STRATEGIES IN THE PROCUREMENT OF TRANSPORT INFRASTRUCTURE

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ABSTRACT

The Public-Private Partnership (PPP) method of procurement has been seen by governments as a means to launch investment programmes, which would not have been possible within the available public-sector budget, within reasonable time. Key guidelines in pursuing this form of infrastructure development have been the demonstration of value for money (VfM) for the public sector and affordability for the private. Risk transfer is considered central to the PPP mechanism in terms of definition, contract negotiation, achievement of VfM and overall project success. Risk allocation, however, is carried out between at least two risk-averse agents facing a risk-sharing problem constrained by bounded rationality, stemming from the uniqueness of the undertaking and resulting in incomplete contracting. Most PPP models developed assume a verifiable payment made by the public sector or users to the private party, while they ignore residual value following contract completion.

Transport infrastructure projects bear unique characteristics. They are cost intensive investments positioned as natural monopolies, which once built cannot be used alternatively. In addition the life of the investment is in the 50-year range (i.e. longer than the average duration of a PPP contract). This combined with the fact that many PPPs in the transport sector base revenues on tolls (i.e. forecasted traffic volumes) introduces uncertainty.

These discrete features of PPP transport projects, i.e. (i) revenue uncertainty and (ii) residual asset value, are modelled as incomplete contracts using game theory. Scenarios are developed based on varying levels of perceived demand uncertainty and residual value. The model is used to predict the possible strategies undertaken by the prime agents, thus providing new insights. Case studies from literature are used in support of model predictions.

Finally, based on model predictions, a decision framework is proposed for the procurement of transport infrastructure. This is considered to be of interest to public contracting authorities in countries with high demand uncertainty and interest in infrastructure residual value, as in the case of developing countries.

Keywords: Public private partnerships, incomplete contracts, game theory, risk allocation, procurement strategies

INTRODUCTION

Transport infrastructure projects bear multiple impacts and are designed not only to address the principal issue of demand in transportation but also weight out, minimize or improve external present and future effects on time saving, air quality, noise, safety, energy consumption, economic growth, land use and real estate development. Due to these multiple direct and indirect socio-economic impacts and in order to meet demand, governments are increasingly looking to a wide range of alternative models characterised by increasing use of private sector resources, expertise and management. Options include the selective outsourcing of specific tasks, fully or partially state-owned companies, not-for profit entities, privatization and Public Private Partnerships (PPPs). This has been recognized as the financing approach to PPPs (Aziz, 2007). Through innovative financing models, governments may access new sources of “borrowing” by which to bring infrastructure on stream sooner than through public funding, but the additional costs of private borrowing need to be offset by increased efficiency. This has lead to the service approach to PPPs (Aziz, 2007). Increased efficiency in management and operation can be achieved through life-cycle costing and design, and thus has lead to the bundling of the design, construction and operation of facilities characterizing most PPPs. The other factor that leads to improved efficiency is the effective allocation of risks to the party most capable of managing the risk or who would assume it with the least cost. Risk transfer is central to the procurement mechanism in terms of method definition, contract negotiation, achievement of value-for-money and overall project success. Risk allocation, however, is carried out between at least two risk-averse agents, a public contracting authority and a private contractor, facing a risk-sharing problem constrained by bounded rationality, stemming from the uniqueness of the undertaking and resulting in incomplete contracting. By specifying the level and type of risks a public client wishes to transfer through the procurement process, strategies evolve with respect to the project.

In the particular case of transport infrastructure there are unique characteristics that need to be considered. Projects in transportation are inherently capital-intensive and often require large sunk investments whereby their recuperation may span over a long period, in many cases in the order of 30 or more years. They are immobile; in fact, transport infrastructure investments are particularly cumbersome to transfer or reallocate and, if reallocation were possible, it would imply prohibitive transfer costs (Grimsey and Lewis, 2002). Furthermore, transport infrastructure projects are, proven to be (Flyvbjerg et al, 2002; 2004; 2006) characterised by enormous cost overruns, which are transport mode specific and due, possibly, to optimism bias in the ex-ante evaluation phase in an effort to secure project approval and funding but which result in the misallocation of scarce resources on the one hand and the reduction in project quality on the other (Polydoropoulou and Roumboutsos, 2009). The outcome, in many cases, limits the range of anticipated benefits and has lead to many “white elephants”. In addition the asset life of the investment is in the 50-year range. In this aspect, revenue related risks are significant in transport projects and usually reflect the uncertainty in predicted traffic volumes and in the willingness of users to pay for services rendered. When considering the long payback period required and the fact that traffic volumes are correlated to regional and international market structure, economic growth and land-use patterns - i.e. they exceed both the public and private sector's ability of control - then addressing the investment risk becomes crucial.

