Contract design and financing mechanisms in transport project evaluation

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Abstract

The construction, maintenance and operation of transport infrastructures require important amounts of public funds; thus, multiple possibilities can be considered when financing. Nevertheless, the way projects are funded has remarkable implications in terms of incentives and therefore considerably affects the estimation of the costs and benefits of a project. Avoiding the importance of concession contracts can lead to estimation errors that would alter the result of the cost–benefit analysis. The purpose of this paper is to analyse deeply the incentives inherent in the institutional design in which transport projects are financed, to try to quantify the consequences of using a particular financing mechanism.
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1. INTRODUCTION

The construction, maintenance and operation of transport infrastructures require significant sums of public funds, from either the central administration, the regional governments or local authorities, the private sector or the users of the infrastructure themselves. Therefore, according to the final financer of the infrastructure, we can distinguish between budgetary funding (when the final payers are the taxpayers) and extra-budgetary funding (if, otherwise, the final payers are the users or direct beneficiaries of the infrastructure).

Among the main sources of budgetary funding the following can be distinguished:

- Direct investment: the investment is afforded with public funds to be paid either through labour certification or upon receipt.
- Shadow tolls: these are used when the private sector finances the project. Through this method, the central administration agrees to return the investment to the private sector through tariffs that rely on the use of the infrastructure.
- Indirect investment: this consists of capital transfers that the central administration addresses to regional governments.

Among the main sources of extra-budgetary funding we can differentiate the following:

- Direct tolls: the users of the infrastructure pay certain tariffs for using it, thus bearing the infrastructure cost.
- Cross-funding formulas: these allow one project to be financed with the resources generated from the operation of another, both being part of a contract between the central administration and a private agent.

Public–private partnerships conciliate the need for new and improved transport infrastructure investments and the necessity of a budgetary balance from the central administration. In this kind of agreement, a private agent bears the investment required in exchange for the right to charge a fee for the use of the new infrastructure. The Concession Contract Regulatory Law for Public Work (Ley 13/2003 Reguladora del Contrato de Concesión de Obra Pública) sets up the conditions under which the concessionaire will be repaid in Spain, either through direct user tolls, shadow tolls paid by the central administration, soft tolls (a mixture of direct and shadow tolls), the operation of commercial areas linked to the concession or other contributions by the central Government.

Although budgetary funding prevails in Spain, there are different performances that try to increase the proportion of extra-budgetary funding in financed projects. A straight example
of this is the so-called Plan Estratégico de Infraestructuras y Transporte (PEIT) in Spain, which expects to pay for about 40% of its projects through extra-budgetary funding (see Table 1). The PEIT also provides an increase in private financing up to 20% of the total investments.

Table 1: Financial sources of PEIT investments

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<th>Projects</th>
<th>FINANCIAL SOURCE</th>
<th>% Total Investments</th>
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<tr>
<td></td>
<td>Budgetary</td>
<td>Other Sources</td>
</tr>
<tr>
<td>Roads</td>
<td>75.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Railways</td>
<td>81.4%</td>
<td>18.6%</td>
</tr>
<tr>
<td>Airports</td>
<td>2.2%</td>
<td>97.8%</td>
</tr>
<tr>
<td>Ports</td>
<td>9.7%</td>
<td>90.3%</td>
</tr>
<tr>
<td>Other Projects</td>
<td>27.7%</td>
<td>72.3%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>59.5%</strong></td>
<td><strong>40.5%</strong></td>
</tr>
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The design of the financing mechanisms of a transport project directly affects the incentives of economic agents. In this paper we deeply analyse the incentives given to all the agents involved in a certain transport project, to try to quantify the consequences of choosing a particular form of financing.

The rest of the paper is organized as follows: Section 2 discusses the asymmetric information problems arising between the regulator and the concessionaire. In Sections 3 and 4 we propose a simple theoretical model as a benchmark and we analyse the kinds of contracts that minimize the strategic behaviour of agents, respectively. Then, in Section 5, the incentives inherent in some of the main contracts used in Spain are studied. Section 6 relates to the examination of different methodologies to forecast ex ante the implications of a type of contract on both the incentives of agents and the levels of some key economic variables. Finally, Section 7 presents some general conclusions.

2. ASYMMETRIC INFORMATION AND CONTRACTS

Let us assume a regulator is willing to carry out a certain project. For that purpose, he offers a company a concession contract. In general terms, concessionaires have further information about costs and market conditions than regulators. Thus, the regulator would face an asymmetric information problem when deciding the financing mechanism or how to repay the concessionaire. In this context, the regulator will have to decide carefully the way
of granting concessions since there is wide empirical evidence that shows that some public funding mechanisms have adverse effects on the efficiency of the transport companies (see Boame and Obeng, 2005; Jorgensen et al., 1997; Romilly, 2001).

