PPP, an Alternative Way of Provision of Public Services [1]

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Abstrakt

Bakalářská práce *PPP, alternativní cesta poskytovaní veřejných služeb* pojednává o výhodách a nevýhodách poskytování veřejných služeb v rámci PPP (z angličtiny Public-Private Partnership) projektů. Práce hledá projekty, u kterých je výhodné spojit stavbu a provozování infrastruktury do jedné smlouvy s jedním dodavatelem. Práce se zaměřuje na komplexnost, kterou se vyznačují PPP projekty a na problémy a výhody z hlediska dlouhého časového období po které jsou PPP projekty realizovány. Zvláštní pozornost je věnována vyjednávací síle, která může být u komplexních smluv rozložena mezi oba smluvní partnery. Dále je zkoumán vliv institucionálního prostředí na užitek vlády plynoucí z PPP projektů. V práci je využita principál-agent analýza. Výsledky modelů pro PPP projekty jsou provnávány s výsledky jakých by dosáhli projekty zpracované tradiční metodou poskytování veřejných služeb. Práce zkoumá ve kterých případech je lepší použit tradičí postup a ve kterých je výhodnější použití PPP projektu. Dále jsou teoretické výsledky porovnávány s praktickými PPP projekty již uvedenými do praxe.

Klíčová slova: Public-private Partnership (PPP), poskytování veřejný služeb, svazování, vládní dodávky.

JEL Klasifikace: D8, D23, L5, H54, H57

Abstract

Bachelor Thesis *PPP, an Alternative Way of Provision of Public Services* deals with advantages and disadvantages of provision of public services by PPP (Public-Private Partnership) projects. The thesis describes when it is beneficial for the government

to bundle the building and operating the infrastructure into one contract. The thesis concentrates on complexity which characterizes PPP projects and on problems and benefits from the long-term duration of PPP projects realization. Special focus is given to negotiating power which may be split between both partners in more complex contracts. Further the the impact of institutional framework on government's welfare is analyzed. In thesis is used a principal-agent analysis. The outcomes of the models of PPP are compared to outcomes which would be achieved with traditional contracts. The thesis show which projects are suitable for PPP contracts and which projects would bring better results with traditional contracting. The outcomes of theoretical models are compared to experience with already realized projects.

Keywords: Public-private partnership, public service provision, bundling, public procurement.

JEL Classification: D8, D23, L5, H54, H57

Prohlášení

Prohlašuji, že jsem předkládanou práci zpracoval samostatně a použil jen uvedené prameny a uvdenou literaturu. Souhlasím s tím, aby práce byla zpřístupněna veřenosti pro účely výzkumu a studia.

V Praze dne 17.6.2009 Viktor Zeisel

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Chapter 1

Introduction of Public Private Partnership

Last decades we can observe a tendency of tighter cooperation of public and private sector in the case of providing public goods and services. One of the arrangements which is recently very popular is Public-Private Partnership (thereinafter PPP). In the United Kingdom is PPP widely called PFI (Private Finance Initiative). PPP are considered as an alternative to traditional public provision of public services. Some commentators are worried that the popularity of the PPP is not based on qualities and advantages of the contract (discussed below), but on the "budget tricks" which enable to take liabilities off the balance sheet of the government. In this thesis I will show the benefits which PPP posses over traditional setting on one hand but on the other hand I will discuss the problems and risks connected to PPP.

1.1 Description of PPP

The PPP is one of the arrangements where state outsources supplies of infrastructure assets and services that have traditionally been provided solely by governments or local governments. The core of PPP is in bundling into one contract what previously was solved by two separate contracts. First contract was designed for building the infrastructural facility and the other for operating this facility. This arrangement is widely used in building and running infrastructural projects such as highways, prisons, water supply etc. There are more designs of PPP. Here is a list of most frequent ones:

- BO - *build and operate design. The very basic design when the contractor finances, builds and then operates the facility.*

- BOT - *build, operate and transfer. The contractor builds, operates and at the end of the concession period transfers the facility to the government.*
- DBFO - *design, build, finance, operate. The contractor designs, builds, finances and operates the facility.*

The public authority have several incentives to cooperate in PPP. First of all is higher quality and lower cost of the service which could be achieved through skillful management which is from the market environment used to competition which increases efficiency. Secondly the government is attracted by the possibility that the private sector brings its own money into the project and that would make the public budgets better looking. The presence of the private partner could as well be seen as a good reason for the direct payments which would be unpopular when collected by government.

The private partner who is providing public services receives a new opportunity which was forbidden for him before.

1.2 Advantages and Disadvantages of the PPP

1.2.1 Advantages

Underinvestment into Quality

In the arrangement with two contracts it could easily happen that the contractor in the first period (building the facility) would underinvest to minimize his cost and then the maintenance costs in the second period (operation of the facility) rise. The builder does not have the incentive to invest socially optimal sum. On the other hand in the PPP arrangement the contractor internalizes the maintenance costs from the second period already in the building period. The typical example is using less quality materials. In many cases it is very difficult or very expensive to observe if the investment was sufficient enough. In the second case it could overinvest as well which could have an effect on the quality of the service. For example too tough controls in the hospital entrance. In this case the builder does not internalize the quality reduction costs. The PPP arrangements make an opportunity for the government to specify the operating parameters already in the first period, such as flow of cars on the highway etc. Flexibility of the project increases as well when the quality parameters are set it on the contractor to adjust the infrastructure to be appropriate. The basic incentive mechanism of cost internalization is described in the first chapter.

Risk sharing

All projects are usually connected with some risk. Some risks are endogenous to the public authority, some to the contractor and some risks are exogenous to both of them. The PPP design can reduce the moral hazard which is more or less part of any contract by transferring the risk to the appropriate partner. Together they can share the exogenous risk which is relief to public authorities. Risk sharing can help with evaluating costs and profits of the project. The public government has the tendency to overestimate benefits and underestimate cost. The presence of private partner can bring realistic view into the process of evaluation. A company from private sector would rather not undertake an investment with doubtful outcome. This mitigates the projects which were wrongly evaluated. These projects can be born as well from politician who wants to be perceived as an active. Sometimes the public authorities just do not have information about the prices on the market (price of labour, commodities etc.). With the problem of appropriate risk sharing we deal in the fifth chapter.

Construction Time

Especially by BOT contracts the contractor has a strong incentive to build the facility as quickly as possible. He knows he has to transfer the facility to the local government after period of time and therefore he would like to use as much of the period as possible to make profit.

Outcome Specifications

The PPP contracts are designed on an outcome base. The contract does not say directly how the infrastructure should look in detail but rather sets a set of quality measures that the infrastructure must fulfill. In a case of highway does not set the number of lanes but rather the density of traffic. In a case of public transportation does not say how many buses have to operate but rather sets how long maximally the passengers should wait. The contract with one of the operators of London Underground was for example set on four following criteria:

- Technical capability of the lines, maximal capacity to reduce durations of trips.
- Time lost by users (trains speed reduction).
- Global service quality perceived and assessed by independent surveys.

Penalties are applied in the case of failure to meet specified standards (mainly when the trains were delayed).

Inter-Generational Fairness

In the traditional setting the government usually pays in advance for whole infrastructure which is then used for longer period of time. It is not sure that the citizens who paid (through their taxes) for the infrastructure will later use it. In PPP settings the payments goes gradually to the private contractor and the infrastructure is usually transferred to the government at the end of contracted period. Therefore users are those who pay for the infrastructure.

Underdeveloped Countries

In underdeveloped countries or countries in transition exists need for wide infrastructural development to catch up with developed states. It is difficult to invest into many projects with limited budget. PPP enables to the governments to undertake these projects at once and spread the costs over long-period.

1.2.2 Disadvantages

Specialization

To be market efficient the entrepreneurs try to be specialized for their part of the market. In PPP the firms do have to play two different roles (a builder and an operator). It could happen that firm which can build a facility with low costs would not be able to operate such a facility with low costs again.

Lack of Flexibility

The PPP is a contract for long period of time and the outcome requirements changes over time. There are two ways how to help by this problem. Firstly the government can connect the demand risk to the payment to the private contractor. Secondly the contract should contain parts which enable adjustments of the quality requirements over time. If none of this is fulfilled then users receive less benefits or costly renegotiation follows. With this problem we deal in the fourth chapter.

Renegotiation

Renegotiation is very costly instrument of adjusting the contracts. PPP is a long-term contract signed in a unstable environment and therefore in many cases tends

to renegotiation. The renegotiation can be led by private contractor when his cost are higher than those expected or by government who can behave opportunistically or who would like to adjust an contract which signed by a preceding administration. There are also cases of strategical cost overruns or strategical incompleteness of the contract when the private operator ex ante plans to renegotiate. In these cases the contractor often collude with public official. With these problems we deal in the sixth chapter.

Chapter 2

Cost Internalization

In this chapter we will focus on basic PPP problem of cost internalization. This chapter should show one of the biggest advantages of PPP over conventional setting. The key issue of the PPP here is bundling of construction and operational stages so that the the consortium internalizes the operating costs already in the construction period. The government is a welfare maximizer and delegates on the private firm provision of the public service. We will use basic model developed by Elisabetta Iossa and David Martimort (2008) where the government has all bargaining power to show incentive inducement. Then we will relax this assumption and modify the model distributing the bargaining power between public and private partner.

The model consists of two periods. First is the building period when the infrastructure is designed and build. Second is operating period when the infrastructure is used and maintained.

The builder can make investments to improve the quality of the project. This will increase the benefit provided by the facility. Thereinafter we will denote social benefit by:

$$B = b_0 + ba,$$

where $b > 0$ denotes marginal benefit from the investor's effort and a denotes this effort. b_0 is base level of benefit provided by the service. The builder receives fixed payment for construction in the first period. In the second period the operator pays maintenance cost depending as well on builder's effort. The operator's cost is then following:

$$C = \theta_0 - e - \delta a + \varepsilon,$$

where θ_0 is the base cost of the service (depends on the technology), e is the effort of the agent to reduce the cost. The a denotes again to quality improvements by the builder. $\delta > 0$ corresponds to positive externality of the quality effort. If it is positive

than the quality improvement leads as well to operating cost reduction in the second period. There is no trade off of quality to cost reduction, both can be achieved with one investment. For example good security system which would make unnecessary to hire security stuff or better materials used to build highway which does not have to be repaired that often. In the other case when $\delta < 0$ the quality improvement is costly and make negative cost externality. There is a trade off between quality of infrastructure and operating costs in the second period. For example well climatized offices would increase the energy cost on one hand but improve the conditions for employees on the other.

It is clear that efforts improving quality and reducing operational costs are expensive. These expenditures are given as quadratic disutility functions $\varphi(a) = \frac{a^2}{2}$ and $\psi(e) = \frac{e^2}{2}$.