Hence, investment in transport infrastructure involves significant risk taking on behalf of the parties participating in project planning and project financing. These issues, i.e. risks and financing are addressed through the procurement mechanism and the strategies developed by the participating parties in this stage.

These strategies and their potential impact on the project has been the object of recent research work based on transaction cost economics and incomplete contract theory considering aspects of the ex-ante and procurement process in a generic form. The present study models and investigates strategies developed in view of the particularities of transport infrastructure: (1) demand (revenue) risk and (2) residual value of the investment following contract completion. Findings are compared to cases in literature and a framework model is presented to guide public sector authorities when faced with the infrastructure financing - procurement problem.

The background to the proposed model is presented in the second part of the paper, followed by the model in the third. Findings are discussed and compared with cases reported in international literature in the forth section of the document leading to the formulation of a framework model for decision-making (fifth section). Conclusions are drawn at the end along with themes deserving further scholarly attention.

BACKGROUND

A number of procurement models are available to public authorities by which to procure the development of transport infrastructure. These may be generally categorized under the greater headings of traditional and public-private partnerships (PPP). Indicative examples of traditional procurement are the established and legally well defined methods of 'Construction Procurement' where the design has been previously procured (Design-Bid-Build) or prepared in house and the 'Design and Build method'. Public Private Partnerships (PPPs) describe known contractual types such as Built-Own-Operate-Transfer (BOOT), Build-Own-Operate (BOO), Design-Finance-Build-Operate (DFBO) and so on. In general, the provision of transport services may be presented as a sequence of tasks – design, construction, operation, which may be procured unbundled (as individual tasks) or bundled representing either the traditional or the PPP form of procurement. In this general approach, the "Design and Build" method may be considered under the title of PPPs (as defined by the US Dept. of Transportation). In most cases (as in the EU) the bundling of tasks refers mostly to the (design) construction and operation, as quality and efficiencies build in the construction phase may be internalised in the operation phase of the project to the benefit of the operator.

This has formed the basis for models presented by Bennett and Iossa (2002; 2006), Hart (1997, 2003, 2007) and Martimort and Pouyet (2008). The first two support the potential of PPPs and lie in the realm of property rights literature and incomplete contract theory (Grossman and Hart, 1986; Hart and Moore, 1999; Anderlini and Felli, 2004). In their approach, inefficiencies in asset's quality-enhancing and cost reducing efforts stem from the hold-up problem that arises when no contract can be written and only ex post negotiation between the government (public sector) and the operator and/or builder (private sector) is feasible. Although ex post efficient, this negotiation generates payoffs which depend on the threat points defined by the ownership structure. The basic issue they respond to is the fact that performance contracts are difficult to write ex-ante. This is especially true with contracts stretching into an unforeseeable future. In addition, if it were possible to write performance contracts ex-ante, then transaction costs would render the task unaffordable. The latter has been challenged by Maskin and Tirole (1999) who, supporting the irrelevance theorem, proposed that instead of foreseeing the possible physical contingencies, the parties should agree and specify ex-ante possible payoff contingencies leading to "complete" contracts.

Martimort and Pouyet (2008), while very similar in their approach, are based on agency theory and look at task assignments in organisations in the presence of agency problems. Through their model and by inducing the "indicator" of positive or negative externalities they justify the potential or not of bundling. Their work stems from Holmström and Milgrom (1991), who showed that in pure moral hazard environments, incentives in one task may destroy incentives in another when tasks are substitutes in the agent's cost function. This result suggests that tasks should be split when there is a negative production externality. Martimort and Pouyet (2008) conclude, amongst others, that positive externality is produced when technological innovation is included. This corresponds to the "productive investment" and "innovation investment" proposed in the models of Bennett and Iossa (2002; 2006) and Hart (2003).