In an asymmetric information context, it is crucial to design contracts in order to discourage opportunistic behaviour. The new regulation theory (see Baron and Myerson, 1982; Laffont and Tirole, 1986 and 1993; Loeb and Magat, 1979) aims to solve these information problems by providing adequate incentives in a principal–agent model. Some authors have applied regulation theory with asymmetric information to the transport system, analysing its implication from a theoretical view (Pedersen, 1994) and from the empirical point of view (Dalen and Gómez-Lobo, 1997 and 2003; Gagnepain and Ivaldi, 2002).

The Spanish transport system is not free from asymmetric information problems. In fact, some authors have suggested that there are significant differences between the efficiency of public and private concessionaires (see de Rus, 1989; de Rus and Nombela, 1997; Matas and Raymond, 1998).

The contract design may have an effect on agents’ incentives to be efficient and/or to increase revenues (for example, attracting new users to the transport system). In the same way, the contract design may bias the technology chosen for the construction of the infrastructure. In this context, we can point out two asymmetric information problems: moral hazard and adverse selection.

Consider a bilateral relationship where one party hires a second one to undertake a certain task or take any decision on his part. The contracting party is called the principal while the agent is the hired one (concessionaire). The purpose of the contract is to benefit the principal. This contract will specify the payments that the latter will give to the agent. In this context, the principal is willing to pay the lowest wage for the highest effort whereas the agent is pursuing the opposite. This is why we can conclude that the agent’s goals are in conflict with those of the principal.

There is asymmetric information when one of the parties, usually the agent, has more information than the other one about some aspects of the contract. Economics of information analyses two basic problems involving asymmetric information: moral hazard and adverse selection.

Moral hazard appears when the agent’s actions cannot be verifiable. In situations involving moral hazard, every party has the same information at the time of establishing the relationship, but once the contract is signed, the principal cannot verify or perfectly control the actions of the agent. The most widespread way to represent this situation is to assume that the agent’s effort is not verifiable and thus it cannot be included in the contract.
According to this, the agent’s wage should not be based on the effort he makes and the reason why he was hired. Contracts then should be designed for providing the right incentives for agents to make the desirable effort voluntarily, although effort is not contractible.¹

The situation where the agent has private information that the principal has not, before establishing the relationship, is called adverse selection. In this context, the principal can verify the agent’s actions, but the optimum decision on the cost depends on the kind of agent or some features of the production about which the latter is the only one who really knows.

3. THEORETICAL REFERENCE MODEL

The theoretical model that will serve as a reference for understanding the problems of asymmetric information facing the contracting party (principal) and the incentives provided by different types of contract to the contracted party (agent) is based on the article by de Rus and Socorro (2006).

Suppose a private company will carry out the construction of a new transport infrastructure and the exploitation thereof through a concession contract. The regulator must decide the kind of concession contract that will allow the firm to recover the investment costs.

Let us denote by $K^*$ the minimum investment cost to be paid by the company for the construction of the new transport infrastructure. Depending on the type of technology that the company decides to use for the construction of the infrastructure, the minimum investment cost $K^*$ can take two possible values, $K^* \in \{\bar{K}^*, \tilde{K}^*\}$ where $\bar{K}^* > \tilde{K}^*$. We assume that the more expensive the technology for the construction of the new infrastructure, the greater the social prestige of the concessionaire. The minimum investment cost is unobservable by the regulator.

The real investment cost needed to build the new transport infrastructure $K$ may be different from the minimum investment cost $K^*$. In fact, being efficient requires the concessionaire to exert an effort. Without such an effort, the company may incur extra costs when building the new transport infrastructure. In fact, cost overruns often appear in large infrastructure projects. While these additional costs can result from unexpected events, the empirical evidence supports the existence of an optimistic bias to favour large transport projects or the use of high technology that turns out to be prohibitively expensive (Flyvbjerg et al., 2003). Moreover, given a certain technology, the renegotiation of the

¹ For further information on the concepts of adverse selection and moral hazard, and on the contract theory and its treatment in the literature, see Macho-Stadler and Pérez-Castrillo (1994).
concession contract is common, which undoubtedly represents a major disincentive for the minimization of costs (Guasch et al., 2008).

