a collateral requirement $k \geq k^*$. Thus, by Lemma 1 it is obvious that an optimal contract involves $k = k^*$ or $k = 0$, depending on the model parameters. The lowest acceptable rate that transfers the risk to the shareholders is $\bar{P}_i^{t=2}(k_i + d_i)$ and the lowest acceptable rate that transfers the risk to the bank is $\underline{P}_i^{T=2}(k_i+d_i) = k_i r_k + (c_1-k)r_b^*$. The difference between these payments is

$$\bar{P}_i^{t=2}(k_i + d_i) - \underline{P}_i^{T=2}(k_i + d_i) = (c_1 - k)(r_b - r_g) + \pi(\varepsilon)c_2 - (1 - r_k)c_2$$

This expression is positive because $(r_b - r_g) > 0$ and $(1 - r_k) < 0$. Thus, a PPP contract that involves $r_b = r_b^*$ is welfare superior to a contract with $P_i^{t=2} = \bar{P}_i^{t=2}$ and $r_b < r_b^*$. The result that a PPP contract should be financed without equity capital follows directly from that $\underline{P}_i^{T=2}(k_i + d_i)$ is minimized with $k = 0$.

Finally, Lemma 2 implies that a conventional contract with collateral requirement is welfare superior to conventional contract with $k = 0$ if

$$\varepsilon \frac{1 - \underline{\pi} + r_k}{\bar{\pi} - \underline{\pi}} < c_2(\bar{\pi} - \underline{\pi}).$$

Since the optimal collateral requirement of a PPP contract must coincide with that of a conventional contract, the conventional contracts are welfare superior to the optimal PPP contract when

$$\underline{P}_j^{t=1} + (1 - \underline{\pi})c_2 - \underline{P}_i^{T=2}(d_i) = (1 - r_g)c_1 < 0$$

Since $(1 - r_g) < 0$, the social cost of the project a conventional contract is lower than that of a PPP contract. ■

Lemma 3 indicates that when the public sector transfers the risk of a cost overrun to the financiers the risk should be transferred fully onto the financial institutes, because the banks can gather the funds required to finance the project at a lower rate than private investors. A contract that induces the financial institute bail out the contractor in all states of the world leads to the same moral hazard problem that emerges between the RG and the contractor. This implies that - unless the bank designs incentive compatible loan contracts with the same collateral requirement required in conventional contracts - the risk profile of a PPP contract is $\underline{\pi}$. In all cases, there is no reason for the public sector outsource the burden of collecting the funds for the investment to a private sector agent, who must pay a higher interest rate for the funds borrowed from the financial market.

4.2 Optimal PPP contracts with monitoring

The result in Lemma 3 is partially driven by the feature that contracts between private financiers and the contractors are equally incomplete as those between the RG and the contractors. It is therefore not implausible to think that the private financiers have an access to the same monitoring technology as the RG.[11] This gives the public sector an opportunity to outsource the risk management activities. If the public sector wishes to use a financial institute as a delegated monitor, the contracts should be designed incentive compatible for the financial institutes.

An incentive compatible PPP contract involves an interest rate (with $k = 0$), which makes monitoring individually rational for the financial institute:

$$r_b \geq r_g + \frac{m + (1 - \bar{\pi})c_2}{c_1} \equiv r_{bm}. \tag{4.2}$$

This expression implies that the expected repayment must be sufficiently high so that it covers the cost of collecting the funds from the capital markets or depositors and the cost of monitoring. Furthermore, monitoring is incentive compatible for the bank, if

$$\bar{\pi} r_{bm}(c_1 - k) - m + (1 - \bar{\pi})[r_{bm}(c_1 - k) - c_2] > \underline{\pi} r_{bm}(c_1 - k) + (1 - \underline{\pi})[r_{bm}(c_1 - k) - c_2],$$

which illustrates that for a given interest rate, r_{bm}, the bank monitors the contractor if the increase in the expected repayment is higher than the monitoring cost $(\bar{\pi} - \underline{\pi})c_2 > m$. Otherwise, monitoring is suboptimal for the bank and the resulting risk profile of the project is $\underline{\pi}$.

The optimal interest rate for a contract that induces monitoring can be solved from (4.2), which implies that the optimal PPP contract without public funding involves an interest rate r_{bm} and a capital structure $K = d = c_1$. The optimal payment is thus $\underline{P}_i^{t=2} = r_{bm}c_1$. The following Lemma further examines the properties of the contract

Proposition 1 *When the banks have an access to the monitoring technology, a PPP contract is socially optimal procurement method, if*

$$m \leq (r_g - 1)c_1 + \varepsilon \frac{1 - \underline{\pi} + r_k}{\bar{\pi} - \underline{\pi}},$$

This implies that the CG should choose only applications with PPP procurement, if the conventional contracts without collateral requirements welfare dominate the contracts with collateral and $\varepsilon \geq (r_g - 1)c_1$.