Finally, a significant problem in performance contracting is the fact that monitoring performance by the contracting party also implies important transactions costs. Dequiedta and Martimort (2004) further identified that it is also dependent on the productive efficiency of the contractor. Menichini (2008) through her model concluded that a two-lender scenario is Pareto superior to the single monopolistic lender contract. Transferring these conclusions to the PPP setting, would, on the one hand, support the incomplete contract theory, as the public contractor resumes to the PPP process to address internal managerial and operational inefficiencies and on the other, that the inclusion of lenders (additional monitoring agents) would improve the monitoring process.

In general, there is a growing literature of incomplete contract theory and Public Private Partnerships, which is concentrated on the issue of optimum bundling of tasks when the produced positive externalities generated by improved quality and/or innovation during the construction stage may be partially or in total internalised in the operating stage by the private partner while, also, resulting in increased welfare for the public one. All models developed assume a constant and verifiable payment made by the public sector, while they ignore impact of asset residual value after the completion of the contract.

The above approaches do not take into account project or sector particularities, which may be a source of strategic behaviour. The proposed model is inspired by the aforementioned models and introduces two additional variables present in transport sector projects (1) revenue uncertainty and (2) residual value after the end of the contract period.

THE MODEL

It is assumed that in transport infrastructure projects specifying service quality is more reliable than specifying the construction and, thus, the bundling of building and operations is a favourable option in terms of the private partner internalising benefits from the quality of design and construction in order to benefit from reductions in operational costs, as described by Hart (2003), Bennett and Iossa (2006) and Martimort and Pouyet (2008). Simultaneously, further benefits are generated for the public partner, through "innovation" (i.e. positive externalities) included in the design and construction.

The model considers four dates: (i) the signing of the contract $t=0$, (ii) the beginning of the operation period, $t=1$, (iii) the completion of the contract, $t=2$ and (iv) the end of the useful life of the infrastructure, $t=3$. Therefore, construction takes place between $t=0$ and $t=1$, contractual operation between $t=1$ and $t=2$, while between $t=2$ and $t=3$ the asset is transferred back to the public party.

At time $t=0$ the private party makes an investment $I_0=i_o+\alpha$, where α is productive/innovative (i.e. a positive externality) and generates benefit. During the operation period, the private party bears a cost $C=C_0-c(\alpha)$, where C_0 is the normative cost of operation and $c(\alpha)$ a cost reduction due to α. At the end of the contract period, the asset has a residual value $R=R_0+v(\alpha)$, where R_0 is the normative residual asset value and $v(\alpha)$ the improved residual value of the project generated by the productive investment α and which cannot be retrieved by the private party. The fee for the procured services (building and operation) is, initially, considered to be fixed, P. Finally, λ_1 is the pre-bidding and negotiation costs encountered by the private party in the procurement process.

Simultaneously, the public party receives a benefit $B=B_0+b(\alpha)$ during operation where, B_0 is the normative welfare and $b(\alpha)$ is the benefit generated by α, as well as the residual value, R, as described previously. The public party, also, bears a cost C either in the form of availability fees or tolls paid by the public users, which equals the "payment", P, received by the private party, as well as costs encountered in the procurement and negotiations process, λ_2. The anticipated costs and benefits for the contracting parties are illustrated in figure.1. Obviously, the public party receives additional benefits through the operation of the asset after the completion of the contract. This latter benefit is not considered in the present analysis as it does not influence the private party's behaviour.

The presentation, actually, describes a fixed price PPP contract, where the contract life is less than the asset life cycle. In order to introduce revenue uncertainty, P is expressed as being equal to revenues generated by a defined toll rate, r, by a normalized demand, $\bar{d}$, over the operational contract period, T ($T=t_2-t_1$). Three cases are analyzed, showing the effect of residual asset value on partner strategies, furthered by the influence of demand uncertainty.

The model does not assume symmetric nor asymmetric information between the contracting agents but a difference in the probability of demand forecasts materialising.

