Private capital incentive model in public-private partnership projects for the development of public infrastructure

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Abstract. Public infrastructure development is considered to be the basis for comfortable living conditions of all the citizens. Therefore, the optimization of public infrastructure should be treated as an important task of any government. The Public-Private Partnership (hereinafter referred to as PPP) model makes it possible to reduce financial pressure on the government budget, to accelerate the construction of public infrastructure and to enhance the efficiency of investment management. The analysis of Russian experience [1], as well as the experience of a number of foreign countries [2], indicates that many issues of financial support, including the issues of reimbursement of costs to public-private partnership entities, have not been sufficiently developed in terms of law and economics. The interval model of a linear compensation mechanism as applied to Chinese PPP models is proposed in this paper. The authors analyze three types of models for subsidizing PPPs by the Chinese government: rate of return model for discounted construction costs; model of discounted construction costs; rate of return model for discounted average construction costs at the beginning of the period. The mechanism for establishing a range of state compensation for additional costs of a private investor due to a reduction in construction time is proposed in the article.

1 Introduction

In traditional public procurement models, the government typically acts as a provider of public services. In government and private capital cooperation projects, the role of the government is changing, and it acts more as a project manager.

Public-private partnership projects can be divided into three categories according to different payment methods such as public payment, user payment and funding gap grant [3]. In PPP projects, authorities are generally responsible for regulating the price and quality of public service infrastructure in order to maximize public benefits. Private capital handles most of the work on the design, construction, operation and maintenance of

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infrastructure, makes a reasonable return on investment primarily through government payments.

Government payments are direct payments by the government to providers of public goods and services. Generally, public service infrastructure projects are not subject to user fees due to their public good nature, and the recovery of investments is usually made through government payments.

Under the PPP model, the government’s responsibility is to formulate an appropriate policy framework, service standards and create a fair and reasonable financing system. It aims at improving the level and quality of infrastructure services, as well as at protecting the public interest. The responsibility of private capital is to provide capital, technology and scientific management; its goal is to receive an acceptable profit from the project and increase the market share.

In PPP projects, private capital increases its operating costs by paying taxes, while the effect of reducing costs takes place. It is significant compared to the traditional public procurement model.

Financial compensation for reducing the construction time for public infrastructure facilities in the implementation of PPP projects is considered in this paper.

PPP projects primarily address three aspects of financial compensation to private capital: option pricing, contractual incentives and dynamic adjustment.

In terms of option pricing of financial compensation, Chen Xiao Zhong et al. considered the problem of the optimal compensation mechanism for real deferred options and analyzed examples of government compensation mechanism of three types of subsidies including investment subsidy, income subsidy and demand guarantee subsidy [4]. Chao Qiang et al. applied the theory of real options in terms of the impact of public financial compensation on the decision of private capital [5].

In terms of contractual incentives for financial compensation, Wu Xiaoling et al. explored the issue of optimal government compensation contracts based on the premise that private capital tends to become overconfident in response to financial compensation for private investment decisions and private self-confidence [6]. Du Yang and others developed a hybrid compensation contract that can coordinate decentralized and centralized decision-making by representatives of government and private capital based on the Stackelberg model [7]. The effectiveness of the contract depended on the ratio of risk aversion by the government, private capital and the volume of expected project income of each party.

Wu Xiaoling and others analyzed the optimal decision of private and public authorities by developing a one-period offset contract and scenario modeling [8]. Numerical analysis showed that contract parameters can be optimally designed to encourage additional initial investment from private capital.

Aminah Abdullah and others focused their attention on trust control issues in the context of contracts for PPP projects [9]. They illustrated trust influence control with particular examples, suggesting that both parties of PPP have to adhere to the concept of a contract in order to promote a long-term mutually beneficial relationship between partners. Chao Qiang et al. explored the gamble between performance by PPP participants, rent-seeking behavior on the part of the project company and incentives and monitoring on the part of the government [10].

Regarding the dynamic adjustment of financial compensation, Li Hao and others proposed a tripartite win-win flexible subsidy mechanism based on a combination of fixed and variable subsidies [11]. They conducted an empirical study of subsidy models for rail transit PPP projects in which variable subsidies are related to the degree of effort and operational efficiency of the private capital side. The results of the study showed that this method of subsidizing creates positive incentives for private capital.
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Fang Ke et al. predicted revenues and expenditures during the concession period by
creating a government tariff subsidy model based on the Gompertz curve. They proposed a
tariff subsidy mechanism for this type of project [12]. Zhi Lu et al. created a theoretical
model of the impact of fiscal subsidy uncertainty on firms’ technological innovation based
on dynamic optimization theory and explored it empirically with the help of certain metrics
to measure this uncertainty [13].

