

A game theory approach for the allocation of risks in transport public private partnerships

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Received 21 February 2006; received in revised form 16 May 2006; accepted 30 June 2006

Abstract

The process of risk allocation between public and private sectors in transport infrastructure agreements is analyzed as a bargaining process between these two agents. Such a process is modelled with a final offer arbitration game. The idea here is to analyze through a game framework the behaviour of the players when confronted with opposite objectives in the allocation of risks. The model shows that when guarantees have a higher value than financial loss we are confronted with strategic behaviour and potential moral hazard problems.

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Keywords: Public private partnerships; Risk allocation; Transport infrastructure; Strategy

1. Introduction

Concerted emphasis has been placed on the development of means by which the private and public sectors can forge partnerships to provide goods and services traditionally provided by the public sector. These partnerships between public and private (PPPs) find their roots in the policy notions of privatization/deregulation of the 1980s [1]. Among the various consequences springing from PPP agreements is the possibility for the public and private sectors to share and allocate risk borne with the investment.

The sharing and allocation of risk in PPP agreements assumes greater importance when we examine infrastructure investments such as transport. Transport infrastructure investments are inherently capital-intensive and they often require large sunk investments whereby their recoup may span over a 30-year period. They are immobile; in fact, transport infrastructure investments are particularly cumbersome to transfer or reallocate elsewhere and, if reallocation were possible, it would imply prohibitive transfer costs

[2]. However, in the past decade transport investment partnerships between the public and private sectors have become conventional practice in developed and developing countries. On the basis of the Maastricht criteria (1992), which requires a diversification of funding sources in the development and operation of transport infrastructures, the European Investment Bank (EIB) has supported the development of more than 100 PPP projects, covering multi-sectoral transport investments, in most EU countries for a total amount of signed loans over €15 billion [3]. A similar situation is apparent when we observe developing countries. From 1990 to 2001, nearly 2500 private infrastructure projects were implemented by the World Bank in developing countries, of which 662 were transport projects with an investment of \$135 billion [4]. The intervention of the private sector in transport investment has shifted the responsibility, and thus fragmented the decision process, which in the past was taken on solely by the public sector. Risks associated with the investment therefore assume a crucial role.

There are many experiences showing that transport investments are highly sensitive to risk allocation [3–5]. For instance, governments can both enhance and depress

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the demand for a certain transport service by means of an *ad hoc* regulation. The experience of the Bangkok congestion charge is a case in point. In this case the Thai government, after having awarded a contract to the Bangkok Expressway Company Ltd. (BECL) for a 12-mile, six-lane private toll road, decided under the pressure of political lobbies and public discontent, to reduce the agreed toll. The BECL asked the government for a delay in the opening of the private road in order to settle the dispute. But the request was nevertheless denied, and the toll road opened under the adjusted toll regime, thus pushing the private company to bankruptcy.

The objective of this paper is to examine the process of risk allocation between the public sector and the private sector in transport PPP agreements. The allocation of risks is examined as a bargaining process between the two agents confronted with the decision about risk allocation offers. Such a process is modelled with a final offer arbitration game. The idea here is to analyze through a game framework the behaviour of the players when confronted with opposing objectives in the allocation of risks. The two different behaviours of the agents will generate the most 'fair' offer, that is, the offer that reduces the probability of a bad outcome.

2. Risks in PPP transport infrastructure

According to the EU *Guidelines for Successful Public and Private Partnerships* (2002), "risk can be defined as any factor, event or influence that threatens the successful completion of a project in terms of time, costs or quality". The allocation of risks among the agents in the project follows two main discriminative criteria [6]:

1. The agent that should bear the risk is best able to influence and control the risky outcome.
2. The risk should be borne by the agent able to bear the risk at the lowest cost.

Unfortunately, these two criteria, although very sensible, often have contrasting results in the risk allocation context. By taking into account both criteria, we may nonetheless be unable to select the same risk-allocated agent; in other words, the agent from which the risk emanates and thus who is best able to control it, may not be able to control the risk in the most efficient way and at the lowest cost. Moreover, intervention by the private sector in public provision has certainly required a radical change of thinking and operating within the public sector; attention has therefore been directed towards more flexible conduct, where negotiation agreements and partnerships to be concluded with the private sector leave behind the rigid framework of governmental rules and procedures.

Risk allocation in infrastructure projects between the private and public sector is thus an uncertain task; the identification of the risks and their correct allocation is complex to determine [7,8]. In PPP contracts risk allocation is seen

as a way to establish financial equilibrium between the partners, therefore inadequate risk assignment can raise the costs of capital as well as tariff levels in the investment. If inefficiencies and raised costs emerge as a consequence of inaccurate risk allocation, this often necessitates the renegotiation of the concessions, and a new risk allocation must be agreed between private and public sector. Renegotiation of PPP contracts can moreover be a lengthy and costly process in which opportunistic behaviour of the parties can hinder the investment.

We can identify four primary risk domains in PPP transport investments. *Technical risks* cover the risks in construction such as cost overruns or delays in completion, as well as risks in the design of the tender specification or contractor design fault. For instance, transport investment costs are on average 28% higher than forecast costs [9,10]. Second, PPP contracts may also encounter *commercial risks* that arise due to uncertainty in the marketplace, such as a change in traffic demand. Demand forecasts often differ from the reality by 20–30% [11,12], thus the overestimation of the transport demand assumes a relevant role in transportation because by being a large, indivisible and immobile investment, transport infrastructure are not flexible to adapt to unforeseen demand scenarios. Third are *the political and regulatory risks* that emerge due to government actions, which affect the private sector's ability to generate profit. These can include actions terminating the concession, imposing of taxes or regulations that severely reduce the value to investors, restrictions on the ability to collect or raise tariffs as specified in the concession agreement, and precluding contract disputes to be resolved in reasonable ways. Even the change of government may generate risks, since a lack of consistency in government priorities and objectives may induce losses for private investors. And finally, *economic and financial risks* emanate from uncertainties concerning economic growth, inflation rates, convertibility of currencies, and exchange rates. In particular, the risks of inconvertibility and transferability relate to the incapacity by the private sector to convert local currency revenues into foreign exchange and to transfer without restriction foreign currency out of the host country [13]. The latter two risks are extremely complex to estimate and allocate. In an analysis conducted by the Institute of International Finance (1995) concerning the level of risk perception held by transport infrastructure private investors in Latin America, the risk of inconvertibility and transferability was considered the most important non-commercial type of risk (see Table 1).

Table 1
Perception of risks by private investors of transport infrastructure investments in Latin America (percentage of respondents)

Risk	Very important	Fairly important	Not important
Inconvertibility/ transferability	93	7	0
War	72	26	2
Expropriation	54	32	15

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