The operator may reduce its operating costs if it exerts enough effort. In other words, the higher the effort exerted by the operator, the closer the efficient and the observed cost functions are. For the sake of simplicity, we assume that both cost functions are related by the following expression:

\[ K = K^* + \theta - e_c. \]

where \( e_c \) denotes the effort exerted by the concessionaire in order to operate efficiently. The parameter \( \theta \) can be understood as an inefficient measure, implying that efficiency can never be achieved if the operator exerts no effort. In order for the model to be well defined, we assume \( \theta = 1 \), and we define \( e_c \) in the closed interval \([0,1]\).

The real cost of investment \( K \) tends to the minimum cost \( K^* \) as the operator exerts a higher effort, that is, as \( e_c \) tends to one.

In general, the concessionaire is better informed about the technical characteristics of the project and therefore about the most efficient way of constructing the new infrastructure. Thus, we assume that the regulator cannot observe (or verify) either the efficient cost function \( K^* \) or the effort exerted by the firm \( e_c \) in order to be efficient, so it faces a moral hazard problem. The regulator can only observe (and verify) real cost functions, that is, \( K \).

The operating and maintenance costs of the new infrastructure during the life of the project are assumed to be constant and they are normalized to zero.

In transport models it is common to distinguish between the offered quantity (or frequency) and the real level of service demanded by consumers (Berechman, 1993; Gagnepain and Ivaldi, 2002; Small, 1990). The two concepts can be related by the following expression:

\[ Q_d = \alpha Q_s. \]

where \( Q_d \) denotes the real level of service demanded by consumers and \( \alpha \) represents the proportion of the offered capacity that is indeed demanded by consumers. The parameter \( \alpha \) is assumed to belong to the closed interval \([0,1]\) and it is a function of two variables:

\[ \alpha = \alpha(x, e_d). \]

where \( x \) denotes a set of exogenous and random variables that affect the final demand but are neither observed nor controlled by the firm. Thus, the proportion in which consumers demand the new transport infrastructure may depend, for example, on their preferences.
about other modes of transport, their income, the price of fuel and especially the population density in the area. All these variables are out of the concessionaire’s control.

The variable $e_d$ denotes the effort exerted by the concessionaire in order to attract new users to the transport system or, in other words, the effort exerted in order to increase quality. Thus, the effort exerted by the firm in order to minimize access and waiting times of passengers clearly affects the demand of the new infrastructure and hence passengers’ willingness to use such an infrastructure. For example, in roads, we can observe six main quality indicators that concessionaires can influence with their effort: the road risk rating compared with other risk ratings for similar roads, the mortality index for the road compared with the mortality index for similar roads, the congestion index, the coefficient of sliding and the quality of the service perceived by users (Sánchez-Solís et al., 2007).

The effort $e_d$ allows the concessionaire to increase the proportion of the total offered capacity $\alpha$ that is indeed demanded by consumers. For the sake of simplicity, we assume that both $\alpha$ and $e_d$ are positively and linearly correlated. This can be formally expressed as follows:

$$\frac{\delta \alpha}{\delta e_d} > 0 \text{ y } \frac{\delta^2 \alpha}{\delta e_d^2} = 0,$$

which intuitively means that the proportion of the capacity used depends positively on the effort exerted by the company, and that additional effort units have a positive and constant effect on the proportion of the capacity that is demanded by consumers.

The concessionaire’s effort to attract users cannot be observed by the regulator. The only variable that the latter is able to observe and verify is the proportion of the offered capacity $\alpha$ that is indeed demanded by consumers, but as far as this measure also depends on some exogenous factors, the regulator cannot determine exactly the effort exerted by the company in order to increase the number of users of the new infrastructure.

The effort exerted by the concessionaire in order to be efficient or attract consumers is not costless. As is usual in the economics of information literature, we assume quadratic costs for effort, $\frac{e_d^2}{2}$ and $\frac{e_d^2}{2}$, which implies either that the marginal disutility per additional unit of effort is increasing or that there are diminishing returns to scale.\(^2\)

The concessionaire’s profits are then given by:

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\(^2\) Some of the authors using the assumption of quadratic costs of effort are Arrow and Radner (1979), Gibbons (1998), Groves and Radner (1972), Rob and Zemsky (2002) and Socorro (2007).
\[ \Pi = -K' - 1 + e_c - \frac{e_c^2}{2} + \int_{t=1}^{N} (p\alpha(x,e_d)Q_d - \frac{e_d^2}{2})e^{-\alpha}dt, \]  

where \( p \) denotes the price charged for the use of the new transport infrastructure (direct toll) and \( N \) represents the new infrastructure’s lifetime. The price and the frequency \( Q_d \) are regulated, so none of these variables can be chosen by the concessionaire. In this framework, the operator can only choose the effort levels \( e_c \) and \( e_d \). Notice that, given that the price and the frequency are regulated, the operating costs are never covered, even when concessionaires make the optimum effort. Thus, public financing is needed.