The delegation of services takes place under information asymmetry and therefore the values a and e are not observable to the government. The information asymmetry creates a moral hazard environment. Only total operating cost C is known to all, therefore this could be the cost used to make the contract between government and private partner. Again we can use the example of a highway. If the builder uses better (and obviously more expensive) technology there is lower need to repair the highway in the second period. Unfortunately it is impossible to observe immediately after it is ready to use, but later (probably in years later) the highway must be repaired and the operating costs are higher.

We can consider government risk neutral willing to maximize the social welfare. The PPP projects are usually very big and therefore we assume that they play crucial role in the private firm's portfolio and the private partner is therefore risk averse. We can denote the rate of risk aversion by $r > 0$, where $r = \frac{u''(w)}{u'(w)}$. For simplicity we assume that the private firm has constant absolute risk aversion, so the function is $1 - exp(-rw)$ [1]. The utility of private partner consist of the payment he gains and effort he must induce.

Timing

The events and decisions in contracting proceed in following order:

1. Decision on the type of the contract: PPP or Traditional setting is made.

[1] $r = -\frac{u''(w)}{u'(w)}$ is constant with respect to w

2. A fixed price contract with the builder is made or $t(C)$ contract with consortium is made.

3. The contract $t(C)$ with operator is made.

4. Builder chooses quality enhancing effort a which cannot be verified by the government.

5. Operator chooses cost reducing effort e which cannot be verified by the government.

6. The operating cost is realized and operator receives his payment.

7. Users enjoy the facility and the social benefit is realized.

First Best Solution

As a benchmark we will use the first best levels of quality enhancing and cost reducing efforts denoted by a^{FB} and e^{FB} respectively. These values would be set in the initial contract (and will be verifiable) and the risk averse private firm would be fully insured by the risk neutral government. In this case the private investor would receive only his opportunity costs and no other rent. The levels of a^{FB} and e^{FB} would be derived from the following equation:

$$(a^{FB}, e^{FB}) = \arg\max_{(a,e)} b_0 - \theta_0 + (b+\delta)a + e - \frac{a^2}{2} - \frac{e^2}{2} \tag{2.1}$$

After maximization we get $a^{FB} = b + \delta$ and $e^{FB} = 1$.
Any profit transfer from the government to the private contractor would reduce social welfare, because of risk-aversion of private partner. The profit for private partner has thus lower utility value than for the risk-neutral government.

2.1 Traditional Setting or PPP?

We will use the previous analysis to determine whether the PPP or traditional setting brings better results for the government's welfare. The crucial question is whether building and operating should be part of one contract (PPP) with one consortium [2] or should be set by two separate contracts with builder and with operator (traditional setting)[3].

[2] These variables will be denoted by subscript P.
[3] This will be denoted with subscript T.

2.1.1 Traditional Setting

Under traditional setting the government signs first the contract with the builder (who chooses the effort level a) and afterwards a second contract with the operator (who chooses the effort e). The operator receives payment according to function of his costs $t(C)$. The total operating costs are known to both parties and therefore is possible to make a contract based on them. We will reduce the analysis only for linear rules and use the cost reimbursement rule described in Holmström and Milgrom (1991). The vector of information signals is C. So the certainty equivalent of the private contractor will come from equation:

$$u(CE) = E\{u[w(\theta_0 - e - \delta a) + \varepsilon - \frac{e^2}{2}]\},$$

where $u(w) = 1 - exp(-rw)$. Remember that this is the case of constant absolute risk aversion.
The payment function will become $t(c) = \alpha - \beta C$. The two extreme cases are when $\beta = 0$ and $\beta = 1$. The former corresponds to clean cost-plus contract with no cost reducing incentives, on the other hand the latter corresponds for incentive contract. Remember again that C is known to both parties and therefore the parties are able to make contract regarding this value.
This makes the certainty equivalent to look as following:

$$CE = -\beta(\theta_0 - e - \delta a) + \alpha - \frac{e^2}{2} - \frac{r\sigma^2\beta^2}{2}$$

where the last term represents the private partner's risk premium insuring the risk-averse private partner from the risk contained in the contract. This risk stems from the noise over operating costs. The bigger noise the higher must the risk premium be. If the contract was purely cost-plus one the partner would be fully insured and he would not demand any risk-premium. On the other hand he would not have any incentive to invest into cost-reducing effort.
The certainty equivalent defines private partner's participation constraint and therefore must be non-negative so that the private partner enters the project. It describes the state when private partner's ex ante utility is equal to zero.
For simplicity we will consider that the builder receives a fixed payment. There are more reasons why this setting reflects reality. For example the government cannot commit himself to cover future rewards or it cannot pay with any delay. There also exists a possibility that the government would join with the operator to pretend he has higher costs and underestimate the costs of the builder. The disadvantage of the fixed price contract is that it lacks the incentive to perform the quality enhancing

effort. The builder would have to bear the cost of the quality enhancing effort, but the possible cost reduction plays role in the second period and he cannot enjoy it. Moreover the government cannot verify the investment and make it part of the contract. With fixed payment which does not reflect the level of quality investment the builder does not receive any incentive to invest into a and therefore following holds for traditional setting:

$$a_T = 0.$$

When it comes to operating period the operator knows that builder did not have any incentive to invest into quality enhancing effort and therefore he does not expect any investment to a. The operator is willing to maximize the certainty equivalent of his expected utility. He chooses the best value of cost reducing effort:

$$e = \arg\max_e \alpha - \beta(\theta_0 - e) - \frac{e^2}{2} - \frac{r\sigma^2\beta^2}{2}, \tag{2.2}$$

which after maximization yields $e_T = \beta$. So the increase in β increases the e cost reducing effort. On the other hand transfers more risk on the risk averse operator and therefore raises his risk premium $\frac{r\sigma^2\beta^2}{2}$.
For this part we assume that the government has all bargaining power then the α will be set to compensate the risk-premium and cover participation constraint of the private partner. Of course the government wants to maximize its welfare at the lowest cost. Government knows that private partner will set $e = \beta$. This composes the problem of the government:

$$\max_\beta b_0 - \theta_0 + e - \frac{e^2}{2} - \frac{(r\sigma^2)}{2}\beta^2,$$

subject to $e = \beta$ In fact government searches for the best tradeoff between the cost reduction effort and the risk premium he has to pay to the private contractor. After solving the optimization problem we get:

$$\beta_T^{SB} = e_T^{SB} = \frac{1}{(1 + r\sigma^2)} < 1 = e^{FB} \tag{2.3}$$

Government will set $\beta = \frac{1}{(1 + r\sigma^2)}$ and private contractor will adjust his cost-reducing effort to $e = \frac{1}{(1 + r\sigma^2)}$. Then is the infrastructure used and government receives his benefit b_0, because the builder did not invest into quality of the infrastructure.
Getting incentives to the contract and transferring some risk on risk averse private firm generate social costs, therefore the second-best solution brings less effort than

first-best one. The social costs increase with the growing risk aversion r of the private partner. Government's welfare under traditional setting:

$$W_T^{SB} = b_0 - \theta_0 + \frac{1}{2(1 + r\sigma^2)} \tag{2.4}$$

is also decreasing with growing risk-aversion of the private partner.

2.1.2 PPP

Let us come to the situation when building and operating are part of one contract. The contractor takes already in the first period into account all the costs of the project in both periods and therefore he is able to already in the beginning of the project count with future operating costs. The private contractor solves:

$$(e, a) = \arg\max_{(e,a)} \alpha - \beta(\theta_0 - e - \delta a) - \frac{a^2}{2} - \frac{e^2}{2}.$$

Both e and a must be non-negative. After running an optimization we gain:

$$e = \beta \text{ and } a = \begin{cases} \beta\delta & \text{if } \delta > 0 \\ 0 & \text{if } \delta < 0. \end{cases} \tag{2.5}$$

Now we see that there are two possible solutions depending on the sign of δ. Let us examine the two cases.

Negative Externality

This is the case where effort to get more quality results raises the operation costs. However contractor is not compensated for this effort and therefore would never engage in such effort. In the operating period he will solve the same problem as operator in traditional setting and therefore there is no difference in cost reducing effort:

$$e_P^{SB} = e_T^{SB}$$

and the same we substitute to the welfare function and thus the welfare levels are the same:

$$W_P^{SB} = W_T^{SB}$$

When the government has full bargaining power there is no difference in the welfare if the externality δ is negative.

Positive Externality

In this second case the quality improvement effort brings lower operating costs. There comes a tradeoff between cost of the investment in the first period and reduction of operating costs in the second period. The government can raise the power of incentives using more incetivized contract with higher β. This also raises the incentive to make the project with better quality parameters. It is big improvement to other types of contract, because the quality itself is impossible to include into the contract, because it is not observable for the government and public.
The government solves following problem:

$$\max_{\beta} b_0 - \theta_0 + (b+\delta)a + e - \frac{a^2}{2} - \frac{e^2}{2} - \frac{(r\sigma^2)}{2}\beta^2, \tag{2.6}$$

subject to $e = \beta$ and $a = \delta\beta$, which are the values of effort the private partner will induce with regard to β that the government will offer.
We optimize over β and get:

$$\beta_P^{SB} = e_P^{SB} = \frac{1+\delta(b+\delta)}{1+\delta^2+r\sigma^2} = e_T^{SB} + \delta\frac{b(1+r\sigma^2)+\delta r\sigma^2}{(1+r\sigma^2+\delta^2)(1+r\sigma^2)} > e_T^{SB}{}^4 \tag{2.7}$$

and we as well get:

$$a_P^{SB} = \delta e_P^{SB} = \delta\frac{1+\delta(b+\delta)}{1+\delta^2+r\sigma^2} > 0 = a_T^{SB}. \tag{2.8}$$

Again the government searches for the best tradeoff between the profit and benefit from both efforts on one side and with costs of the efforts and risk premium on the other side. We see that both efforts are bigger than in the case of traditional setting. We have $\beta_P^{SB} = e_P^{SB} > e_T^{SB} = \beta_T^{SB}$, and thus the risk premium $\frac{(r\sigma^2)}{2}\beta^2$ is bigger in the case of PPP. This is caused by bigger risk transfer from the government to the private partner and by the need of the private partner to be insured. This creates also bigger social cost which is on the other side outweighted by the gains from higher efforts. We add both levels of effort to the welfare function of the government and we and get:

$$W_P^{SB} = b_0 - \theta_0 + \frac{(1+(b+\delta)\delta)^2}{2(1+\delta^2+r\sigma^2)} \tag{2.9}$$

Comparing this with the welfare obtained by traditional contracting we see that:

$$W_P^{SB} > W_T^{SB}$$

In the case of positive externality ($\delta > 0$) the welfare brought by PPP is increasing in δ:

$$\frac{\partial}{\partial\delta}(W_P^{SB} - W_T^{SB}) > 0$$

[4]Note that with $r\sigma^2 \leq \delta b$ is $e_P^{SB} \geq e^{FB}$.