Proof. Observe first that $m \in [0, (\bar{\pi} - \underline{\pi})c_2 - \varepsilon]$. Thus, when $m = (\bar{\pi} - \underline{\pi})c_2 - \varepsilon$ we have

$$w[\Gamma_i(\underline{P}_i^{t=2}, d)] - w[\Gamma_i(\bar{P}_i^{t=1}, k^* + g)] = (1 - r_g)c_1 - (\bar{\pi} - \underline{\pi})c_2 + \varepsilon + \varepsilon \frac{1 - \underline{\pi} + r_k}{\bar{\pi} - \underline{\pi}}$$

where $-(\bar{\pi} - \underline{\pi})c_2 + \varepsilon = -m$. If the RGs cannot induce prudential risk management with collateralized contracts, Lemma 2 implies that $-(\bar{\pi} - \underline{\pi})c_2 + \varepsilon \frac{1 - \underline{\pi} + r_k}{\bar{\pi} - \underline{\pi}} > 0$. Thus, the effect of PPP contracts in welfare is positive provided that the premium the banks pay for their loans in the money market is sufficiently small relative to the investment the contractors must make manage the risk prudentially. A sufficient condition (not a necessary one) for this is $\varepsilon \geq (r_g - 1)c_1$.

[11] See Diamond (1984).

If the CG rather finances conventional contracts with collateral than contracts without collateral, Lemma 2 implies that $-(\bar{\pi}-\underline{\pi})c_2+\varepsilon\frac{1-\underline{\pi}+r_k}{\bar{\pi}-\underline{\pi}}<0$. Thus, the CG prefers PPP contracts if the premium is sufficiently small relative to the difference between the monitoring cost and the information rent the tax payers must pay the contractor for prudential risk management. Formally, $m\leq(r_g-1)c_1+\varepsilon\frac{1-\underline{\pi}+r_k}{\bar{\pi}-\underline{\pi}}$. ■

Proposition 1 indicates that PPP contracts may improve the efficiency of public procurement when the monitoring cost is sufficiently low. The intuition for this result is straightforward. A PPP contract transfers the risk to the financial institute, which has an incentive monitor the contractor. The delegation of the monitoring activity is optimal for the public sector, if the monitoring cost is lower than the information rent the public sector incurs in the collateralized contracts and the cost of raising funds from the capital markets is modest for the banks.

4.3 PPP contracts with public capital

The results just derived are a manifestation of the argument against PPP contracts in a sense that high interest rates of private equity and bank loans indeed increase the procurement costs. To counter the critics some countries have used PPP contracts where the capital structure of the project is a combination of public and private capital. These contracts have been criticized, because public funding may prevent efficient transfer of risks to the private financiers.[12] In this section I provide a qualification to this view showing that an optimal PPP contract involves a capital structure that is a combination of public funds and debt.

Suppose that the capital structure of an investment project involves g_i units of public funds and a bank loan equal to $d_i=c_1-g_i$. A payment that is individually rational for the contractor is then $P_i^{t=2}\geq g_i+r_b(c_1-g_i)$. If the government uses the PPP contract to delegate the monitoring activities to the bank, the amount of public funds used in the project finance must be sufficiently low so that the bank carries the risk of the cost overrun. Using (4.1) with $k_i=0$ we can readily solve for g^*, which is the highest amount of public funds that satisfies this criteria for a PPP contract. With a given interest rate r_b the upper bound for the public funds to be used in the project can be written as

$$g^*=c_1-\frac{r_g}{r_b}c_2$$

Since $r_b\geq r_g\geq 1$, the parameter g^* is the proportion of public funds that minimizes the costs of implementing a PPP contract that transfers the risk onto the bank.

In a similar manner as in (4.2) the interest rate that induces monitoring is

$$r_{bm}^*=r_g+\frac{m+(1-\bar{\pi})c_2}{(c_1-g^*)}.$$

where $r_{bm}^*>r_{bm}$. This illustrates the feature that an increase in g^* increases r_{bm}^*, as it must be individually rational for the banks to carry the risk of a cost overrun and monitor the contractor.

These results imply that optimal financial design of a PPP contract satisfies the following welfare properties

Proposition 2 *The optimal capital structure of a PPP contract involves g^* units of public funds, c_1-g^* units of debt finance and an interest rate r_{bm}^*.*

[12] For empirical evidence on risk transfer and financial discipline in procurement contracts see Dobrescu et al (2008).

Proof. Let $P^{t=2}[r^*_{bm}(c_1 - g^*), d^*_i + g^*]$ and $P^{t=2}[r^*_{bm}(c_1 - g_i), d_i + g_i)$ denote a contract with different capital structures so that $d_i = c_1 - g_i > c_1 - g^* = d^*$. The payment $P^{t=2}[r^*_{bm}(c_1 - g), g)$ is linear and decreasing in g. Therefore, a PPP contract with g^*units of public capital is welfare superior to PPP contract with $g = 0$, because

$$w[\Gamma_i(P_i^{t=2}, d)] - w[\Gamma_i P^{t=2}[r^*_{bm}(c_1 - g^*), g^*]] = (1 - r_g)g^* < 0$$

When $g \to c_1$ the cost of a PPP contract coincides with that of a conventional contract without collateral, which by Proposition 1 is welfare dominated by the PPP contract with $g = g^*$. ■

Propositions 1 and 2 summarize the main results of this paper. PPP contracts may increase welfare if the public sector cannot implement a system where the incentives of the taxpayers coincide with those of the civil servants. If the CG could induce prudential risk management on behalf of RG, the funding for the projects should originate from public sector as this minimizes the interest rates costs of the projects. However, soft budget constraint in the public sector mitigates monitoring in the public sector and thereby induces inefficiently high number of cost overruns.