In what follows we analyse how the way concessionaires are financed (the type of contract) has a significant effect on the incentives of the company to be efficient and attract users.

### 4. CONTRACTS AND INCENTIVES

There are several ways for the central government to remunerate concessionaires for their investments, but basically we can talk about three: cost-plus contracts, subsidies per passenger or shadow tolls, and fixed-price contracts.

In cost-plus contracts, concessionaires will only receive public funding if they have losses. These losses will then be fully or partially financed. There are no incentives with these contracts for concessionaires to try to be efficient or attract new users to the transport system. As far as effort is costly and there will be no public funding unless there are losses, the optimum effort level will be zero: \( e_c = e_d = 0 \). The main problem here is that the concessionaire is not the residual claimant of its effort. Moreover, with this kind of contract concessionaires will always choose the most expensive technology.

Subsidies per passenger consist of giving a lump sum to concessionaires for each passenger that uses the new infrastructure. Although the economic literature has traditionally considered this system as an optimal tool to increase the concessionaire’s effort to be efficient or attract users (Glaister and Collings, 1978; Nash, 1978), we will argue that in an asymmetric information context, they may not be the best solutions in terms of incentives and risk sharing.

Recall that the final demand for the new infrastructure depends not only on the concessionaire’s effort to attract users, but also on a sort of exogenous stochastic variable that the regulator cannot observe ex ante. Thus, the risk of demand should not be borne just by the concessionaire. On the contrary, there should be an efficient distribution of the risk between the concessionaire and the regulator. As far as it depends on exogenous variables, the level of demand does not reveal any information about the company’s real effort.
According to this, a high demand does not necessarily imply a high effort from the concessionaire, so a subsidy per passenger may be both inefficient and inappropriate. In general, the subsidy per passenger should be greater, the higher are the signals received by the regulator that the concessionaire has made a greater effort. For example, a high demand for the new infrastructure where the population density is low is a signal of greater effort than a high demand where the population density has increased (e.g. because new houses have been built in the area). Therefore, subsidies may be adjusted in light of statistical inference. Fixed subsidies per passenger in cases in which exogenous variables have positively affected the level of demand may be excessive.

Excessive subsidies pose additional costs to society in terms of efficiency and equity. On the one hand, tax collection does not occur at zero cost to the economy. On the contrary, there are administrative, management and distortion costs that make a public grant of 1 euro cost $1 + \lambda$ euros to the society, where $\lambda$ represents the additional cost of public funds.

Although an adjustable subsidy per passenger may provide the necessary incentives to attract new users to the infrastructure, it has the drawback of the difficulty to predict ex ante the final amount to be financed by the central government, as it will depend on the final number of users of the new infrastructure.

A fixed-price contract consists of making the concessionaire a fixed transfer, regardless of its profits. Thus, if companies are efficient enough they can keep the surplus, while if they are not, they will incur losses. This type of contract is optimal in terms of efficiency, choosing the most appropriate technology and attracting users to the new infrastructure. Moreover, there is empirical evidence that shows that operating costs are lower with fixed-price contracts (see, for the French case, Gagnepain and Ivaldi, 2002, and for the Norwegian case, Dalen and Gómez-Lobo, 1997 and 2003 or Jorgensen et al., 1997).

This kind of contract provides higher incentives to concessionaires. Moreover, unlike what happens with the subsidy per passenger, it is easy to predict the amount of money that the regulator should allocate for funding the new infrastructure, minimizing the distortion costs and equity problems. However, fixed-price contracts generally involve more risk to the concessionaire, so the probability of renegotiation may be increased (Guasch, 2004). In this sense, the fixed-price contract can be adjusted considering the trade-off between incentives and risk sharing. The regulator should use the information of observed deficits and other variables, such as the price of inputs, to infer the concessionaire’s behaviour. Thus, small deficits are greater signals of high effort if the prices of inputs have been high rather than if they have been low. Therefore, by statistical inference, the fixed quantity to be granted to a concessionaire with small deficits should be higher, the higher the prices of inputs are.
5. TYPES OF CONTRACTS USED IN SPAIN

Most of the contracts used in Spain can fit into the above classification. As an example of this, we analyse the Spanish urban transport contracts signed since 1995 to finance the operating and maintenance costs of concessionaires in four Spanish regions: Madrid, Barcelona, Valencia and the Canary Islands (see Socorro and de Rus, 2008). We also analyse the type of contracts signed under the PEIT. Finally, we briefly review some models of concession management used in Spain for first-generation highways (Sánchez-Solino et al., 2007).