This is made by higher levels of quality enhancing effort and cost reducing effort.

$$a_P^{SB} > a_T^{SB} = 0 \text{ and } e_P^{SB} > e_T^{SB}$$

The effect bringing this increase in welfare is cost internalization of quality enhancing effort already into the building period.
There are two sources of the welfare raise from quality enhancing effort a. First is given by the level of positive externality δ and the second is given by direct marginal benefit from the effort b. When we take the cost of this effort together it makes net benefit $(b+\delta)a_P^{SB} - \frac{(a_P^{SB})^2}{2} > 0$.
PPP projects bring more incentives to invest in quality as well as in cost-reducing efforts. They shift as well more operational risk on the private partner and changes the cost-reimbursement rules. This can be characterized by following:

$$\beta_P^{SB} = e_P^{SB} > \beta_T^{SB} = e_T^{SB} \text{ for } \delta > 0.$$

On the other hand PPP setting transfers bigger part of the operational risk to the private partner and raises the risk-premium $\frac{r\sigma^2\beta^2}{2}$ as well in comparison to the traditional setting, if the externality is positive.

2.2 Negotiation Power

The model from Iossa and Martimort (2008) assumed that the government has all bargaining power and the government extracts all the surplus generated by the efforts enhanced by builder and operator. The cost reducing role is obvious in the operating cost equation:

$$C = \theta_0 - e - \delta a + \varepsilon.$$

The whole gain $e + \delta a$ was in previous chapter extracted by setting appropriate α. Now we will relax the assumption about the absolute negotiating power of the government and make the model more general showing different share of the negotiating power between the government and private contractor.

2.2.1 Sources of Negotiation Power

To main characteristic of the PPP project is the long period they last. In such long term contract many different conditions has to be stated (see chapter 4 Changes in Time) and also Risk Sharing is more complex than in traditional contracting (see chapter 5 Risk Sharing). There are also other institutional dangers connected to

costly renegotiation (see chapter 6 Renegotiation). The outcome specification of the contract has to be elaborate so that the government receives what it really wants. Therefore the PPP contracts must be very complex to cover all these risks and problems. According to Bajari et al. (2006) by more complex contracting, negotiation is usually preferable to auction, therefore we will assume tough negotiation in the PPP contracts and it is not sure that the government would be able to extract whole gain. The infrastructure projects undertaken under PPP contract are usually very big and not every firm can afford to join such projects. The firm or consortium of firms must be able to build and operate the infrastructure and there is obviously fewer firms that can do both than those than can either build or operate the facility. The smaller number of firms reduce the competition and the government's negotiating power reduces.

2.2.2 Modified Model of PPP

Now we will create a model where the government does not posses all the negotiation power. Let λ be the private partner's negotiation power and $1-\lambda$ the negotiation power of government. According to their negotiation power both parties will share the gain provided by the efforts. The gain of private partner will be:

$$\pi = \lambda(\delta a + e)$$

and obviously this must be subtracted from the government's welfare function. We see that we do not assume traditional negotiating over whole gain from the project, but only over gains from cost-reduction efforts.
The negotiation will be again based on operating costs C which are known to both parties. So the cost reimbursement rule changes to:

$$t(C) = \alpha - (\beta + \lambda)C$$

There is as well the gain ba the government receives by raising the quality enhancing effort and thus raising the benefit. This is ignored by the private partner. The reason is that the benefit is realized by the government after the role of private partner ends and private partner does not know the the level of marginal benefit from the effort. The solution when government could contract, observe and check all features in this scheme will be:

$$(a^{NB}, e^{NB}) = \arg\max_{(a,e)} b_0 - \theta_0 + (b + \delta(1-\lambda))a + (1-\lambda)e - \frac{a^2}{2} - \frac{e^2}{2} \qquad (2.10)$$

After maximization we get $a^{NB} = b + \delta(1-\lambda)$ and $e^{NB} = 1-\lambda$ which are smaller than the first best values. Even the government pays all the cost it does not receive

whole gain from the efforts. Therefore it sets the efforts lower and thus lowers its welfare.
The negotiating power reduces social welfare from two reasons. Firstly it reduces the efforts induced by contractor and secondly it transfers part of the profit to the risk averse private partner.

Now we get back to the case where the government is not able to contract a and e. The consortium already includes its negotiating power its certainty equivalent and maximizes its overall expected payoff for both periods:

$$(e,a) = \arg\max_{(e,a)} \alpha - (\beta+\lambda)(\theta_0 - e - \delta a) - \frac{a^2}{2} - \frac{e^2}{2} - \frac{r\sigma^2(\beta+\lambda)}{2}.$$

Even though the government receives smaller profit from the induced effort the private partner remains with the same risk aversion and therefore the government still insures the private partner for whole incentive payment (which is now represented by $(\beta+\lambda)C$).
Both e and a must be non-negative. After running an optimization we gain:

$$e = \beta + \lambda \text{ and } a = \begin{cases} \beta\delta + \lambda\delta = \delta(\beta+\lambda) & \text{if } \delta > 0 \\ 0 & \text{if } \delta < 0. \end{cases} \tag{2.11}$$

The possibility to extract part of the gain gives added incentive to invest into the project.

Negative Externality

It is no surprise that with negative externality there is no investment into quality enhancing effort. There is no gain from a that could be extracted by the private partner.
The government then solves following problem:

$$\max_{\beta} b_0 - \theta_0 + (1-\lambda)e - \frac{(1+r\sigma^2)e^2}{2},$$

subject to $e = \beta + \lambda$ The cost reducing effort in this case is:

$$\beta_P^{SBN} + \lambda = e_P^{SBN} = \frac{1-\lambda}{1+r\sigma^2} = e_T^{SB} - \frac{\lambda}{1+r\sigma^2} < e_T^{SB}$$

This result is not surprising. Even the private partner receives an additional incentive to invest into cost-reducing effort government knows about this incentive and therefore reduces his incentive payments. Further more the government does

not enjoy whole cost-reduction but still pays the whole risk-premium. The government searches the best tradeoff between the profit he gets from the cost-reduction effort which is now $(1-\lambda)(e+\delta a)$ on one hand and the cost of the effort and risk premium on the other. Therefore it decreases its incentive payment even more than by $\beta - \lambda$.

The welfare gain is represented by:

$$W_P^{SBN} = b_0 - \theta_0 + \frac{(1-\lambda)^2}{2(1+r\sigma^2)}$$

The most important result is that with private partner's positive negotiation power under PPP the welfare gain of the government is lower than under traditional setting:

$$W_P^{SBN} < W_T^{SB}.$$

The case of traditional contract here is only special case where $\lambda = 0$. If we substitute this we would get equations we already know. Crucial is how the incentive which private partner receives by additional gain from investment changes the results. In other words how does λ affect welfare. And we can see that λ makes purely negative impact on welfare. In this case the dominance of PPP over traditional setting was successfully questioned.

Positive Externality

With positive externality $\delta > 0$ following holds:

$$a_P^{SBN} = \delta e_P^{SBN}. \tag{2.12}$$

and government now includes his profits from inducing the effort a. The gain he receives with growing benefit of the project ba and his share of cost-reducing gain $(1-\lambda)\delta a$:

$$\max_{\beta} b_0 - \theta_0 + (b + (1-\lambda)\delta)a + (1-\lambda)e - \frac{a^2}{2} - \frac{e^2}{2} - \frac{r\sigma^2}{2}(\beta+\lambda)^2, \tag{2.13}$$

subject to $e = \beta + \lambda$ and $a = \delta e$.
We optimize over β and get:

$$\beta + \lambda = e_P^{SBN} = \frac{1 - \lambda + \delta(b + (1-\lambda)\delta)}{1 + \delta^2 + r\sigma^2} \tag{2.14}$$

Again we see added incentive by negotiating power to invest in both efforts. We add both to the welfare function and get:

$$W_P^{SBN} = b_0 - \theta_0 + \frac{[1 - \lambda + (b + \delta(1-\lambda))\delta]^2}{2(1+\delta^2+r\sigma^2)} \tag{2.15}$$

From this follow the values of a and e:

$$e = \frac{\delta(b + \delta(1-\lambda)) + 1 - \lambda}{1 + r\sigma^2 + \delta^2} \text{ and } a = \delta e \tag{2.16}$$

If we compare this result with PPP without negotiation it is straightforward that if the government has all negotiation power it brings more effort than the situation when the power is distributed between both parties. The same reason holds as by negative externality. The government has to pay all costs and risk premium but does not receive all gains. The shift of β is smaller in this case compared to negative externality thus the government enjoys whole gain to the benefit ba.
The overall welfare of the government in this case is:

$$W_P^{SBN} = b_0 - \theta_0 + \frac{(1 - \lambda + (b + \delta(1-\lambda)\delta))^2}{2(1 + r\sigma^2 + \delta^2)} \tag{2.17}$$

We will now focus on two extreme cases when $\lambda = 0$ and when $\lambda = 1$. The former case when government posses all bargaining power is the same as in previous section. In the latter case when all the bargaining power is on the side of private partner we have the expected government welfare:

$$W_P^{SBN} = b_0 - \theta_0 + \frac{(b + \delta))^2}{2(1 + r\sigma^2 + \delta^2)}$$

The social welfare declines with growing negotiation power of private partner. Still there is a possibility that even if the private partner extracts all cost-reducing gains the government would prefer this solution over traditional setting.

$$W_P^{SBN}(\lambda = 1) > W_T^{SB} \text{ if } b > \sqrt{\frac{1 + r\sigma^2 + \delta^2}{(1 + r\sigma^2)\delta^2}}$$

Even in the case with positive externality there is no certainty that the PPP will outperform traditional setting. In a case of too high negotiation power and low marginal benefit from quality. The benefit brought by quality enhancing effort must be larger than risk premium paid to private partner and gain from cost reducing effort in traditional setting. On the Figure (2.1) we see the interval when it is still beneficial to undertake PPP and when the Traditional settings is better.
The decision between PPP projects and traditional setting must be very thoroughly evaluated, because high negotiation power of private partner can make the PPP projects costly.

2.3 More Complete Contracting

So far we have analyzed only situations, where in traditional setting was not possible to bring incentive payments into building period due to incomplete contracting.