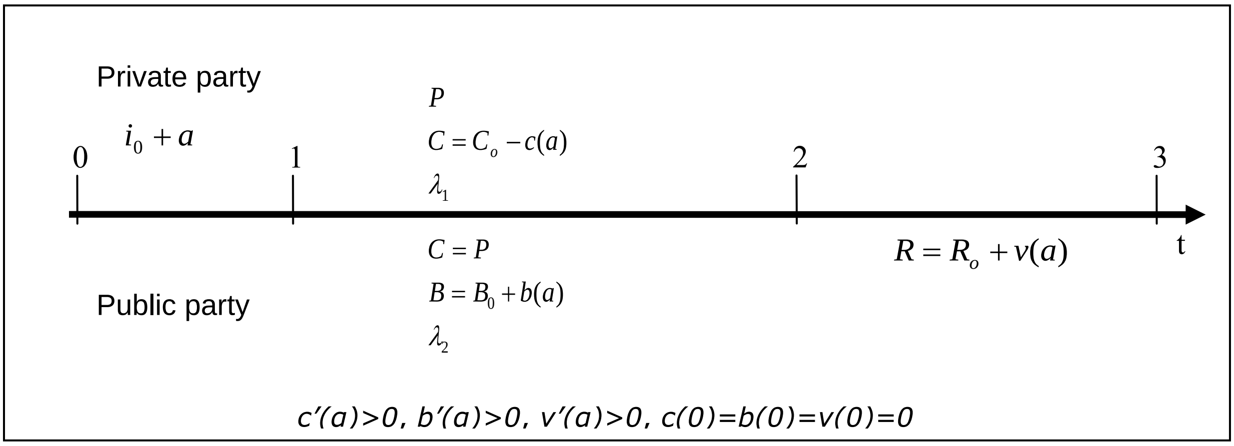

Figure 1- Partners' anticipated costs and benefits during the project time line

Notably "α" is an investment parameter in both a tangible and intangible sense, which describes an effort and, possibly, a risk for the private party, which, however, leads to a beneficial outcome (*c'(α)>0*, *b'(α)>0*, *v'(α)>0*, *c(0)=b(0)=v(0)=0*). This outcome, while, it may be described in monetary terms for the private sector as a reduction in operation/maintenance costs, *c(α)* – for example construction in a design which facilitates maintenance and reduces maintenance costs -, it is not equally tangible for the private sector, where benefit, *b(α)*, may represent social overall benefit, user satisfaction.

Case I: Residual value and demand uncertainty

In this case residual asset value is gained by the public partner following the completion of the contract period. This situation describes most arrangements were the length of the contract reflects the time period for the private party to make a reasonable payback on his investment. The contract period is less than the operational life of the asset.

Based on the Figure 1, the private and public partners wish to maximise respectively equations (1) and (2).

$$\max\{P - C - I - R\} = \max\{P - C_0 + c(a) - \lambda_1 - i_0 - a - R_0 - v(a)\} \quad (1)$$

$$\max\{B - C + R\} = \max\{B_0 + b(a) - P - \lambda_2 + R_0 + v(a)\} \quad (2)$$

The first order conditions for the private party are $c'(a) - v'(a) = 1$, indicating the need to either choose an $\hat{a}$ that will off-set the lose of residual value through reduction in operational costs or an $\breve{a}$ that will minimize *v(α).*

If there is a competitive supply of private parties bidding for the contract than:

$$P = r\bar{d}T = C + \lambda_1 + I + R = C_0 - c(a) + \lambda_1 + i_0 + a + R_0 + v(a) \quad (3)$$

where *r* is the normative toll rate, $\bar{d}$ is the normative demand forecasted by the public party and *T* is the operating period from *t=1* to *t=2*. Notably, in a competitive bidding environment, the bid would be equal to the costs incurred. If *r* and *T* are fixed or constrained (e.g. public policies limiting toll rates, competitive bidding etc.), then the bidder, depending on his estimate of whether the demand forecast was over- or under-estimated will adjust the second part of eq. (3) accordingly. Moreover, though over- and under-shooting happen, overshooting tends to prevail (Estache, 2001; Trujillo et al, 2002; Flyvbjerg et al, 2002; 2004), in which case, the risk averse private party will assume that the normative demand forecast $\bar{d}$ is overestimated and try to further minimise the second part of eq. (3). Therefore, optimally, within his strategy, will build an infrastructure and operate it so as to minimise residual value, i.e. $R_0 + v(a) \to 0$ and $c'(a) = 1$.

The benefit for the public party would then be $B_0 + b(a) - P - \lambda_2$, while the useful life of the infrastructure will be reduced respectively (or in practice, eliminated). It is noted that the loss for the public party is greater than just the residual value considering that benefits from operating the asset after the transfer will also be lost.

