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Review

Quantitative analyses of highway franchising under build-operate-transfer scheme: Critical review and future research directions

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ABSTRACT

Private provision of the public highways through the build-operate-transfer (BOT) scheme has become popular worldwide. Studies published in dozens of academic journals have investigated various kinds of cases of BOT highway projects. However, there appears to be a lack of systematic and critical overview on what specific problems and research methodologies these studies proposed and used for quantitatively analyzing the BOT highway projects. Therefore, this study critically reviews the relevant traffic oriented quantitative studies, which mainly focus on the determination of fundamental design factors for a BOT highway project in the planning stage. The existing studies are thoroughly examined according to the characters of BOT highway projects. To conclude, this study points out the limitations of the current studies and provides some tangible future research directions with practical relevance.

1. Introduction

Nowadays, with the rapid increasing travel demand and high economic pressure, more and more highways are built under a build-operate-transfer (BOT) scheme to raise direct private finance. The World Bank Group defines a BOT project as "a private sponsor builds a new facility at its own risk, operates the facility at its own risk, and then transfers the facility to the government at the end of the contract period". As for a highway project under the BOT scheme, private firms receive a concession to finance, build, operate, and collect tolls on the highway for a specific period of time, after which the ownership of highway is transferred to the government. Following some European practices financed by the private firms in 1960s-1970 s, several governments have been becoming the users of highway concessions under the BOT scheme. Typical examples include Mexico City - Guadalajara highway project (Swan, 1993); Kepong toll highway in Malaysia (Walker and Smith, 1995); Don Muang toll highway in the metropolitan Bangkok of Thailand (Ogunlana, 1997); Guangzhou-Shenzhen super-highway in China (Yang and Meng, 2000).

In general, the implementation of a BOT highway project includes several processes and participants, as shown in Fig. 1. These skeleton processes can be summarized as follows. The brief process begins when the government identifies a BOT highway project and calls for proposals from private firms/developers. Next, the interested private firms, maybe cooperated with equity investors and lenders, make the feasibility study and submit their proposals. The government evaluates the submitted proposals and concessionaire. After a few rounds of negotiations, a BOT highway project contract is finalized with

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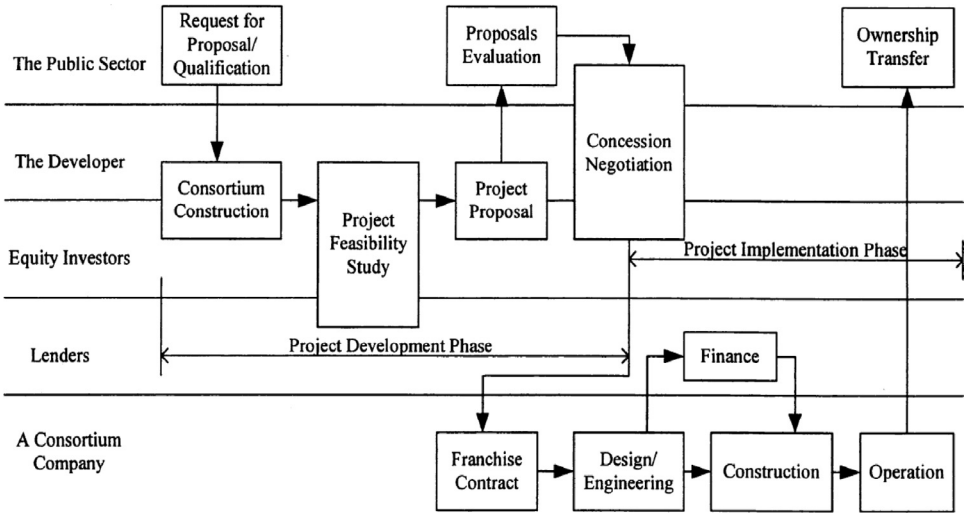

Fig. 1. The skeleton processes of BOT projects (Ock, 1998).

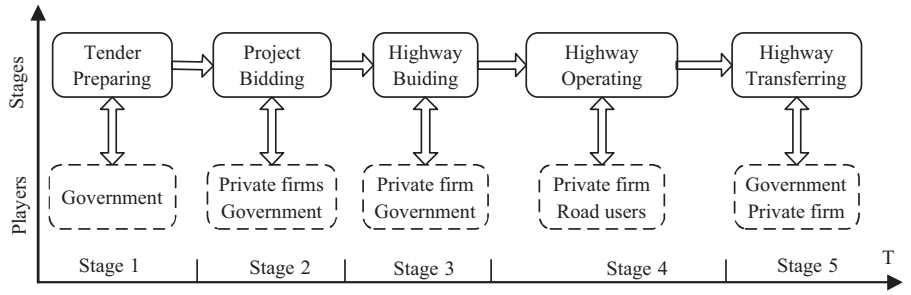

Fig. 2. Five stages of a BOT highway project with different players.

comprising the build/design, finance, and operation process. At the end of the concession period, the highway is transferred to the government. For short, the participants of a BOT highway project can be simplified and classified into three main players: *government, private firms, and highway users,* and the other participants are included into the cooperation with the government or private firms.

As shown in Fig. 2, the three main players are typically involved in the five stages of a BOT highway project - *tender preparation, tender bidding, highway building, highway operating and highway transferring*. Among them, Stages 1 and 2 are vital to the success of a BOT highway project. This is because, during the two stages, the government and private firms will negotiate and determine the terms and conditions of contract for their respective interests, including the fundamental factors or variables of the concession period, highway capacity, toll charge, service quality, and maintenance intensity. Since traffic demand for a BOT highway is market driven and has some uncertainties, these fundamental factors or variables have to be well addressed based on the necessary economic analyses. Otherwise, the private firms may go bankrupt without a rational viability analysis. For example, in the early 1970 s, three of four concessions in France went bankrupt during the financial crisis after the oil shock, which were bailed out by the government. At the same time, several of 12 BOT highway projects in Spain went through higher investment costs than anticipated and lower traffic demand than expected. As a result, three of them went bankrupt and the remaining contracts required renegotiations (Engel et al., 2002). Moreover, many private highways with reasonable traffic prediction also require renegotiation. Guasch (2004) examined that in a study of more than 1000 PPP contracts during the 1990 s in Latin America, over 60% of substantial terms have been renegotiated and changed within three years. The high incidence of renegotiation has some non-negligible negative effects on the design of an efficient BOT highway contract. For instance, when the BOT highway bidders expect a high possibility of renegotiation, they may have strong incentives to submit bids containing promises that are impossible to honor but high competitiveness to be awarded the tender. Therefore, many researchers have attached great importance to predict and investigate various economic issues of the highway franchising among the two stages.

According to Tang et al. (2010), studies on BOT highway projects can be classified into the empirical and non-empirical analyses. A few articles reviewed the relevant empirical and qualitative studies of private transportation infrastructures, including Nijkamp and Rienstra (1995), Fisher and Babber (1996) and Small (2010). To the best of our knowledge, however, there seems to be no systematically review carried out so far on the traffic related quantitative studies of highway