A PPP contract is a device, which delegates the monitoring activities away from the inefficient RGs to private financial institutes. This arrangement is socially optimal if the financial institutes can collect capital at a sufficiently low interest rate so that the difference between the public and private interest rates is modest. Furthermore, the positive welfare effects from PPP contract can be achieved only if the costs of financial instrument available for the RGs in the design of conventional contracts are high relative to the monitoring cost.

As for the financial structure of the PPP contracts, the last result of the study shows that optimal PPP contracts entail a capital structure, which is a combination of public capital and a loan from a financial institute. This finding contradicts the current practices where most of PPP contracts are financed with a combination of private equity and loans from financial institutes.

5 Conclusion

The aim of this paper was to examine the capital structure of public procurement contracts and derive socially efficient contracts in the presence of a soft budget constraint in public sector. A special attention was paid to a comparisons between conventional procurement contracts and PPP contracts. The assumptions regarding the difference between the procurement contracts were the following. In conventional contracts, the public sector finances an initial investment project managed by a contractor. In a PPP contract the contractor gathers the funds for the investment from financial markets and the public sector pays a service fee to the contractor after the completion of the project.

The model shows that when the incentives of the government agents are imperfectly aligned the central government cannot induce the regional governments monitor the procurement contracts, because the responsibility to finance cost overruns remains with the central government. A PPP contract delegates the monitoring task to a financial institute, which - unlike the regional government - has a hard budget constraint and an incentive monitor the contractor. The contract is therefore welfare superior if the monitoring cost and the interest rate for the funds the financial institutes gather from the capital markets are sufficiently low compared to the agency costs the public sector incurs using conventional contracts.

The results provide a formal analysis of arguments presented in public debate for and against Public-Private-Partnerships. The argument that PPP contracts are welfare inferior, because the interest rate payments for private investors contribute to inefficiently high procurement costs, is well grounded in cases where the public sector acknowledges the project risks and designs the

procurement contracts accordingly. In this case, the private capital just increases the costs of the public sector without positive effects on project management.

The argument that PPP contracts contribute to more efficient public procurement is correct when there are well established reasons to believe that public sector fails to solve the agency problems inherent in imperfect procurement contracts. Carefully designed PPP contracts help the public sector internalize the costs the improvements in project management may require. As for the optimal capital structure of PPP contracts, the results show that PPP contracts in their current form, where equity finance constitutes a considerable share in the financial structure of the contract, are sub-optimal, because higher interest rates increase the cost of PPP contracts compared to PPP contracts financed with a combination of public funds and debt from financial institutes.

References

Arrow, K. and Lind, R.: 1970, Uncertainty and the evaluation of public investment decisions, *American Economic Review* **60**, 364–378.

Chan, Y.-S. and Thakor, A. V.: 1987, Collateral and competitive equilibria with moral hazard and private information, *The Journal of Finance* **42**(2).

Dewatripont, M. and Maskin, E.: 1995, Credit and efficiency in centralized and decentralized economies, *Review of Economic Studies* **62**, 541–556.

Diamond, D. W.: 1984, Financial intermediation and delegated monitoring, *The Review of Economic Studies* **51**(3), 393–414.

Dobrescu, G., Friebel, G., Grosjean, P. and Robeck, K.: n.d., The Determinants of Performance in Building Infrastructure in Transition Economies.

Flyvbjerg, B., Bruzelius, N. and Rothengatter, W.: 2003, *Megaprojects and Risk: An Anatomy of Ambition*, Cambridge University Press.

Grimsey, D. and Lewis, M. K.: 2004, *Public Private Partnerships: The worldwide revolution in infrastructure and provision and projects finance*, Edward Elgar.

Hart, O.: 2003, Incomplete Contracts and Public Ownership: Remarks, and an Application to Public-Private Partnerships*, *The Economic Journal* **113**(486), 69–76.

Hart, O., Shleifer, A. and Vishny, R.: 1997, The Proper Scope of Government: Theory and an Application to Prisons*, *Quarterly Journal of Economics* **112**(4), 1127–1161.

Kornai, J.: 1979, *Economics of shortage*, North-Holland, Amsterdam.

Maskin, E. and Tirole, J.: 2008, Public–private partnerships and government spending limits, *International Journal of Industrial Organization* **26**(2), 412–420.

Qian, Y. and Roland, G.: 1998, Federalism and the Soft Budget Constraint, *American Economic Review* **88**(5).

Theory of the Firm: Managerial behavior, Agency Costs and Ownership structure: n.d.

Times, F.: 2008, Eu transport projects face Ă40bn overrun, *Financial Times, April 7* .

Williamson, O.: 1967, Hierarchical Control and Optimum Firm Size, *The Journal of Political Economy* **75**(2).

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