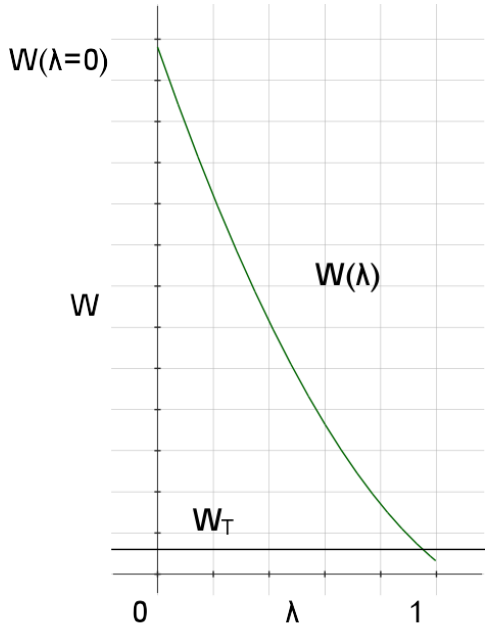

Figure 2.1: W as function of negotiation power and W_T.

Now we will focus on situations where the government is able to specify and check some variables characterizing quality of the project and add them to the contract with the builder. Government may run some audit to observe the investment into the quality. We did not assumed it before because government officials do not have any incentive to do this.

2.3.1 Operating Cost Reduction

We will now loose the assumption that government cannot link the payment to the builder to operating cost C. This is clearly one of the indicators of the project's quality. We will let the contracts linear for simplicity and of the form:

$$t_B(C) = \alpha_B - \beta_B C$$

Again using model from Iossa and Martimort (2008) will be compared with results from previous sections describing simple PPP and PPP where both parties negotiate about the share of the gain from investment.

Traditional Setting

In this setting builder is given an incentive to exert effort to improve the quality of the infrastructure. The builder solves problem:

$$\max_a \alpha - \beta_B(\theta_0 - e - \delta a) - \frac{a^2}{2}$$

and his optimal effort is given by:

$$a = \beta_B \delta.$$

We assume that the builder is risk averse and we will assume that the operator has same degree of aversion. In order to induce a quality enhancing incentive we have to pay to the builder a risk premium. $\frac{r\sigma^2\beta_B^2}{2} = \frac{r\sigma^2 a^2}{2\delta^2}$. It is clear that the risk premium raises quickly when δ is small enough and the uncertainty about the operating cost make it very difficult to observe builder's effort a. This means the smaller positive externality the bigger risk premium to the builder. The government's welfare function will become:

$$\max_{(a)} b_0 - \theta_0 + (b+\delta)a - \frac{a^2}{2} - \frac{r\sigma^2}{2}\beta_B^2 + e - \frac{e^2}{2} - \frac{r\sigma^2}{2}\beta^2,$$

subject to $a = \beta_B \delta$ Now we can easily find what is the level of effort:

$$a_T^{SBC} = \frac{(b+\delta)\delta^2}{\delta^2 + r\sigma^2}.$$

The operating effort e remains the same since the problem of the operator did not change. After substitution into welfare function we get:

$$W_T^{SBC} = W_T^{SB} + \frac{\delta^2(b+\delta)^2}{2(b^2 + r\sigma^2)}.$$

We see that the improvement from the previous section is quadratic in δ which is very small for weak externalities.

PPP

By PPP we do not have to add any incentives, because they were already present in the case without complete contracting. The outcome in this case is the same and we can see in previous section.

As more complete contracting induce higher efforts it makes preferable solution over more PPP projects where the private partner has higher negotiation power, but still with very low negotiating power the PPP is preferred way of contracting. On the Figure (2.2) we see how the interval when the PPP is beneficial has been reduced by added incentive to the builder to invest into a.

Conclusions

Appropriate PPP contract induces quality enhancing effort when there exists a positive externality on future costs from quality improvement. The reason is that the

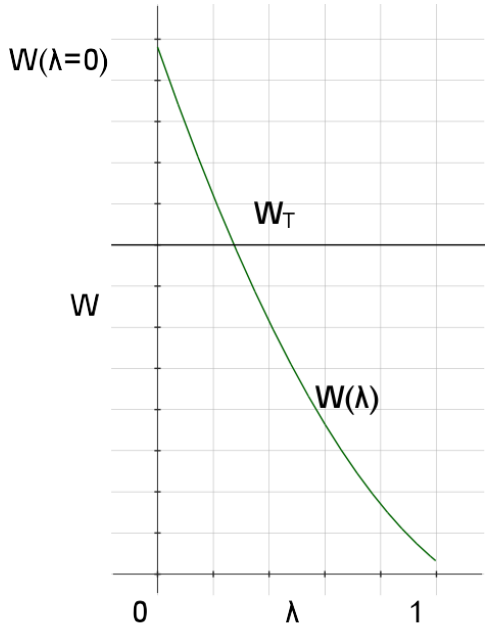

Figure 2.2: W_T based on a and $W_P(\lambda)$.

private contractor in the case of PPP internalizes future operating costs already into the building period. In the traditional setting where the builder cannot internalize impact of his effort neither on benefit to the government nor on costs. As well PPP contracts involve more risk transfer on the private partner. This induces bigger risk-premium by risk averse contractors which has to be paid by the government.
The PPP are always preferable solutions when the government has all bargaining power. By more complex contracting as some PPP projects the government does not posses all bargaining power and has to share part of the gain from quality enhancing and cost-reducing effort with the private partner. With growing bargaining power of the private investor the level of both efforts sinks as well as the welfare of the government. If the government's negotiation position is too weak traditional setting can outperform PPP. This depends mainly on magnitude of positive externality and on marginal benefit from the quality enhancing effort.
When the government is able to contract, observe and check some indicator of quality already in the first (building) period then the builder exerts some quality enhancing effort but smaller than in the case of PPP where government has all bargaining power. Still reduces the interval of negotiating power when it is still beneficial to undertake a PPP project.

Experience

The results tell us that there should be cost savings and quality improvements in the infrastructural projects delivered under PPP. The Treasury Taskforce report (Arthur Andersen and LSE, 2000) estimated saving on sample of PFI projects equal to 17% compared to traditional procurement. Moreover 80% of PPP projects had met their initial delivery time targets which is significantly more than 20% which was achieved by comparable public sector project under traditional setting. Especially in the prison sector there were significant cost reduction based on modern security designs. These designs then did not need so many guards and the cost saving on the labour force was significant. The overall cost reduction made 30%. This definitely fits our model if we assume that the better security system is quality enhancing investment and it creates big externality on the operating costs in the second period. On the other hand there are many who argue that the prisons which are run under PFI do not provide increasing quality and the conditions in those prisons are worse than in those government lead. They argue that the salaries are significantly lower in the "private" prisons and that is according to them the biggest source for cost reduction. Another set of data from Bland-Brude, Goldsmith and Välilä (2006) studied road projects financed by EIB between 1990 and 2005 in EU-15 and Norway. They found out that the ex ante contracted prices were 20% higher by PPP projects than in traditional procurement.

The problem with quality was not only observed in the prison sector but as well by school buildings. The report by Audit Commission (PPP Focus, Education 2, 2004) noted that the quality of school buildings was in many cases very bad. Schools had few windows and poor acoustic and air quality. These results are probably caused by negative externality of this quality improvement. The more windows the higher operating costs. This also confirms the theoretical model.

The principal-agent analysis focused only on the high-powered economic incentives. In many cases of public sector policies they may crowd out intrinsic motivation of agents working for example in the social area. Workers in public sector are often intrinsically motivated to provide optimal effort and therefore we do not need any high-powered incentives and risk transfer which raises the risk-premium which raises the cost of the project.

Chapter 3

Ownership

From the previous chapter it seems that PPP outperforms the traditional setting in every contract design where the government has all negotiation power and in some cases where the negotiation power is split. The view of previous chapter was only limited to the agency problem. A problem of making the best contract. In this chapter we will focus more on organizational designs based on model of Iossa and Martimort (2008) but counting as well negotiating power which can be in the interval $\lambda \in \{0, 1\}$. So far we did not consider ownership structure of infrastructure to play any role. In this chapter we will consider PPP and an organizational form where the private partner not only designs and operates the infrastructure but he owns it as well. On the other hand in the traditional setting the government buys the facility from the builder and operate it itself or through some private firm. This will be compared to the state when the government does own the infrastructure all the time.

The PPP contracts are usually considered for 25-30 years and after this period there is an infrastructure which has some quality depending on the effort of the builder. We assume that the investment into quality does not depreciate over time. We can distinguish two types of facilities. Firstly those which are demanded from users out of the government. This group includes beside others offices, leisure centers, higher education institutions, accommodation, etc. Second group includes very specific assets which can be hardly used by institutions other than government such as prisons, hospitals, elementary schools, etc.

The value for the government at the end of the period if the asset would be later on used for its original purpose is sa, where $s > 0$. The value if the facility will be later used for purposes of the private sector will be γsa, where $\gamma < 1$. The γ indicates how specific the asset is. We see that it is optimal that after the period of PPP it is optimal when government follows using the facility.

The optimal first-best value of quality enhancing effort changes to:

$$a = s + b + \delta$$

Unfortunately there is no additional incentive in the traditional public ownership, because government owns the asset for all the time.

3.1 Private Ownership

Ater the contracted period the private partner transfers the infrastructure to the government or to some private company. The value for the government is higher so the efficiency criterion advise us that the facility will be transfered to the government for certain payment. In the case when the government has all the bargaining power is the price:

$$p = \gamma sa$$

If we again split the bargaining power λ[1] for private partner and $1 - \lambda$ for government we get following price:

$$p = sa(\gamma + \lambda(1 - \gamma))$$

The $\lambda(1 - \gamma)sa$ is a private partner's net profit. It is increasing in a so the higher is the quality enhancing effort the higher is benefit by transfer to the government. The owner has also lower incentive to invest into the asset when it is a specific one. For the specific assets there is lower demand from private sector and that decreases the payoff of the owner.

3.1.1 Traditional Settings and Private Ownership

In the case of private ownership and traditional setting the conditions are contracted ex ante. After the infrastructure is build the government as the buyer makes an audit to observe the quality of the infrastructure. This is a significant difference to the previous chapter. For government official it is costly to run such an audit so they do not do it if it is not necessary. In the case that they are buying a new infrastructure price audit is necessary.

Government pays to the private partner the cost of his effort $\frac{a^2}{2}$. The builder maximizes his net profit from his negotiating power:

$$a_T^{PO} = \lambda(1 - \gamma)s \tag{3.1}$$

[1] For simplicity the same bargaining powers as in previous chapter will be used

There is no change in the operator's effort:

$$e_T^{PO} = e_T^{SB}$$

At the end of the day the government's welfare consists of:

$$W_T^{PO} = W_T^{SB} + (b + \delta + s)\lambda(1-\gamma)s - \frac{\lambda^2(1-\gamma)^2 s^2}{2}. \tag{3.2}$$

From above we see that private ownership increases rapidly welfare by traditional contracting. In the case of government's full negotiation power the builder does not have any net profit from the ownership and therefore does not induce any effort and therefore the welfare stays constant with traditional setting and public ownership. The private ownership is beneficial in the case that when:

$$\lambda < \frac{2(b+\delta+s)}{(1-\gamma)s},$$

which is always because $1 - \gamma < 1$.