2 Materials and methods

Among the existing models for financing and subsidizing PPP projects, three widely used
financial models include the rate of return model for discounted construction costs, the
discounted construction cost model, and the rate of return model for discounted average
construction costs at the beginning of the period. The rate of return model for the
discounted average construction costs at the beginning of the period is described in the
Chinese government manual “Guidelines for the Affordability of Public and Private Capital
Cooperation Projects”.

The rate of return model for discounted construction costs is based on project
construction cost, combined annual discount rate, reasonable rate of return. This model
provides facilitation of reaching agreement between the government side and the private
capital side.

This model is widely applicable to PPP construction projects such as municipal roads
and bridges. It was regarded as a basis for building our own model of stimulating the timing
of projects and their commissioning.

The discounted construction cost model uses borrowed funds as the basis for the
required amount of project capital, compounding the return on investment with the interest
rate on the loan. This model enables to reduce the debt ratio of the authorities and ease the
financial pressure on the budget. It is a suitable model for PPP projects in places with low
government incomes but is less beneficial for private capital.

The rate of return model for discounted average construction costs at the beginning of
the period is based on project construction cost, which is then adjusted considering the
annual discount rate and a reasonable rate of return at the beginning of each planning
period. The rate of return model for discounted average opening construction costs
increases the return on investment for private capital. However, it is less beneficial for the
government.

The timing of implementation and commissioning in PPP projects is their important
component. These issues are not considered in the above models. Linear measures of
incentive cost compensation in connection with the early commissioning of the project is
proposed in this paper.

3 Results

Considering the reduction in the construction time for public infrastructure facilities, the
presence of an effect for the state in PPP projects is a necessary condition for determining
the effective interval of financial compensation from the state. In order to build a
reasonable financial compensation model for this type of project, it is proposed to introduce
linear incentives. By exchanging information and incentive mechanisms between the two
parties, cooperation between the public and private sectors can be facilitated. This will
make better use of resources to complete the construction of PPP projects.
The sum of construction cost within the original time frame and remuneration for the reduction in construction time will form the total cost of construction including the reduction in its terms.

According to the Financial Feasibility Study Guide for Government-Private Cooperation Projects issued by the Ministry of Finance of the People’s Republic of China, the initial construction cost can be calculated as follows:

\[ C = I(1 + r)^N / 360, \]  

where \( I \) – total investment in the project;  
\( r \) – rate of return on investment;  
\( N \) – initial construction time in days.

The amount of remuneration (Ct) is proposed to be set differentially depending on the timing of the reduction according to the following formula:

\[ (Ct) = I x r x \lambda t(N-Nt)/360, \]  

where \( \lambda t \) – remuneration coefficient for reducing construction time by \( t \) days; \( \lambda t > 1 \); \( Nt \) – actual construction period.

In view of the foregoing, a linear financial reward model is proposed for PPP projects paid by the state. This model assumes:

1. Motivating private investors for construction through a differentiated incentive strategy.
2. Payment for projects by the state is carried out on the basis of regional building codes, the actual construction time.
3. Implementation of targeted incentives for private capital.

In a formalized form, the above starting points are presented in the model below.

\[ F= I(1 + r)^N/360 + I x r x \lambda t(N-Nt)/360, \]  

where \( F \) – the total cost of construction.

Weitzman proved the rationality of linear contracts [14]. Holmstrom and Milgrom demonstrated that the linear contract achieves optimal results [15].

Setting the remuneration coefficient differentially depending on the timing of the reduction for PPP projects with a long construction period seems reasonable for the authors. For example, for road construction objects with a period of two or more years, the authors propose to establish three gradations: reduction of terms by 20 days with a remuneration coefficient equal to 2; when the construction period is reduced by 40 days, the value of the remuneration coefficient is set equal to 3; if the construction period is reduced by more than 41 days, set the value of the remuneration coefficient equal to 3.5.

The ranges of possible reduction periods and the values of the remuneration coefficients are fixed accordingly by agreement of the parties in the PPP contracts.

4 Conclusion

The interval model for a linear offset mechanism based on publicly funded PPP projects is proposed in this paper. The effective interval of financial compensation is a reasonable interval in which both the state and private capital can receive the most desired benefits.

Given the fact that the construction effect of a PPP project is highly dependent on private
capital, it is important to encourage private investors to seek the best construction effect, which is essential to the success of the project. The government approach to compensation for PPP projects is based on the cost of project construction. Stimulation of private capital should be carried out in order to increase the construction efficiency which involves, inter alia, reducing construction time.

References