5.1. The Spanish Urban Transport Contracts

The Spanish urban transport contracts were initially conceived as an instrument to support the urban transport system. The main objectives of such contracts are the promotion of the public urban transit, the encouragement of public transit operators’ efficiency and the establishment of a stable financing system for public transit operators. This financing system must be compatible with the public funds available to the different public authorities that are concerned. The approach adopted by the central administration to finance the needs of the operating companies has changed over time. We can mainly distinguish four stages: from 1990 to 1993, from 1995 to 1997, from 1999 to 2001 and from 2002 to 2004.

During the first period, from 1990 to 1993, the central Government financing mechanism was based on the total number of passengers, establishing a subsidy per passenger or a subsidy per passenger-km. Moreover, regional governments agreed to finance the operating deficit of concessionaires not covered by the central Government. During this period, the central Government signed an urban transport contract only in two Spanish regions: Madrid and Barcelona. In both cases, the subsidies from the central Government were insufficient to cover the operating costs, so additional financing from the regional governments was needed. The regional governments financed the difference between the observed operating revenues and the observed operating costs. Thus, the urban transport contracts signed in Spain during the period 1990–1993 were a kind of cost-plus contract, providing no incentives to public transit operators to be efficient and attract new consumers.

During the second period, from 1995 to 1997, the central Government financing system was still based on a subsidy per passenger or passenger-km. However, the urban transport contracts included some new features. For the first time a minimum cost coverage coefficient for public transit operators was included. This coefficient guaranteed the minimum percentage of operating costs that should be covered with operating revenues. In the urban transport contract signed in the second period, once again regional governments
promised to finance all the operating deficits that were not covered by the central subsidies. Just like in the first period, the central Government signed an urban transport contract only in Madrid and Barcelona. In both cases, the central subsidies were insufficient to cover the operating costs, so the regional governments’ additional financial support was needed. Given that the regional governments only financed the difference between the observed operating revenues and the observed operating costs, the public transit operators exerted the minimum effort to satisfy the minimum cost coverage coefficient. Thus, once again this urban transport contract was a kind of cost-plus contract and provided few incentives to public transport operators.

During the third period, from 1999 to 2001, the financing criteria of the central Government completely changed. Instead of paying a passenger or a passenger-km subsidy, the central Government decided to pay a percentage of public transit operators’ losses. In particular, during this period the central Government financed 45% of all the operating deficits. The minimum cost coverage coefficient was still included in the new urban transport contracts, and as usual, the regional governments promised to finance all the operating deficits that were not covered by the central Government. Thus, 100% of the operating deficits was financed by a public entity, though a minimum cost coverage coefficient was required. As a consequence, even though during this third period the public financing scheme completely changed, the result in terms of incentives is the same as that in the previous period: a cost-plus contract in which public transit operators would exert the minimum effort to satisfy the minimum cost coverage coefficient.

Finally, during the fourth period, from 2002 to 2004, the central Government decided to pay a percentage of the total operating costs (between 20% and 30%). The rest of the operating costs should be covered through operating revenues and regional governments’ funds. Moreover, no minimum cost coverage coefficient was included in the urban contracts signed during this period. Since all the operating deficits were financed by the central Government or the regional governments and no minimum cost coverage coefficient was required, public transit operators had no incentives to exert any positive effort. We are again facing a cost-plus contract that poses no incentives for concessionaires to reach an adequate effort level.

Therefore, we can conclude that none of the Spanish urban transport contracts signed since 1990 has provided the right incentives for concessionaires to be efficient and attract users to public transport.
5.2. PEIT Contracts

Within the funding strategies of the PEIT performances, both direct or deferred investments and private investments are included.

Direct and deferred investments are aimed to meet timing commitments, maintain some budget stability and reduce the deficit of the public accounts (PEIT, 2004):

**Direct investments:** they refer to the traditional budgetary investment paid by all taxpayers, users or not of the infrastructure. The payment is made through several certificates during the construction of the infrastructure.

**Deferred investments:** some of the mechanisms used in a deferred investment are:

- **Total price payment:** the difference between this kind of investment and the traditional direct investment is that the payment of the total cost of the infrastructure is only made once it has been completely constructed.

- **Shadow tolls:** in this case, the private sector finances the investment with a commitment from the central Government to pay it back during a certain period through some agreed tariffs according to the use of the infrastructure.