3.1.2 PPP and Private Ownership

Ownership has its value as well in PPP. With the same price for asset the consortium solves following problem:

$$(e, a) = \arg\max_{(e,a)} \lambda(1-\gamma)sa + \alpha - (\beta+\lambda)(\theta_0 - e - \delta a) - \frac{a^2}{2} - \frac{e^2}{2} - \frac{r\sigma^2\beta^2}{2}.$$

After optimization we get following incentive constraints:

$$e = \beta + \lambda \text{ and } a = (\beta+\lambda)\delta + (1-\gamma)\lambda s \tag{3.3}$$

Now we will move to the government reaction. Adding the two incentive constraints from above we get governments optimization problem:

$$\max_{\beta} b_0 - \theta_0 + (b + s + (1-\lambda)\delta)a + (1-\lambda)e - \frac{a^2}{2} - \frac{e^2}{2} - \frac{r\sigma^2}{2}(\beta+\lambda)^2, \tag{3.4}$$

subject to $e = \beta + \lambda$ and $a = \delta e + \lambda(1-\gamma)s$.
We get following values of effort:

$$\beta + \lambda = e = \frac{\delta(b + s + (1-\lambda)\delta) + \delta\lambda(1-\gamma)s}{1 + r\sigma^2 + \delta^2}$$

and

$$a = \delta e + \lambda(1-\delta)s$$

From above is clear that private ownership induces more investment into quality and cost reduction efforts.

Now we will use the welfare function under traditional setting but with private ownership as a function of e to see the improvement:

$$W_P^{PO}(e) = W_T^{PO}(e) + (b + (1-\lambda)\delta + (1+\gamma)\lambda s)\,\delta e - \frac{\delta^2 e^2}{2} - \frac{r\sigma^2(\beta+\lambda)^2}{2}, \quad (3.5)$$

where

$$W_T^{PO}(e) = b_0 - \theta_0 + s a_T^{PO} - \frac{(a_t^{PO})^2}{2} + e - \frac{(1+r\sigma^2)}{2}e^2.$$

The answer if PPP is or traditional contracting is preferable is not that easy. Under private ownership is PPP more beneficial if and only if there is an positive price externality in quality effort. When there is a positive externality than it depends on the ratio of negotiating powers. With reasonable negotiating power is PPP again more beneficial than traditional contracting. Even more private ownership expands the interval of negotiating powers when it is still beneficial to undertake PPP project instead of traditional setting.

$$a_P^{PO} > a_T^{PO} \text{ and } e_P^{PO} > e_T^{PO} \text{ and } W_P^{PO} > W_T^{PO} \text{if and only if } \delta > 0$$

The negative externality affect decision between PPP and traditional setting easier. By private ownership has the builder incentive to invest into the asset quality. By PPP is the incentive decreased by internalizing this negative externality (the consortium would have to pay for that in the second period).
On the other hand the builder does not internalize the positive externality and therefore underinvestment occurs.

Conclusions

Analyzing ownership is an alternative approach to the usual principal-agent model. The model shows that private ownership induces additional incentive to invest into the quality of the infrastructure and therefore private ownership of the facility always beneficial when the externality is positive. With negative externality the incentive of private partner generated by the private ownership is reduced and therefore private ownership does not bring so much effort by PPP contract as by traditional contract. This is caused by the negative externality internalization by the contractor with PPP contract.

Experience

The ownership of facilities constructed for the provision of public goods tends to remain public after the contracted period. They are usually used for the service they were originally designed. By very little amount of mostly generic facilities the ownership stays in the private hands.

Chapter 4

Changes in Time

The PPP projects usually last longer period of time. The contracts are usually made for 25-30 years. Within the long term come more specification and problems over the scope of basic agency problem introduced in the previous chapters. We will use the models from Iossa and Martimort (2008) but again we will add the reasonable assumption that by PPP there exist negotiating power on the side of private partner.

4.1 Flexibility

The advantage of PPP contracts is their output orientation. The public partner contracts some quality standards and private sector is responsible for fulfilling these standards. For example instead of saying that the highway should have two or three lanes the government sets how maximally dense the transit there should be and the private partner has to adjust the conditions on the highway to enable flowing transit. PPP arrangements as already discussed are developed for a long-time horizon. In 20-30 years the quality requirements are probably subject to change. Therefore there emerge need to make the contract flexible so it could be adjusted for new requirements. This probability that the contract would be obsolete is in PPP much greater than in traditional way of contracting, where the contracts are usually designed for shorter period and contracts are based on input variables. The output orientation can turn into disadvantage.

The changes to contractual situation which are anticipated could already part of the initial contract. This applies mostly to the changes of capacity. But not all the changes can be anticipated in advance. For example research in medicine can increase the requirements for hospitals. Changes in social preferences of society on schooling and education can make infrastructure obsolete. Contract flexibility is

then crucial part of the contract mainly in those sectors where technology and preferences change quickly.

It is very important to have clauses which enable the public partner to change clauses on mutual consent basis and make the government renegotiation possible, when the original contractual requirement becomes outfashioned. Unfortunately for the government the renegotiation does not take place in competitive environment, but rather in bilateral negotiation. The private partner may use his strong bargaining position or the government can cease the contract despite private partner's past investments. When the contractual parties do not find consent or the new contract terms rigid and inflexible PPP might become inefficient solution and it is unclear whether it is able to meet future demand. This is a source for another cost of PPP which we will analyze in this section. This is an information cost which is not present by the traditional contracting. If this cost is higher that the gain form internalizing the externality from quality enhancing effort then traditional contracting outperforms PPP.

We will assume now that the parties cannot to find a consent or the renegotiation cannot occur at all thus the contract does not reflect the real public sector's demand. We will use our basic model from the first chapter. We will assume inelastic demand for the service which affects operating costs in a case of government's full negotiating power as following:

$$C = \theta_0 - \gamma e - \delta a + \varepsilon,$$

where γ is a positive random variable with mean 1, $E_\gamma(\gamma) = 1$. We will assume in this case that quality effort will make a positive externality on operating costs $\delta > 0$. In case of PPP where the government does not hold all negotiating power it will be as following:

$$C = \theta_0 - \gamma(1-\lambda)e - \delta(1-\lambda)a + \varepsilon,$$

If γ would be known in the time of contracting of operational period it would became part of a contract and our previous results would remain unchanged and PPP would outperform the traditional way. For PPP it means that change in operating costs would have to be known already in the first period when the contract is negotiated.

Unfortunately the contractor by PPP does not know γ in the first period and the contract cannot fully include this parameter. In this case the government looses its flexibility, because it is obliged to fulfill the contract made before γ was realized. We still assume the welfare from the first chapter and we know that if the δ is reasonably small than the difference between welfare from PPP and traditional

contracting is $W_P^{SB} - W_T^{SB}$ is of order δ. If δ is small enough than traditional settings outperforms PPP even with government posses all negotiation power. It still holds that with growing negotiating power of the private partner the government's welfare shrinks.

It is also clear that in areas with uncertain conditions the PPP setting becomes less attractive, because the cost of information increases private partner's uncertainty and because the government cannot offer appropriate incentive payment. By traditional contracting the γ is realized in the beginning of the second period and therefore could be included into the contract.

4.2 Quality Investment in the Operating Period

We will continue with the setting that operating phase consists of two periods. The infrastructures depreciate over long time period. The investors have two possibilities. Firstly they can invest to quality and improve the infrastructure in a long run. This could include renewal investments etc. Or secondly they can reduce their efforts to cut the maintenance cost.

We will analyze similar situation to the previous basic model, but we will look now on two operation periods. They can be either bundled to one contract and that would be the case similar to PPP or there will be two separate contracts with two different contractors similar to traditional settings. The firm receives an infrastructure at date $t = 1$ and its aim is to manage it for the government. There is possibility to invest to the quality of the infrastructure at cost $\frac{a^2}{2}$. This investment results in lowering the operating cost in the second period $t = 2$. If the investor chooses not to make any investment ($a = 0$) he will face higher operating cost in the next period. Cost in the first period is given by:

$$C_1 = \theta_0 - e_1 + \frac{a^2}{2} + \varepsilon_1,$$

and in the second period by:

$$C_2 = \theta_0 - e_2 - a + \varepsilon_2,$$

where ε_i is operating cost uncertainty and it is normally distributed with zero mean. The e_i is maintenance effort at date i.

We see that the investment a raises the cost in the short-run but makes positive externality to the second period, so that the operating cost in the long-run are reduced. The government cannot observe the level of the investment because it is aggregated

with other costs.
The investment is not only cost-reducing, but also socially desirable. Consistently with previous chapters we assume that the social value of the infrastructure is $b_0 + ba$ with $b > 0$. If the investment was publicly observable we will receive the first best level satisfaction level of the investment: $a^{FB} = 1 + b$. The private optimal level is $a = 1$.
When we add negotiation power one problem occurs. The quality investment is not observable to the government and counts to the operating costs in the first period. The parties can negotiate only about the profits they can observe. Their contract has to be made on the basis of cost C which in the first period includes the cost of renewal investment $\frac{a^2}{2}$ as well and therefore the negotiation cannot as in the second chapter consist of net profit from the efforts so the cost for quality enhancing effort has to be added:

$$\pi = \lambda(e_1 + e_2 + a - \frac{a^2}{2})$$

The problem of the private partner is then following:

$$\begin{aligned}(a^*, e_1^*, e_2^*) \quad = \arg\max_{(a,e_2,e_2)} \quad & \sum_{i=1}^{2} \left(\alpha_i - (\beta_i + \lambda)(\theta_0 - e_i) - \frac{(r\sigma^2)(\beta_i + \lambda)}{2} - \frac{e_i^2}{2} \right) \\ & -(\beta_1 + \lambda)\frac{a^2}{2} + (\beta_2 + \lambda)a\end{aligned}$$

which delivers following efforts:

$$e_1 = \beta_2,\ e_2 = \beta_2 \text{ and } a = \frac{\beta_2 + \lambda}{\beta_1 + \lambda} \tag{4.1}$$

We will begin the analysis showing what would happen if the private partner was offered a contract that would induce the same level of cost-reducing effort as in the case of traditional setting. This means that $\beta_1 + \lambda = \beta_2 + \lambda = \beta_T^{SB}$ and the efforts are then $e_1 = e_2 = \beta_T^{SB}$ and $a = 1$. The effort a is privately optimal, but not so socially when $b > 0$. With the offer $\beta_T^{SB} - \lambda = \beta_1 = \beta_2$ the government's welfare will be:

$$W_P^{SB} = W_T^{SB} + b + (1 - \lambda)(\frac{1}{2} - 2\lambda e)$$

If we take the extreme when all negotiating power is on the side of the government, then there is no doubt that PPP is for the government better choice. With growing λ the government's welfare sinks and it depends on the magnitude of b when PPP still outperforms traditional settings.