Notably, whether $\bar{d}$ is over- or underestimated will have no impact on quality and/or innovativeness of the construction as probabilities will not materialise before the operation stage. The public party may be willing to undertake the demand risk by providing subsidies and/or securing minimum revenues. This approach will generate benefits such that maximise a fixed price contract and might lead the risk averse agent to follow a conservative strategy with limited benefits to be generated. In addition, as the objective would be to minimise operating costs and (eliminate) residual value, there is less incentive for improved quality and innovation in construction and more in introducing managerial and process innovations. This approach seriously limits the scope of a PPP arrangement.

The above denotes the zero-sum approach to the PPP contracting game, which delivers less benefit to the public party as it provides fewer incentives to the private party to create positive externalities.

Case II: Nash bargaining of benefits, residual value and demand uncertainty

When addressing the problem within a Nash Bargaining framework, all external benefits are shared and internalised respectively, i.e.

$$\max\{B - C - I + R\} = \max\{[B_0 + b(a)] - [C_0 - c(\alpha)] - [i_0 + \alpha + \lambda_1] + [R_0 + v(a)]\} \quad (4)$$

and an *α* is selected such that

$$\frac{1}{2}\left[b'(a) + c'(a) + v'(a)\right] = 1 \quad (5)$$

This is an improved solution with respect to the one described by eq. (1) and (2), but it implies a "transfer" payment made to the private party which is connected to the residual value of the asset at the end of the contract.

When considering the affect of the demand forecast $\bar{d}$ and revenues generated through toll payments, then in a competitive bidding environment:

$$P = r\bar{d}T = C_0 - c(a) + \lambda_1 + i_0 + a + R_o + \tfrac{1}{2}v(a) \tag{6}$$

When compared to eq. (3), eq. (6) leads to better offers. However, the issue of demand risk continues to influence strategies. If again the risk averse agent makes the assumption that demand forecasts are overestimated, while providing a fixed r and T, he will, again, adjust his selection of investment α to reflect his estimated $d^* \prec \bar{d}$, through unverifiable cost parameters such as the residual value (or life) of the asset.

As this may not be a beneficial outcome for the public party, she will negotiate the sharing of the demand risk. Ex-ante typical solutions (subsidies and secured revenue) will reduce the problem to the one described in Case I, which limits the private party's incentives to generate positive externalities.

Nash bargaining may provide solutions, when the problem (i.e. smaller than anticipated traffic volumes) arises, through respective negotiation clauses following the idea behind the irrelevance theorem as proposed by Maskin and Tirole (1999), whereas instead of foreseeing the possible physical contingencies, the parties agree and specify ex-ante possible payoff contingencies. In addition, as has been pointed out in the literature (cf. Hart and Moore, 2007), it may sometimes be possible to allocate at a re-negotiating date t_n bargaining power at initial date t=0. Clearly, in the case of symmetric information (or in this case equal assigned probabilities of traffic forecasts) that has usually been studied, at date 0 the parties would always agree to give the investing party the right to make a take-it-or-leave-it offer at date t_n. However, if the parties know that there will be asymmetric information (or a difference in assigned probabilities), a model studied by Schmitz (2008) implies that they might well agree to allocate all the bargaining power to the non- investing party, i.e the public party.

Case III: No residual value

In this case t=2 and t=3 coincide, and the life of the asset equals the contractual period. Therefore:

$$\max\{P - C - I_0\} = \max\{P - C_0 + c(a) - \lambda_1 - i_0 - a\} \tag{7}$$

$$\max\{B - C\} = \max\{B_0 + b(a) - P - \lambda_2\} \tag{8}$$

Eq. (7) and (8) mirror those presented by Hart (2003), indicating that optimum bundling is expected only in the case where no residual asset value is anticipated by the public party and a fixed fee is offered.

The introduction of the forecasted demand $\bar{d}$ and the respective revenues, in a competitive environment produces:

$$P = r\bar{d}T = C_0 - c(a) + \lambda_1 + i_0 + a \qquad (9)$$

Interestingly enough, in this case whether over- or under-shooting of the demand forecast exists, the private party can only do better by introducing a productive investment *α* which will reduce its operating/maintenance costs by *c(α).*

DISCUSSION AND CASE IMPLEMENTATIONS

Using Case III as a starting point, it may be concluded that optimum bundling under the assumptions made may occur in situations where the contract period spans the life of the asset, i.e. when complete ownership is passed to the private party.

In situations where the life of the asset exceeds that of the defined contract period, bundling leads to suboptimal results due to conservative strategies developed by the private party as there is no benefit in improved residual value (Case I) or partlial benefit in residual value (Case II) when asset transfer payments may be foreseen. Ex-post evidence of this effect is not currently available, as most PPP projects have not yet completed their contractual life.