- **Infrastructure management service:** in a pre-existent infrastructure a service is contracted. The central Government regularly pays some amounts of money. In this case, the service provider is responsible for undertaking the necessary investments in the infrastructure (PEIT, 2004).

In terms of incentives, both direct investments and the total price payment lead to similar results to those of cost-plus contracts. That is, the concessionaire has little incentive to operate efficiently.

On the other hand, with a shadow toll the central Government pays a certain fee based on the use of the infrastructure during a specified period. In terms of incentives, this mechanism is similar to a subsidy per passenger and hence it is a very high-powered incentive scheme, providing the concessionaire with the highest incentives to attract users and operate efficiently. The reason is that with this financing mechanism, the concessionaire is the residual claimant of its effort. However, we would like to highlight that even though it is a very high-powered incentive scheme, the distribution of risk may not be appropriate. In general, it is not optimal for the concessionaire to bear all the construction and demand risk for the new infrastructure. Concessionaires should not be penalized for variables that are out of their control. Thus, the central Government should use some verifiable information from other variables, such as the price of inputs or the
population density of the area, either to update the tariffs or to extend the concession period.

As far as the infrastructure management service is concerned, the PEIT does not specify the way in which the central Government will pay concessionaires. It could consist of a fixed transfer of money (fixed-price contract). As we have already discussed in Section 4, this type of contract implies the best incentives to operate efficiently and attract users (i.e., improve the quality and safety of the infrastructure). Once again the reason is that, in this case, the concessionaire is the residual claimant of its effort. Furthermore, with this system the central Government can easily predict ex ante the amount to be financed each period. However, we would like to highlight that in order to reduce the risk borne by the concessionaire and to minimize the probability of renegotiation, the fixed quantity paid by the central Government should be adjusted annually by statistical inference.

On the other hand, regarding the remuneration of private investments, the PEIT establishes that the Public Work Concession Scheme will be used in ports (with an estimated volume of around 50% of the total investments), in roads (with an estimated volume of around 25% of the investments in the new infrastructure) and to a lesser extent in railways (PEIT, 2004). In particular, the way in which the concessionaire will be paid for its investment is regulated by the Regulatory Law of the Concession of Public Works (Ley Reguladora del Contrato de Concesión de Obra Pública), including the following:

- Direct tolls paid by users.
- Shadow tolls paid by the central Government (art. 246.4, Law 13/2003).
- Soft tolls, a mixture of direct and subsidy tolls.
- Other contributions of the central Government (art. 224.3, Law 13/2003), which, though limited to the assumption that “there were economic profitability or social reasons, or singular demands arising from the public purpose or general interest of the work to grant”, may include joint financing, through cash or non-cash contributions, subsidies or repayable loans with or without interest. All of these, as far as the principle of the concessionaire’s risk assumption is concerned, are satisfied.
- Exploitation of shopping areas (art. 246.5, Law 13/2003), as complementary activities of public work.

Direct tolls give concessionaires the best incentives to operate efficiently and attract users to the new infrastructure, since concessionaires are the residual claimant of their effort. However, direct tolls could limit the accessibility of the new infrastructure, so they should be regulated and combined, where appropriate, with a subsidy per passenger (soft tolls). As
mentioned before, both subsidies per passenger and shadow tolls should be adjusted by statistical inference, in order to avoid the concessionaire assuming all the risk. Another possibility would be to lengthen the term of the concession. All these alternatives would undoubtedly reduce the likelihood of renegotiation.

On the other hand, it is difficult to evaluate the consequences in terms of incentives of the other contributions of the central Government referred to in article 224.3 of Law 13/2003, because they can take very different forms. If the central Government decides to subsidize a proportion of the investment costs, it will use a kind of cost-plus contract (with low incentives). However, if the central Government decides to grant a fixed quantity to the concessionaire, it will use a fixed-price contract, which implies high incentives to reduce costs and operate efficiently.

Finally, the right to exploit commercial areas complementary to public works, if any, would imply high incentives to construct the infrastructure efficiently, since once again the concessionaire would be the residual claimant of its effort. It could also positively affect the incentives for the concessionaire to attract users to the new infrastructure, since such an action would also increase the benefits of the commercial area.

5.3. Concession Management Models in First-Generation Highways

The first toll-free highways managed and funded by the central Government in Spain started being built in the early 1980s under the so-called Plan General de Carreteras 1984–91. Nowadays, first-generation highways are seen as an inadequate infrastructure for the existing technical models and for the needs of the society (Sanchez-Solino et al., 2007).