To induce higher quality effort the best solution is to separate the payments and make the contract for the first period more cost-plus (β_1 moves towards 0) and for

the second period incentive contract (β_2 increases). This would clearly increase $a = \frac{\beta_2 + \lambda}{\beta_1 + \lambda}$ and thus help the contractor to enjoy his investment and bear low costs of it. It would as well increase benefit for the government.

Conclusions

The parties by PPP sign at the beginning contract which lasts for long time period. The PPP contracts are signed before the building period for both periods. The uncertainty about future operating costs creates information cost. This cost is not present by traditional contracting because when the traditional contract is made the cost is already known and can be included into the contract. The preference between traditional contract and PPP setting depends on the magnitude of the externality. If the loss of not internalizing of externality is bigger than the information cost the PPP is preferable setting.
In the long run the infrastructure depreciates and to keep the operational costs lower there is need for renewal investments. When the contractor does not know if he could benefit from this investment he does not undertake any. In PPP the contractor is sure that he will enjoy the benefit from this investment and therefore can already in the first operational stage internalize the cost reduction and invest into the quality of the infrastructure. It is beneficial to insure the private partner in the first period when he induces unobservable investment with more cost-plus contract and in the second period increase the incentive payment so that he can enjoy his investment.

Experience

A typical example of inflexible projects were the university dormitories. When they were build 20 years ago none could have expected that a microwave will be common need. The contracts did not include adjustment clause and therefore the benefit from dormitories was not optimal. This very simple thing can make the situation worse if the contract is inflexible.
A direct implication of the theoretical model is that PPP are not suitable for projects in fast-moving sectors. For example projects from the IT area are not recommended for PPP by HM Treasury int the UK now.

The private partner has an incentive to react on changes in public demand when

he share part of the demand risk. Next chapter shows us what is the right risk sharing mechanism.

Chapter 5

Risk Sharing

The PPP projects are designed for a long period and usually take place in uncertain environments. The difference and advantage for the government to the traditional setting is that in PPP some amount of risk bears also the private partner. This chapter will show how to manage risks in PPP and how to spread them that the outcome brings highest social benefit.

5.1 Demand Risk

Very important role in the PPP contracts plays demand. The question how to share the demand risk is one of the most important in the whole contract. In traditional contracting the private partner is not affected by demand, therefore evaluation of the demand risk is solely on public officials and they have tendency to exaggerate benefits and demand for their services. The risk sharing is provided by appropriate payment mechanism.

Basically there are three types of payment mechanisms. First of them is direct payment. Users pay for the service they consume directly to the operator. As example we can use highways paid solely by tolls. In this case the contractor bears whole demand risk alone. Second method is based on usage. Government collects the fees paid by users and then transfer a payment to the contractor. The risk sharing depends on how the transfer mechanism is dependent on the actual use of the infrastructure. Last option is to pay for making the infrastructure available. Government pays to private partner for running the infrastructure but the private partner bears no risk. This is usually case of prisons and hospitals and similar infrastructure projects. Concrete payment mechanism could be a combination of all mentioned above.

So far we focused on the third option when the government pays for the availability. In this chapter we will focus on the part where private investor finance the project and receives his initial investment as well through direct payments from users.
We will assume demand to be inelastic up to some price level p_0.

$$D(p) = a + d_0 + \eta,$$

where η is normally distributed random variable with zero mean $\eta \sim \mathcal{N}(0, \sigma_\eta^2)$. a denotes demand enhancing effort which could be seen as investment into quality as well as marketing and advertisement effort. This demand enhancing effort is induced at cost $\frac{a^2}{2}$.

The firm would like to extract the whole consumer's surplus by means of fixed fee. This could be toll in a highway or fare in public transportation. The expected revenue from users is given by:

$$E_\eta(R) = p_0 E_\eta(a + d_0 + \eta) = p(d_0 + a).$$

For simplicity we do not assume operating costs so there is no incentive problem on the cost side.
Again we will use linear payment mechanism:

$$t(R) = \alpha + (\beta + \tau)R,$$

where α is fixed subsidy by the government and β is the share of the revenue left for the private partner. τ will denote Pigouvian subsidy in case that providing the infrastructure creates some positive externality. The share $1 - \beta$ is left to the government for fixed payments or covering other risk not included in the model. In the case of $\beta = 1$ and $\alpha = 0$ whole gain from providing the infrastructure will be left to the private partner and he receives no additional subsidy from the government. On the other hand private partner would bear whole demand risk on his own. This resembles very much concession contracts. In the case of $\beta = 0$ the private partner would receive fixed payment which is the case of availability payment we discussed so far. In this case whole risk would be beard by the government.
The private partner maximizes his effort to boost his certainty equivalent:

$$a = \arg\max_a \alpha + (\beta p_0 + \tau)(d_0 + a) - I - \frac{a^2}{2} - \frac{r\sigma^2(\beta p_0 + \tau)^2}{2}, \tag{5.1}$$

where I denotes initial investment private partner has to undertake to build the infrastructure. After optimization we get:

$$a = \beta p_0 + \tau$$

The certainty equivalent declines with growing risk aversion. If the private partner is too risk averse it the PPP project becomes too costly for the government. When the risk aversion is high government should insure the private partner with higher fixed payment. The government is risk neutral and social welfare will be raised.
Public goods often provide positive externality. This externality should be compensated by Pigouvian tax. For example public transportation reduces number of car in the streets. Highways can reduce number of cars on the roads of lower quality. The model shows that when the positive externality is compensated then the investor has stronger incentive to invest into quality of infrastructure and therefore the demand is increased.

5.1.1 White Elephants

Less evident but very important in the model is that private partner is the one who evaluates the demand. Public officials do not have so deep market knowledge and they often overestimate the demand. Sometimes the public officials deliberately overestimate the demand to enforce project just to be seen active to collect popular votes. Since the private partner would not join the project if his certainty equivalent would not be positive the demand with government proposed β must fulfill:

$$I \leq \alpha + (\beta p_0 + \tau)(d_0 + a) - \frac{a^2}{2} - \frac{r\sigma^2(\beta p_0 + \tau)^2}{2}$$

Private partner must evaluate the costs of the project and the demand for the project. This can mitigate "white elephants"[1] like highways from nowhere to nowhere.
This model can work in such infrastructure projects as highways, public transportation etc., it is not appropriate solution for hospitals, schools, prisons and similar projects. There is the availability solution more appropriate, because demand in such facilities is less quality elastic and therefore the quality effort is not successfully induced. We shall add one more parameter ω which will show how much the quality a affects the demand. Adjusted demand function will look like:

$$D(p) = d_0 + \omega a + \eta$$

The private partner's maximization problem changes to:

$$a = \arg\max_a \alpha + (\beta p_0 + \tau)(d_0 + \omega a) - I - \frac{a^2}{2} - \frac{r\sigma^2(\beta p_0 + \tau)^2}{2}, \qquad (5.2)$$

[1] Sadka E., 2007

We see that both β and a are growing with ω. ω is high especially for sectors where the public contractor can successfully affect the demand through improving quality as transportation, leisure centers etc. For projects in sectors as hospitals, schools, prisons should the government cover all the demand risk.

If there exist other factors which could affect demand, then the partner who is able to affect these factors should bear the risk. Certainly the volume of traffic on a toll highway depends on how other means of transportation will be subsidized by the government. If there are another roads or railways that provide similar service and are subsidized by the government then the government should be the one to bear the risk. In the case of highway it is also important if the government connects new highway with already existing road system. As well the demand for public transportation varies according to government's decision to ban the cars out of the city or not etc.

5.2 Other Risks

5.2.1 Costs

There are also risks not affecting demand in PPP projects. The public official does not operate on the market and is not familiar with the prices. The prices in public and private sector might differ. It is important that the project is evaluated at the same prices (including cost of labour) paid by private sector.
A very similar thing occurs by discount rates. The PPP projects are usually long-term designed and the benefits come later in the time but most of the costs must be spend immediately. The financial sector lends to governments at lower interest rates and therefore it can happen that the cost-benefit analysis would be positive for the government but negative for the private partner.
Financial sector considers less probable that the government would default on its loan than private partner and therefore provides government with lower interest rates. Even for the same infrastructure project the financial sector would the government lend to the government cheaply that to private firm even the riskness of the project is the same. This has actually nothing to do with the project because the financial sector believes that the government would repay its debt even if the project was unsuccessful. Therefore the project should be evaluated again in private sector prices, because those are really connected to the project.

5.2.2 Exogenous Risk

It is desirable that the exogenous risk to both parties bear the public partner. Private partner is usually the smaller one for whom is the public project relatively big one and plays crucial role in his portfolio. That is a source of his risk aversion. On contrary the public partner could be assumed risk-neutral and he does not demand insurance payment for the risk arising from the project.
For example the inflation risk or risk connected with the oil price (for transportation projects) are not dependent on the private partner and should be insured by risk neutral (or at least very little risk averse) public partner.

Conclusions

The risk sharing in PPP between public and private partner brings more efficiency if the payment mechanism is well designed. The higher ratio of private partner payments stems from the direct payments, the higher demand enhancing effort he induces. The cost of the project raises with growing risk aversion of the private partner. If private partner is too much risk averse then the public partner should adjust the payment method so that the private partner receives more fixed payment and less dependent on collected fees. Transferring more risk on the private partner improves evaluation of the project since the public officials have tendency to over valuate benefits and demand and under-valuate costs. The parties should bear the risk that is endogenous to them (risk that they can affect). The exogenous risk to both partners should bear the government because of his lower risk aversion. We should follow the private partner's cost-benefit analysis since it evaluate better concrete project.

Experience

The results suggest that by some project transferring demand on private partner increases incentives to invest into demand enhancing quality effort. This is only possible when the demand is quality elastic. The example of badly contracted risk sharing are cafeterias in the UK. After a famous chef Jamie Olivier showed in his show how unhealthy the food at schools is, changed the demand in favour of healthier food. Unfortunately the contracts with cafeterias providers insured him too much for the demand risk that he had no incentive to adopt himself for the new demand.