Demand uncertainty invokes additional suboptimal results as the private party will adjust its strategy to his anticipated demand. The provision of demand securities through subsidies or secured minimum revenues does not seem to improve the situation and are less beneficial than fixed price contracts. Notably this is an interesting finding and one that goes against the “user pays principal”. This may also be an alternative explanation to the fact that even during an economic crisis transport infrastructure where the end-user is represented by corporate or commercial clients tends to continue development (i.e., airports, ports, cargo railways, etc.) in contrast to transport infrastructure where the end-user is represented by consumers (i.e., urban transport, toll roads, etc.). This has been the case in East Asia, Russia, Mexico, Brazil and Argentina during the 1990s (Estache et al, 2007).

All cases assumed a competitive bidding environment. This has not been identified in practice. More so, the problem usually identified is the limited number of bidders involved and the threat of developing a PPP oligopoly. However, though this has seemingly been the outcome of expensive bid preparation processes and long negotiations, on the other hand oligopoly conditions may lead to improved quality due to the fact that in this case the bidder will submit a bid *P*>P*, which would allow him to make the productive investment *α*. This brings up two issues: (i) *P*>P* may make the project affordable for the private party but may not produce value for money for the public sector and (ii) an increased *P** will be expressed as either an increase in the normative toll, *r*, or an increase in the duration of the PPP contract, i.e. $t_2 \rightarrow t_3$, which leads to Case III. Choosing to maintain contract duration and ride the cash flow problem through increases in toll rates has been the basic cause of PPP failure in toll roads, as the involved parties (and principally, the public party) ignore related demand and political sensitivity issues, such as the feeling of fairness (Fujii et al, 2004).

An example is the M1/M15 toll motorway in Hungary, where traffic volumes were about 40% lower than anticipated, despite the forecasts being prepared by independent experts. Higher toll rates did not cover for low volume. Instead, they led to a court case by dissatisfied road users. A similar case is the Sydney Harbour Tunnel, where users saw a rapid rise in toll charges to cover commercial miscalculations.

Another issue to be addressed are λ_1 and λ_2 which may be considered as ex-ante transaction costs to be retrieved during the project pay-off by both parties. As analysed by Anderlini and Felli (2004) both parties will be involved in the transaction if the anticipated benefit of the transaction is greater than the ex-ante costs involved. However, while PPPs have been known to involve considerable pre-bid costs, the private party will always anticipate recovering them during the contractual period. The model foresees recuperation during the operational phase. However, it is not unlikely that these costs may be considered as part of the investment. This triggers strategic behaviour, as reduction in investment costs will most likely lead to the reduction of the indefinable productive investment, α, and therefore jeopardize the entire contract, as it will lead to greater operational costs and so on. This has been addressed as an important success (failure) factor in literature under the title of public sector competence, transparency and legislative framework in place to support PPPs.

For example, in August 1997, Gdansk Transport Company obtained the concession to finance, build and operate a section of the Autostrada A1 from Gdansk to Torun. Due to multiple rounds of renegotiations and frequent adjustments to legislation taking place, the concession agreement was, only, signed in August 2004, 7 years after the beginning of negotiations. The final contract specifications of the project were significantly changed and the construction was divided into two projects, instead of the original plan of one project.

Finally, Case II considers the option of negotiation, in order to allow for sharing of unforeseen (usually adverse) events. Alternatively, Case II may also foresee the realization of an “alliancing” potential between the public and private party, through an option of “value contracting”, where benefits achieved are shared between the contracting parties. However, this approach in non-cooperative environments, may lead to increased complexity (Segal, 1999) and negotiation clauses may be a source of additional strategic behavior. The failed London Underground PPP project could be considered as such a case, where affordability in the base case was not proven but re-negotiations were foreseen every 7,5 years in a 30 year contract (Shaoul, 2002).

A final note concerns the “productive” investment α, which in itself introduces additional risk as it concerns the introduction of innovative aspects in construction, management/operation and maintenance. As such, the private party will avoid introducing “radical innovations” or innovations that have not been tested (Roumboutsos and Liyanage, 2010). Therefore, if not properly monitored the private party will tend to avoid making this “productive investment” and the construct will be reduced to traditional procurement with all tasks assigned to a single agent.