As recognized in the PEIT, the new demands on road infrastructure and the significant increase in traffic and the number of accidents make it necessary to undertake some improvements and fitting-out performances to adapt first-generation highways to the actual requirements of safety and technical recommendations in roads.

Road management has traditionally been accomplished in Spain through concession contracts. Through these contracts the concessionaire takes care of the routine maintenance operations, viability and in some cases the rehabilitation and upgrading for a certain period.

While these concession contracts involve good incentives for cost reduction, they may have adverse effects on the quality of the service. Thus, Law 13/2003 implied a major change in road management as it includes, in Article 244, an innovative aspect: the possibility of incorporating quality indicators that may have an impact on the remuneration of the concessionaire. The Law sought to encourage concessionaires to be as efficient as possible
from the social point of view, establishing some mechanisms of economic compensation for accident reduction and increased quality in the service.

6. FORECAST OF THE CONSEQUENCES OF A TYPE OF CONTRACT

Given the incentive problem that affects some contracts, the ex post results of the projects may not coincide with those initially expected. Thus, the ex post evaluation becomes essential to testing whether the predictions were correct ex ante, to understanding the deviations and to improving future ex ante proposals. In other words, the ex post evaluation produces feedback on the actions that have been carried out, allowing the parties to learn from the mistakes and correct them in future projects.

The ex post evaluation has been increasingly used to evaluate changes in regulatory policies since 1990. A clear example is the UK National Audit Office, which has worked extensively in this field both for infrastructure industries and for the regulation of financial services. Other examples are the U.S. Congressional Budget Office or the World Bank Evaluation Unit.

Through the ex post evaluation we may be able to predict ex ante the consequences of each type of contract. The consequences of one type of contract or another can be measured in very different ways. First, we could try to measure the success of a contract through the occurrence or not of a renegotiation. While it is true that in some instances renegotiations are necessary, many others respond to the opportunistic behaviour of concessionaires or governments themselves that impose additional costs on society. Secondly, we could measure the success of a contract by the level of efficiency of the concessionaires.

6.1. Relationship between the Type of Contract and the Likelihood of Renegotiation

To analyse the relationship between the type of contract and the likelihood of renegotiation, we will take as a reference model the one developed by Guasch (2004). Guasch (2004) analysed more than 1,000 concessions in the Caribbean and Latin America during 1985–2000. His sample shows that renegotiation processes are a common practice, especially in the case of transport concessions, where about 55% of the contracts end up in a renegotiation.

Guasch (2004) uses a PROBIT model to analyse which variables influence the likelihood of renegotiation. The explanatory variables included in the model fall into three major areas: regulatory policy (the existence of a regulatory body, the autonomy of the regulatory body and/or the type of regulation), the concession design (award criteria, investment...
obligations, the nationality of the concessionaire, the level of competition in the award process and/or the existence of macroeconomic shocks) and political influences (the level of corruption and/or electoral cycles). *Table 2* presents the marginal effects that these significant variables of the model have on the probability of renegotiation.

*Table 2: Marginal effects of significant variables on the probability of renegotiation*

<table>
<thead>
<tr>
<th>Significant variables affecting the probability of renegotiation</th>
<th>Marginal effect on the probability of renegotiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existence of a regulatory body</td>
<td>20–40%</td>
</tr>
<tr>
<td>Award criteria</td>
<td>20–30%</td>
</tr>
<tr>
<td>Type of regulation</td>
<td>20–30%</td>
</tr>
<tr>
<td>Autonomy of the regulatory body</td>
<td>10–30%</td>
</tr>
<tr>
<td>Investment obligations</td>
<td>10–20%</td>
</tr>
<tr>
<td>Nationality of the concessionaire</td>
<td>10–20%</td>
</tr>
<tr>
<td>Extent of competition in the award process</td>
<td>10–20%</td>
</tr>
<tr>
<td>Macroeconomics shocks (devaluations)</td>
<td>10–15%</td>
</tr>
<tr>
<td>Electoral cycles</td>
<td>3–5%</td>
</tr>
<tr>
<td>Award process</td>
<td>10–20%</td>
</tr>
</tbody>
</table>

*Source: Guasch (2004)*

As far as the regulatory policy is concerned, the existence and type of regulation is a highly significant variable when considering the probability of renegotiation. In particular, fixed-price contracts (price caps) imply a greater risk to the concessionaire and therefore a higher probability of renegotiation. As shown in *Table 2*, the use of these contracts could increase the likelihood of renegotiation between 20 and 30%.