Chapter 6

Renegotiation

Public contracting takes place in an uncertain environments and sometimes in an environment where government cannot or even worse does not want to commit itself to the best available contract. In this chapter we will compare different approaches leading to renegotiation in PPP. The first described by Martimort and Iossa (2008) and the second where the basics will be taken from Maskin and Tirole (2007) describing biased public official and at the end of the day we will show how renegotiation stemming from limited commitment reduces welfare.

6.1 Cost Overruns

Public contracting takes place in an environment full of uncertainty and it is not only government who wrongly estimates possible benefits and costs of the project. As government officials usually overestimate the benefits of the project and demand for it the private contractor tends to underestimate the costs of the project. This creates place for contract renegotiation led by private contractor in the second period.

We will model this setting using simplifications from previous chapters. We will not take to account building stage and investment efforts. The government holds for this model all negotiation power again. We will analyze the moral hazard sourcing from the uncertainty on future costs. Operating costs will be now represented by:

$$C = \tilde{\theta}_0 - e + \varepsilon.$$

From equation above the base cost level $\tilde{\theta}_0$ is uncertain. With probability $1 - \nu$ is the base cost level high, $\theta_0 = \overline{\theta}$. With probability ν is base cost level low, $\theta_0 = \underline{\theta}$. The difference between the two base cost levels will be denoted $\Delta\theta = \overline{\theta} - \underline{\theta} > 0$.
In the time the contract when both parties sign the contract none of them has any

information about the base cost level in the second period. In the second period the private contractor learns privately the cost and reports it to the government. This creates a state of asymmetric information between the contractor and government. The government will make the contract so that private contractor will truthfully reveal his information on the cost level ex post. The classic revelation principle is in detail explained in Laffont, Martimort (2002). Government offers menu of contracts in our case two [1] contracts $\left\{(\alpha(\hat{\theta}_0), \beta(\hat{\theta}_0))\right\}_{\hat{\theta}_0 \in \left\{\underline{\theta}, \overline{\theta}\right\}}$. The fixed fee will be contracted as $\alpha(\hat{\theta}_0)$ and $\beta(\hat{\theta}_0)$ as a share of the cost which the private contractor will claim in the second period. The firm always chooses the effort $e = \beta(\hat{\theta}_0)$. The certainty equivalent for the private contractor for the ex post information is:

$$U(\theta_0) = \max_{\hat{\theta}_0} \alpha(\hat{\theta}_0) - \beta(\hat{\theta}_0)\theta_0 + \frac{(1 - r\sigma^2)\beta^2(\hat{\theta}_0)}{2}. \tag{6.1}$$

6.1.1 Revelation Principle

We will use the procedure described in Laffont and Martimort (2002) with the basic profile $\left\{(\alpha(\hat{\theta}_0), \beta(\hat{\theta}_0))\right\}_{\hat{\theta}_0 \in \left\{\underline{\theta}, \overline{\theta}\right\}}$. This will help us to show that even accounting the moral hazard problem still we get the efficiency affected.
To force the contractor behave truthfully incentive constraints and participation constraints has to be fulfilled. Firstly it must be beneficial for the private partner to admit that the costs are low if they are low:

$$U(\underline{\theta_0}) > U(\overline{\theta_0}) + \Delta\theta\beta(\overline{\theta}) \tag{6.2}$$

and as well it has to be beneficial for him to report high costs, if they are really high:

$$U(\overline{\theta_0}) > U(\underline{\theta_0}) - \Delta\theta\beta(\underline{\theta}) \tag{6.3}$$

These constraints will ensure that the private contractor would not strategically exaggerate (or downgrade) his costs. Secondly ex ante the contractor wants his expected utility (income) to be non-negative:

$$\nu u(U(\underline{\theta})) + (1 - \nu)u(U(\overline{\theta})) \geq 0, \tag{6.4}$$

where we consider the firm to be constantly risk averse so the utility could be rewritten as $u(x) = (1 - exp(-rx))$.
Optimal solution:

$$U^*(\tilde{\theta}_0) = 0 \text{ and } e^*(\tilde{\theta}_0) = e_u^{SB}$$

[1] The number of contracts corresponds to the number of possible cost levels.

is no longer possible. If this contract would be offered to the private partner, whatever cost he would learn he would report the high cost. The firms will be lead by incentive to exaggerate their costs and cost overruns would appear in every contract and it becomes new equilibrium.

To make the truth telling mechanism working we have to make the incentive represented by (6.2), (6.3) and (6.4) binding. We will achieve this by lowering the operating effort $e(\overline{\theta})$. This will on one hand increase the risk-premium which will be paid on behalf of government but it will make the contract look like cost-plus one in the case of high level of base cost $\overline{\theta}$ and the firm will be less sensitive to the value of innate costs. When the $e(\overline{\theta})$ reduced enough then the private partner would choose the $e(\underline{\theta})$ in the case of low cost and he would also admit that the cost is high if the situation is so. The value $e(\underline{\theta})$ remains the same induced by β^{SB}.

By reducing the incentive we also reduce social benefit, but only in the case of high base level cost. Overall when the uncertainty plays role the PPP brings lower social benefit. It does not mean that PPP is not preferable solution any more. This problem can occur by traditional contracting even though the uncertainty about costs is already weak in the time of contracting.The solution of the same problem in traditional contracting will be the same shift of incentive scheme. We can summarize it in following inequalities:

$$U^{SB}(\underline{\theta}) > 0 > U^{SB}(\overline{\theta})$$

and

$$e^{SB} = e_T^{SB} > e^{SB}(\overline{\theta}).$$

Although this mechanism induce revelation for the efficient firm, from above we can see that low efficient firm get into a loss. This may cause problems for the whole project, when the firm decides to abandon it or at least the firm would threat that it abandon the project and creates a hold-up problem.

As public service outsourcing project are usually the big ones it could mean for the firm great even unbearable loss. Some government would like to insure running of the project by making subsidy and move the benefit of the private partner at least to zero. Therefore for each state of the world must hold:

$$U(\tilde{\theta}) \geq 0, \forall \tilde{\theta}.$$

In other words we added second, participation constraint. This narrows the room to make incentive and leads to following effort choice:

$$e^{SB}(\overline{\theta}) = \frac{1}{1 + r\sigma^2}\left(1 - \frac{\nu}{1-\nu}\Delta\theta\right)$$

If the government does not insure the contractor ex ante and still wants to run the project which brings benefit to the government. The renegotiation of the contract is usually very long, difficult and very costly although it appears regularly. In the famous case of London Underground it lead to the bankruptcy of the contractor and in many other cases the government was forced to bail out his private partner and firm led renegotiation mostly favour contractors.

6.2 Biased Official

As already mentioned above PPP gives public authority more opportunities to invest because the initial costs are not that high for the public budget. Politicians are then tempted to invest into more projects. In the set of all these projects are some which costs are greater than benefits. The source of overinvestment may be a state that politicians are not unbiased and objective. They can support some part of the society who would benefit from specific project even if the price of the project is high which would divers the decision away from the decision of a theoretical welfare maximizer. In this part we will concentrate onto how the mechanism with official's favoured and unfavoured group works. Using model from Maskin and Tirole (2008) we will briefly show how spending cap helps and show other dangers leading to renegotiation.

6.2.1 Model Settings

We will now leave the problem of exerting effort and move more to problem of choosing a contractor not based on his efforts, but based on his relation to the politician.

There exist a continuum of interest group indexed by $i = [0,1]$ in the society, but only a fraction $f \in (0,1)$ is favoured by the public official and its benefit is weighted by $\alpha_f > 1$ by public official. The rest of the groups are then unfavoured and their benefit is weighted by the public official by $\alpha_u < 1$. Each interest group offers a project to the government. We will again assume that there are projects with higher costs C_H and projects with low costs C_L. With probability ρ is the project C_L one and with probability $1 - \rho$ is the project C_H one. There exist a probability x that the contractor and public official (not the public at large) learns the cost of the project ex ante. When the cost is not known ex ante we will refer to a $\tilde{C}$ project, where

$\tilde{C} = \rho C_L + (1-\rho)C_H$. We assume that the C_L and C_H projects are contracted with the fixed price, because the costs are known ex ante. For the $\tilde{C}$ project is the cost-plus contract appropriate, because we assume that the contractor does not invest his own money and has to be insured for the case of C_H project. The public is able to check that if fixed price contract is signed than it is as well fulfilled. The costs are borne to all interest groups but benefited is only the interest group which runs the project. The benefit for the interest group will be denoted by B. We assume that: $C_H > B > \tilde{C}$

Without loss of generality we will assume that $E[\alpha_i] = f\alpha_f + (1-f)\alpha_u = 1$. The welfare of interest group i is given by following:

$$y_i B - E[y_j C_j],$$

where E denotes expectation operator and y could take shape of $y_i = 1$ the project is undertaken and $y_i = 0$ the project is not undertaken.

The government receives the offers from all interest groups. He knows the cost only by some of them and these are contracted for a fixed price. By $\tilde{C}$ project neither the government nor the contractor knows the price ex ante and therefore are contracted with cost-plus contract. After the realization of the real cost it is either C_L or C_H paid to the private contractor. When the government maximized only social welfare it should undertake all C_L and $\tilde{C}$ projects but none of C_H project.

Unfortunately the government in our case maximizes expected welfare of interest groups weighted by his weights α_f and α_u:

$$E[(\alpha_i B - C_i)y_i].$$

To introduce a potential conflict between official's action and social welfare we assume following:

$$\alpha_f B - C_H > \alpha_u B - \tilde{C} > 0$$

which means that the official would rather undertake costly project for his favorite group than $\tilde{C}$ project benefiting unfavoured group. This contradicts the social welfare maximization because it is socially desirable that no C_H project is undertaken and all $\tilde{C}$ are undertaken. Anyway the low cost projects will be always undertaken since they are contracted for fixed price. Maskin and Tirole (2008) introduced linear accounting system with well set accounting costs $\hat{C_L}$, $\hat{C_H}$ and $\hat{C}$ representing low fixed price contract, high fixed price contract and cost-plus contract respectively and with the budget cap G:

$$n_L\hat{C_L} + n_H\hat{C_H} + n\hat{C} \leq G, \tag{6.5}$$

where n_L, n_H and n describe proportions of low price, high price and cost plus project, respectively. The accountants who check the work of the public official set the spending cap G so that the public official does not overinvest. Unfortunately they do not have any information on real cost ex ante, but they see which projects were contracted with fixed price contract and which for cost-plus contract. The accounting cost $\hat{C_H}$ is set to ∞ to prevent its realization. If the public official would invest into C_H he would overrun his spending cap. Unfortunately this is not enough to prevent the C_H projects from realization. The public accountants do not know the price ex ante and in they cannot distinguish $\tilde{C}$ project and C_H project ex ante. The public official will misuse the situation and he will collude with the private contractor he favours and he would gimmick the C_H contracts as $\tilde{C}$ cost-plus contract.
Following shows us the preferential rank of the official

$$\alpha_f B - \tilde{C} > \alpha_f B - C_H > \alpha_u B - \tilde{C} > \alpha_u B - C_H.$$

There does not exist a system how the accountant can distinguish uncertain project $\tilde{C}$ and high cost project C_H declared as uncertain. Now we know that the public accountants to reduce the loss on social welfare must exclude all unfavoured $\tilde{C}$ contracts to exclude the C_H as well or they must include them also with respective part of C_H contracts. If they did not do that the public official would exchange some $\tilde{C}$ contracts for C_H of his favoured interest group which are socially undesirable. Then the total social welfare would shrink. So there are two possibilities how to set the spending cap G. First includes only all low cost contracts and favoured uncertain contracts. The second is wider and includes favoured high cost contracts and uncertain unfavored contracts as well. The decision between these two variants depends on next inequality:

$$x(1-\rho)f(B - C_H) + (1-x)(1-f)(B - \tilde{C}) > O \tag{6.6}$$

If the inequality holds, then the negative impact of C_H projects is outperformed by the positive impact of $\tilde{C}$ and overall they bring together positive net benefit to social welfare. If it does not hold then both should be excluded because the loss stemming from C_H contracts is bigger than the benefit that bring $\tilde{C}$ contracts.