The above brief descriptions of public sector strategic behaviour vis-à-vis transport project undertakings presents a strain to public authorities and constitutes the underlining reasons of less than anticipated project delivery. The paradox in essence lies in the fact that the public sector through procurement strategies seeks to transfer risk to the private sector. However, in the particular case of transport infrastructure projects which are high risk investments, because of its size and diversity, the public sector is able to absorb large amounts of risk. This is not typically the case for private companies, regardless of their size and there are numerous cases presented in literature where the public sector had to step in and resume all risks and liabilities.

FRAMEWORK DECISION MODEL

The model, its analysis and the subsequent discussion may be expressed in the decision framework presented in figure 2. The starting point is the evaluation of whether the proposed project has the potential to include innovations by the private sector (i.e. tested innovations, as suggested by Roumboutsos and Liyanage, (2010)). If positive, than the PPP model of procurement may be considered. If not than traditional procurement (unbundled tasks) is more appropriate. Availability of funding will define if the project will proceed through traditional procurement or whether by specifically including innovations it will be reconsidered for the PPP model.

The test concerning the potential of restricting pre-contract costs is important. If respective legislation or procedures supporting transparency are not in place than the project will be burdened with unproductive costs which will potentially limit the impact of any investments in innovation or otherwise “productive” inputs. A key question, which follows, is for the public sector to evaluate the importance of utilising the asset after the contract completion. If not, then the model has proven that it is more beneficial to assume a contractual duration which is approximately equal to the estimated useful life of the procured asset. Otherwise, it is better to foresee a transfer payment.

Finally, if the private sector is willing to assume the demand (revenue) risk, than potential negotiation clauses for adverse conditions with the bargaining power assigned to the public party should be foreseen. Otherwise, as it was predicted by the model the application of availability fees might be more beneficial.

The proposed decision framework in structured sequentially considering that decision points are clear and evenly weighted. However, it is obvious that this is not the case in most real life situations where decisions are weighted and trade-offs made based on the specific conditions involved. Transport policy and governance issues are primarily a source of increased complexity when designing the procurement method. PPPs attract greater competition (more bidders) when the under auction infrastructure may be positioned as a natural monopoly or with limited competition. Trade-offs are made between greater transaction costs and potential for monitoring efficiency and contract incompleteness.

