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Programming, optimal pricing and partnership contract for infrastructures in PPPs

Alain Bonnafous [1]

University of Lyon, Laboratoire d'Economie des Transports, France

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A B S T R A C T

The development of various forms of public-private partnerships for the financing, building and operating of public infrastructure has not fundamentally altered the economic calculations involved. This chapter examines to what extent it is necessary, however, to change the way that government uses socio-economic and financial evaluations, whether to optimise investment programming or pricing. Ensuring a coherent match between these two types of optimisation can provide a principle for determining the optimal programming price.

We begin by showing that when projects are financed by both users (toll revenues) and taxpayers (subsidies), it is socially beneficial to plan these investments on the basis of the net present value (NPV) provided by each unit of public money invested. This NPV/subsidy ratio must obviously be higher than the public-funding scarcity coefficient or else the investment would destroy more wealth than it would produce.

One of the ways of improving this ratio is also to optimise the toll level, since increasing it can lower the subsidy but has an adverse impact on the user surplus, it is essential to set the optimal toll.

In the case of an approved project considered in isolation, we show that the optimal toll depends upon the public-funding scarcity coefficient. If there is no scarcity, the optimal toll is zero. As public-funding becomes scarcer, the optimal toll draws closer to the toll that optimises revenue.

In the case of a programme of several projects subject to budget constraint, we show that the optimal toll no longer depends upon the public-funding scarcity coefficient and that there are several scenarios depending on the relative values of the maximum revenue and the total cost of the project:

- when, whatever the toll, revenue can no longer cover over half of the cost, it is socially beneficial to choose not to levy any toll;
- when there is a toll that covers the total cost, the operator may be left free to set it at the level he sees fit, with the issue of how the profits are to be shared between the franchisee and the franchisor being settled separately;
- when the maximum revenue of the project falls between half and all of the total cost, the value of the toll that maximises the welfare function is lower than the revenue-maximising toll and must therefore be set for the private operator by government.

Thus, the partnership contract must be given a different content in these three cases of optimal pricing.

Preamble: Most of the theoretical studies devoted to optimising public investment programming and infrastructure pricing have, since the work of Jules Dupuit (1844), focused on the salient issues of the transport sector, even though this work was relevant to all sorts of public infrastructure. The analysis presented in this paper deals with transport economics, but in line with this tradition, is also applicable to any field in which public-funding is combined with commercial revenue. For example, the question of determining how the financing of an opera should be shared between taxpayers and opera-goers raises the same type of issues as the optimal combination of tolls and subsidies for financing a motorway project. This report will be focused on these issues. We shall see that certain precautions are called for in investment programming together with some new thinking on pricing principles.

E-mail address: Alain.Bonnafous@let.ish-lyon.cnrs.fr.
[1] Emeritus Professor of the University of Lyon, Laboratoire d'Economie des Transports.

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1. Introduction

The vigorous development of various forms of public-private partnerships in the field of public infrastructure investment and operation has renewed interest in theoretical thinking about what had been considered as methodological givens in the field of the public economy. By definition, a PPP system must combine the rationales of government and of a private operator. The latter's objective function is the profit of the operation, a profit that is obviously discounted and if appropriate enriched by taking uncertainty into account. The government's objective function is the discounted variation in social welfare that takes into account, in addition to the operator's profit, factors such as public spending, user surpluses and environmental impact. Many factors can affect both these objective functions differently, in particular infrastructure pricing, which is in principle not the same depending on whether it optimises the operator's profits or social welfare.

The questions raised by these renewed arrangements between the public sphere and private partners have mainly concerned one of the most fertile fields of recent decades, i.e. the theory of incentives. The studies in this field have focused most especially on the specific nature of a partnership contract and thus the principal/agent relationship, following the ground-breaking work of Jean-Jacques Lafont and Jean Tirolles (1993). Many particularly useful articles on PPPs, including the most recent ones, have continued work within this theoretical tradition (such as Desrieux, 2006; Hart, 2003). However, little work has been done on the contributions and changes to the public economy implied by this new development.