The characteristics of the concession contract are also crucial to determining the likelihood of renegotiation. Awarding contracts based on the lowest tariff rather than the highest transfer fee significantly increases the probability of renegotiation. Similarly, the level of competition during the award process and the existence of investment obligations in the contract are both variables that significantly increase the probability of renegotiation.

Finally, political influences affect the probability of renegotiation basically in two ways: the higher the degree of corruption in the country, the greater the probability of renegotiation, whereas this probability also increases if there has been a change of power in the government of the country.
6.2. Relationship between the Type of Contract and the Efficiency of the Concessionaire

To analyse the relationship between the type of contract and the efficiency of the concessionaire we will consider as a reference the article by Gagnepain and Ivaldi (2002).

Gagnepain and Ivaldi (2002) use data from the French urban transport network during the period 1985–1993, comparing the results obtained in those areas with a fixed-price contract and those areas with a cost-plus contract. The estimated operating cost function depends crucially on the level of service offered, the quantity and price of inputs and a parameter of inefficiency. Formally, the cost function to be estimated is given by:

\[ C = \rho \beta_1 + \xi (\beta_1 \ln w_L + \beta_M \ln w_M + \beta_I \ln w_I + \beta_Y \ln Y + \beta_K \ln K + \beta_\theta \theta) + (1 - \rho)(\ln \beta_1 + \beta_K \ln w_L + \beta_M \ln w_M + \beta_I \ln w_I + \beta_Y \ln Y + \beta_K \ln K + \beta_\theta \theta), \]

where the parameter \( \rho \) is set to 1 if there is a fixed-price contract, and 0 if there is a cost-plus contract. The variables \( L, M, I \) and \( K \) represent the inputs: labour, materials and energy, soft capital and hard capital, respectively. \( w_L, w_M \) and \( w_I \) denote the prices of inputs, while \( Y \) denotes the level of service offered. Finally, \( \theta \) is a parameter that represents the inefficiency.

Gagnepain and Ivaldi (2002) find that the observed average income is 21.75% higher with a fixed-price contract than with a cost-plus contract. By contrast, the estimated marginal and average costs are around 4% lower with a fixed-price contract.

Therefore, taking into account the observed average income and the estimated average and marginal costs reported by Gagnepain and Ivaldi (2004), we can conclude that the type of contract significantly affects the ex post results of transportation projects.

7. CONCLUSIONS

The construction, maintenance and operation of transport infrastructures involve important sums of money, and there are many possibilities to be considered at the time of financing: financing from the central government, funding by the private sector through a concession contract, etc. The way transport projects are funded significantly affects the incentives of all the economic agents involved, so it should undoubtedly be taken into account in any cost–benefit analysis.

In general, the companies that undertake the construction and/or the operation of transport infrastructures have more information than the central government about their costs and the
market conditions. Thus, when deciding the financing mechanism the central government will face an asymmetric information problem.

In an asymmetric information context, it is essential that contracts provide the right incentives for agents not to behave opportunistically. The type of contract may affect agents’ incentives to be efficient and/or increase revenues (i.e. by attracting new users to the transport network). In the same way, the type of contract may bias the correct choice of the technology to be used in the construction process.

There are several ways for the central government to remunerate concessionaires for their investments, but basically we can talk about three: cost-plus contracts, subsidies per passenger (or shadow tolls) and fixed-price contracts.

With a cost-plus contract, concessionaires will only receive public funding if they have losses. These losses will then be fully or partially financed. With such a contract, concessionaires have no incentives to be efficient or attract new users to the transport system, since effort is costly and public funds are only obtained if they have losses.

Subsidies per passenger consist of giving a fixed quantity to concessionaires for each passenger that uses the new infrastructure. Although this way of financing leads to good results in terms of incentives, it also implies that concessionaires bear all the demand risk and the probability of renegotiation increases. Furthermore, although a subsidy per passenger adjustable by statistical inference can provide the right incentives to attract users to the new infrastructure, it has the drawback that it is difficult to predict ex ante the final sum to finance, as this will depend on the final number of users.

With a fixed-price contract the concessionaire receives a fixed transfer, regardless of its benefits. Thus, if companies are efficient enough they can keep the surplus, while if they are not, they will have losses. This type of contract is optimal in terms of constructing efficiently, choosing the most appropriate technology and attracting new users to the infrastructure. Nevertheless, similarly to subsidies per passenger, this kind of contract implies more risk for concessionaires and thus a higher probability of renegotiation (Guasch, 2004).

The way transport projects are financed has, thus, important implications in terms of incentives and considerably affects the correct estimation of costs and benefits. Ignoring the importance of the type of contract may lead to estimation errors and may affect the results of any cost–benefit analysis.
REFERENCES