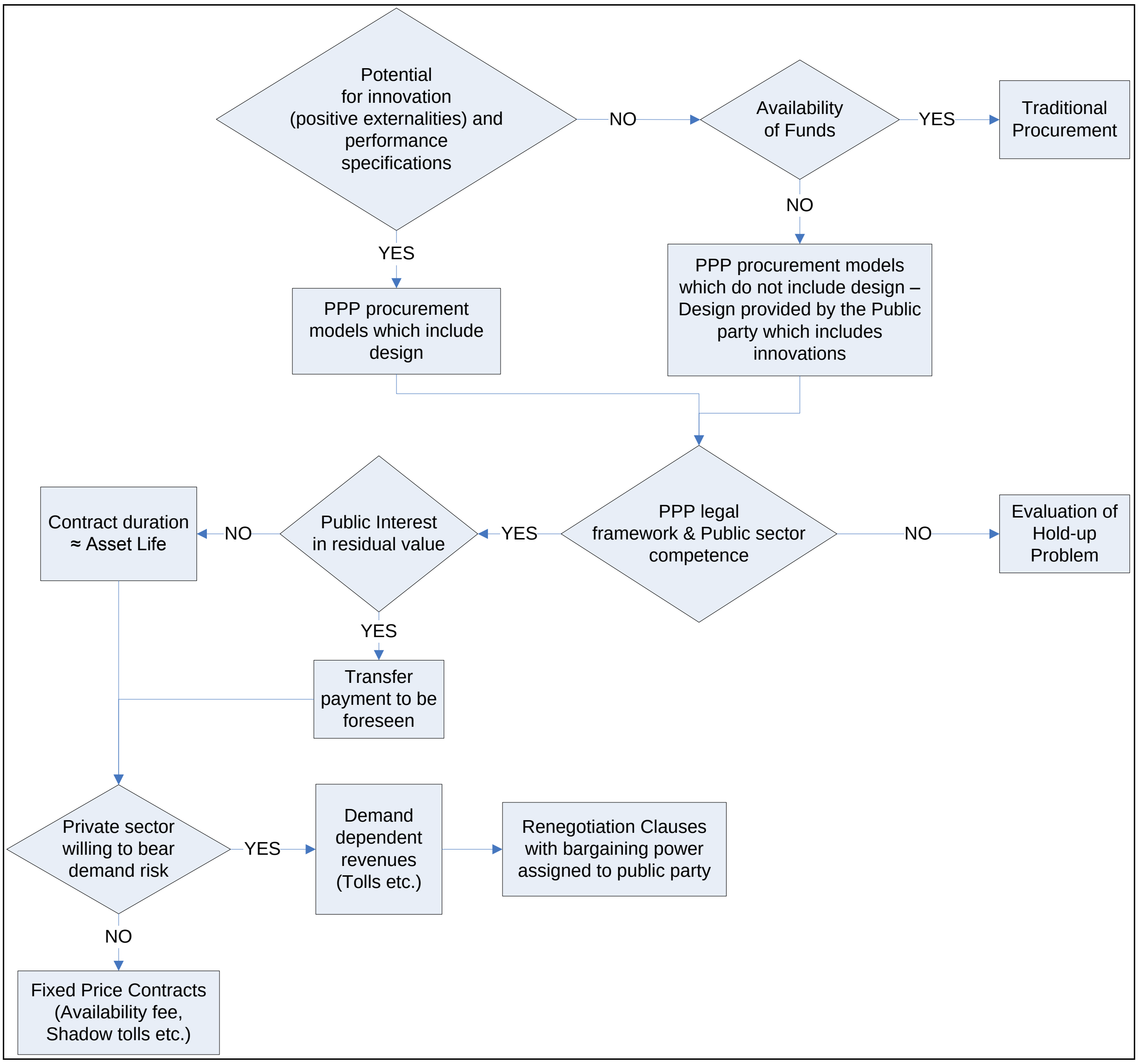

Figure 2- Decision Framework

One implicit assumption made, when developing this framework, is that the infrastructure investment is equally beneficial to the public and private sector. This is not the case when sustainability policy issues are considered in the Cost – Benefit Analysis (Roumboutsos, 2010) (or in any other equivalent project appraisal method). In this case, the project might prove positive for the public sector and lesser so for the private counterpart seeking a considerable return on investment.

Finally, as transport demand is related to the global economy forecasting future trends and events bears an impact on the strategic behavior of both parties (public and private) and the feasibility of the undertaking. Most probably, between the extremes of totally publicly financed or totally privately financed infrastructure, shared financing and shared management might prevail. With respect to the model, this would be reflected in a reduction in initial investment of i_p, the contribution of the public sector. Notably, this approach is used in many cases (cf. European Structural Funds) leading to the so-termed Hybrid PPPs (World Bank, 2006).

CONCLUSIONS AND FURTHER RESEARCH

When considering Public Private Partnerships in transportation projects, the most crucial characteristics are demand uncertainty and the useful life of the investment after the completion of the respective contract. The first reflects uncertainty in forecasted traffic volumes and corresponding revenues while the second challenges the concept of life cycle planning. To this end, a model is developed as an extension to those presented in literature on the bundling of project tasks and incomplete contract theory, which includes these typical characteristics of transport infrastructure projects, i.e. residual asset value for an investment in the transport sector subject to demand risk. Model findings indicate that suboptimal results are to be expected especially in the case of risk averse private parties which tend to have the perception that presented demand forecasts are overestimated. The inclusion of negotiation clauses and asset transfer payments at the end of the contract period seem to provide improved conditions to develop beneficial strategies. Optimal results can only be anticipated in the case where contact duration is approximately equal to infrastructure useful life. Overall model justification is currently not fully available, as most PPP contracts have not yet reached their completion. That is, to date there is no information reported concerning the residual value and the useful life of the infrastructure following contract completion. However, the model was compared to failure cases reported. In addition, strategies developed by the public party vis-à-vis the procurement process are not totally represented in the above formulation. More specifically, the additional benefit ($b(\alpha)$) produced for the public sector should also include items of budgetary planning etc.

In any case, the model emphasizes the need for public contracting authorities to take a more strategic view at the procurement phase. To this end, based on the model and its analysis the decision framework model proposed may assist public authorities in selecting the best suited procurement model for the development of transport infrastructure. The framework model is based on the analysis of risk transfer and the anticipated strategic behaviour that may be adopted by the private sector vis-à-vis the procurement model.

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