In the specific case of France, a second event renewed the problem of evaluation, and was triggered by the conclusions of the Working Group of the French Planning Authority chaired by Daniel Lebègue (Commissariat General du Plan, 2005). Its mission was to think about the relevant value of what is conventionally known in France as "the discount rate of the Plan", which had been set at 8% for some twenty years. In addition to the strong theoretical reasons supporting a lower rate (Gollier, 2002), the fact of the matter is that this 8% rate was ill suited to taking environmental externalities into account effectively in the economic calculation, since it resulted in giving a very low weighting to the distant future. For example, a value considered over a 30 year time horizon is virtually divided by 10 if it is discounted at an 8% rate. It is only divided by roughly three with a discount rate reduced to 4%, i.e. the rate that was recommended by the Lebègue Report[2] and that was used in official instructions (Ministry for the Environment, 2005). In this way, France aligned itself more closely with the rates used in EU countries, such as 3% in Germany.

However, this recommendation had the effect of multiplying the number of new projects considered to be cost-effective, since their net present value (NPV) now became positive if their socio-economic internal rate of return (IRR) fell between 4% and the former rate of 8%. It also generated a growing number of "potential" projects, i.e. for which the optimal implementation date had already passed since their immediate rate of return was higher than the official discount rate. This made it more urgent to rank the potential projects and programme them in an order that would maximise the welfare function. This optimisation not only implies the order of implementation of projects, but also the subsidies that each of them may require and, therefore, the constraint in terms of available public-funding. The aim of this paper is to point out some recent results on this optimisation subject to a public-funding constraint and to formalise the role of pricing when these projects involve a public–private partnership or, more generally, joint financing by users and taxpayers.

2. Summary of some recent episodes on the ranking of potential projects

The prior work that we must refer to at this point in our presentation has mainly dealt with the evaluation and programming of transport investments. To place this work in context, we should point out the what the ordinary practice has been in this field (particularly in France), both for projects financed through public-funding, such as roads or motorways not operated under a franchise, and for projects financed through their revenues, such as toll motorways. In the first case, the concept of financial return was irrelevant since the projects did not generate any commercial revenue. In the second case, the financial rates of return were calculated solely to ensure that the projects could be self-financing and not to rank them, for the aim was not to optimise the profit of the project developer, whether this was a public establishment such as the national rail transport company (SNCF) or a semi-public company holding a motorway franchise. Thus, whether or not a toll was to be charged, investment programming was long based solely on the socio-economic evaluation of the investments.

As an initial approximation, the socio-economic rate of return (ERR) was used to rank the potential projects, i.e. those whose net present value (NPV) was positive and whose optimal date of implementation had passed. When a project designated as having priority (because its ERR was very high) had a financial internal rate of return (IRR) that was insufficient to ensure its self-financing, additional funding was required, which might be a subsidy, as in the case of the TGV high-speed trains built after the South-East TGV line, or a disguised subsidy, as in the so-called system of "*adossement*" long used for toll motorways in France. This consisted of commissioning the franchisee of a motorway network to construct and operate a complementary segment that was financed partly by the cash-flows from older segments and that included, if necessary, a lengthening of their franchise.

This system recently disappeared, around the turn of the last century, as it was incompatible with European legislation, but also because of the growing number of projects that do not have a sufficient IRR to be able to finance them without subsidies. All this has enhanced the rationale of joint financing by taxpayers and users and, consequently, public–private partnership in the broad sense, rather than in the restrictive sense of a partnership contract. For example, the franchise for which competition is open for the infrastructure of the South Atlantic Europe (SEA) TGV line is obviously a PPP. However, this posed the problem of the optimal programming of investments in new terms that were not immediately recognised.

This problem can be stated very simply: it consists of determining, among the potential projects, those that will be selected and their optimal implementation date so that, subject to the available public budget constraint, the net present value (NPV) of the programme thus established will be maximised.

In this programming problem, the subsidy rate obviously plays a major role in formulating the budget constraint. For each project, this rate is simultaneously a function of the financial rate of return that an investor may require, of the project's intrinsic rate of return and, thus, of its economic characteristics. A formulation of this function has been proposed (Bonnafous, 2002), which has made it possible to establish the equivalent of numerical tables or counting frames as represented on Figs. 1 and 2. To facilitate the analysis, we suppose a standard case in which the capital cost is incurred at an

[2] More specifically, the report recommends a decrease of the (real) discount rate to 4 % and even a gradual lowering of the rate to 2% for time horizons longer than 30 years (Commissariat Général du Plan, 2005).