Both situation with loose or tight limit outperform the traditional settings because PPP prevents early assessments. In the traditional setting would be the projects evaluated firstly for their first period price which is same for all and therefore the public official would only invest in projects benefiting his favoured interest groups

no matter what are the costs in the second period.

6.2.2 Intertemporal Transfers

Still there exists some dangers even the spending cap is set on appropriate level. When the contractor is sure he is going to be the one who will undertake the project as well in the second period he might ask for a smaller payment in the first period if he sees the chance to collect higher revenue in the second period. Obviously in the in the conventional contracting the contractor would not agree to accept a payment below the cost in the first period.
The public official may let the contract for his favoured group deliberately incomplete as a strategic decision. This often leads to renegotiation. This renegotiation could lead to a hold-up problem, where the contractor has a stronger position. Public official can also pass the incomplete contracts to the following administration if he is not elected again. Then following administration must pay the cost of incomplete contracts.
This reduces rapidly the social welfare and creates very undesirable situation. This would not be possibly under unbundled contracts, because the first contractor would never accept lower payment. This shows that even when the PPP can mitigate the early assessment of the project and might seem beneficial, it contains more risk connected with biased public official. He can join the public contractor and make a very incomplete contract that would lead for example in the second period to costly renegotiation.

6.3 Limited Commitment of the Government

In the third chapter we summarized that the government should increase subsidies in the second operating period to reward the private partner for his initial investment in the first operating period. We will now look at the situation when the government is not able to commit itself to such agreement and instead a renegotiation takes place in the second period.
The best solution is to make the contracts binding also for the future governments. This solution is unfortunately also not flawless. The first government can delay the payments and move them to the following one or it would leave the contract strategically incomplete as was shown in previous section.

At the end of the first period the investment a^0 counts already to sunk costs and the conditions for the second period are going to be renegotiated. This would induce maintenance effort and insurance conditionally on the investment level a^0 as in the second chapter in the case with negative externality. This yields maintenance effort and cost reimbursement rule:

$$\beta_2^0 + \lambda = e_2^0 = e_P^{neg} = \frac{1-\lambda}{1+r\sigma^2}$$

The firm is anticipating β_2 in the second period and of course it knows the β_1 and whole incentive scheme for first period a chooses his investment:

$$e_P^{neg} = e_1 a. \tag{6.7}$$

This makes the variable for the government's problem for both periods:

$$\max_{a,e_1} 2(b_0 - \theta_0) + \frac{(1-\lambda)^2}{2(1+r\sigma^2)} + (1-\lambda)e_1 - \frac{(1+r\sigma^2)}{2}e_1^2 + (1-\lambda+b)a - \frac{a^2}{2},$$

subject to (6.7).
It is obvious that when government is not able to fulfill its commitment fully (from whatever reason) the social welfare is lower than with full commitment. It also plays role that the government does not realize that the private partner adjusts his investment also in the first period. Contractor chooses $e_2^0 = e_P^{neg} < e_2^{SB}$and uses less benefits from his investment in the first period. If the contractor should invest then he must get bigger payment for his first period effort. That is only possible when the contract in the first period looks more like cost-plus one.
The overall conclusion is that if the government cannot fulfill its commitment then the contracts tend more to the cost-plus ones for both periods and the investment efforts would be lower:

$$e_2^0 < e_1^{SB},\ e_2^0 < e_2^{SB} \text{ and } a^0 < a^{SB}$$

Let us imagine another situation when the renegotiation is not sure. There exist probability p that in the second period government would not fulfill the contract and would like to renegotiate. This setting is rather realistic. Between the two periods there may be elections, financial crises. Especially in developing countries is the risk higher.
In this case again the first-period private investor's investment a^0 is sunk and with probability p the government would like to renegotiate the cost reimbursement rule for the second period. Again the firm chooses its maintenance effort and insurance

conditionally on its investment in the first period a^0. The private partner's effort is a combination of second-best effort and effort where the government behave opportunistically:

$$pe_u^{SB} + (1-p)e_2 = e_1 a. \tag{6.8}$$

It is clear that with growing risk of renegotiation effort lowers as well as the investment in the first period. This induces less social welfare. In the literature this is called "ratchet effect"[2]. They described how "ratchet effect" makes the private partners to behave similarly in the first period as they are not much investing into the quality of the infrastructure. This erases the difference between PPP method and traditional contracting.

Conclusion

Renegotiation is a very costly instrument of changing the contract. The long term contracts include uncertainty about future costs. This forces the government to offer more cost-plus contracts for cases that the costs will be high. The cost-plus contracts do not induce investments into quality and cost reduction efforts. If the contractors would not be insured against high cost then renegotiation is very probable. The cost uncertainty can appear by traditional contracting as well, but it is less probable as the operating contracts are signed later when there is already more information about costs.

Very often the renegotiation occurs in countries which are politically unstable and their institutional framework is not developed. It appears that collusion between public officials and private contractor rapidly increases the cost of the projects. The cost of the projects in such cases is even increased with the cost of renegotiation stemming from strategically incomplete contracts.

The government can also renegotiate the contract and try to exploit the investment made in the first period. The private partner expects this behavior from opportunistic principal and adjusts his efforts already in the first period. The whole process does not bring to the government expected payoff and it reduces his welfare.

The PPP projects are not suitable to very uncertain and political risky environments. In these environments the there is a huge risk of renegotiation and the cost to prevent renegotiation in such environments is also significant.

[2] Laffont and Tirole, 1993

Experience

In Latin American countries which are considered to have lower institutional quality that between 1989 and 2000 79% of total government led renegotiations occurred after first election (Guash, Laffont, Straub, 2006). We can assume that the favoured groups in the society changed and the government wanted to change the contracts. As well strategically incomplete contracts is a type of collusion between government and private contractor. According to Engel et AL (2003) was public highway construction project in Argentina in the 1990 very vague. The location of the toll booths was left unspecified, allowing the contractor to place them strategically and thereby raise motorists' costs above anticipated level.
The political uncertainty deter many firms to take part in such a project. With the lower number of potential contractors increases the risk that they will agree on price and their negotiating power rises. With higher negotiating power shrinks the government's welfare and therefore political stability and well designed institutions are crucial for running a PPP project.

Conclusions

PPP is an alternative way to provide public goods or services by private partner. Its main features are cost internalization by bundling building and operating period, risk transfer from government to private partner and long-term contracting. Its main use is in sectors as transportation, schooling, water supply, energy supply, and health. The PPP contracts must be very complex to cover the risks and changes in time, therefore traditional procurement is not suitable and bilateral negotiating takes place. In this negotiation government does not necessarily posses all bargaining power. In my thesis I rigorously described the benefits of PPP, the role of private partner's negotiating power in the contract and main dangers connected to PPP.

The thesis showed that PPP projects can outperform traditional contracted projects. The main benefit stems from bundling the building and operational periods. This enables builder to internalize the operating costs which makes incentive to invest in quality already in the building period. This investment brings lower operating costs in the second period. This is connected with risk transfer on risk averse contractor, so the government is forced to pay him a risk premium. Nevertheless this transfer creates better quality of the project and cuts the price of the project. On the other hand the private contractor uses his negotiating power to share profit from his investment and therefore cuts the profit of the government. Some projects nevertheless can be beneficial for the government even if he does not posses any negotiating power over cost-reduction delivered through PPP. This is cause by high impact of quality on operating cost which induces higher investment into quality thus raises government's benefit.

The bundling concerns not only building and one operating period, but also generally more operating periods. With more operational periods a very similar problem occurs with renewal investments. The PPP contract assures the private partner that he will run the project in all operating periods, therefore he does not invest only to cut the operating costs at the moment but invests to renewal of the asset to pay for lower operating cost even in the following periods.

The focus on long term does not bring only benefits but it is connected to many uncertainties. PPP projects are usually signed for 20-30 years and it is very difficult

to predict how the public demand and costs will change. The long-term duration of the contract creates inflexibility which can make the contract obsolete in future and thus reduce the government's benefit. PPP is especially unsuitable for projects which evolve quickly over time. IT systems are typical example of sector where renegotiation may very probably occur. Other examples could be schooling or hospitals where the quality depends on the level of human capital. The renegotiation is a costly procedure where the government can lose most of its benefit and in an extreme case it could be forced to cease the project.

The problems with inflexibility can be partly solved by transferring some demand risk on private partner. This is only suitable when the demand for the infrastructure is quality elastic. This creates an additional incentive to invest into infrastructure quality and adjust it to the public demand. In areas where the demand is difficult to predict, the risk transfer instead creates a need to insure the contractor which could be by high risk aversion very costly. From the very same reason the government should insure his private partner to exogenous risk. Naturally the private partner should be insured by the government also for the risk which is endogenous to the government. When the payoff of the private partner depends on the demand, the private partner carefully evaluates the project. This can mitigate the projects which would be inviable on the normal market.

For good results of PPP contributes stable political and institutional framework. When the government is able to offer a menu of contracts for possible cost levels and it is able to fulfill its commitment then even if the cost is higher than expected, then renegotiation does not occur. On the other hand in states where governments changes often and the government does not fulfill the commitment of preceding one, the costs of PPP raise and investment into quality is lower, thus the benefit for the government is lower as well. Even worse situation stems from governments which colludes with their private partners. They can make strategically incomplete contract to induce renegotiation in the following period. They pass the costs of the project onto next administrations which has to lead costly renegotiation.

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