Using bargaining-game model to negotiate compensation for the early termination of BOT highway projects

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Abstract
Build-operate-transfer (BOT) highway projects are widespread around the world. However, many BOT highway projects are terminated before the expiry of the concession period for a variety of reasons, such as unreasonable decisions and a lack of a risk allocation mechanism. As the most concerning issue for the government and private sector, compensation for early termination has been a major controversy due to the lack of a fair and reasonable decision approach. This paper proposes an effective method to evaluate the compensation amount for projects with incomplete contracts using game theory. First, a bargaining-game model with complete information is constructed to analyse the process of negotiation, for which the influences of the government investing in a new road and the traffic demand changes of the early terminated project on bargaining are taken into consideration. Then, the Nash equilibrium solution of the model is derived by backward induction, and a discussion of the properties of the solution is presented. Finally, the model results are verified using the Wutong Mountain Tunnel BOT project in China. This paper provides a solution to compensation for early termination of BOT highway projects with incomplete contracts.

1. Introduction

In recent years, build-operate-transfer (BOT) arrangements have been widely applied in public infrastructure around the world (Kwak et al., 2009; Tan, 2012) and have contributed to accelerating economic growth and improve quality service delivery (Akintola et al., 2003). Under a BOT scheme, the private sector is given the responsibility to finance, design, build, operate and maintain relevant facilities during the concession period and is allowed to charge user tolls until the project is transferred back to the government after the expiry of the franchise (Walker and Smith, 1995).

Characterized by large-scale investments and long concession periods, BOT highway projects have high and multi-dimensional risks (Liu et al., 2014; Niclas and Krüger, 2012). In practice, unreasonable decisions and a lack of well-designed risk allocation arrangements make many projects difficult to recover the investment, and they fail to operate (Feng et al., 2015). As a result, these projects have to be terminated early (Guasch, 2000; Valipour et al., 2015). Early termination means that a project fails to go through the construction or operation phase before the expiry of the concession period due to a variety of risks and uncertainties related to the project (Chen and Dolo, 2008; Chen, 2009; Dahdal, 2010; Demirag et al., 2011; Xiong and Zhang, 2014). For instance, the concession period for the South Bay Expressway BOT project in California is 35 years, but disappointing traffic revenue and serious cost overrun led the project company to bankruptcy after...
8 years of operation, and the franchise was prematurely terminated (Xiong and Zhang, 2014). Although project termination is a crucial risk for BOT highway projects, it has often been overlooked, and uncertain termination-related clauses make projects more difficult to terminate smoothly (De, 2001; Talus, 2009).

Data in the Private Participation in Infrastructure (PPI) Database of the World Bank show that 186 out of 5066 PPP projects in developing countries from 1980 to 2015 were terminated prematurely (PPI projects database, 2016). Most of the prematurely terminated projects reached a buyback agreement with the government. In the process of buyback, decision making about compensation is the most critical issue for both the government and private sector and has attracted increasing attention worldwide (Chen and Dolo, 2008; Chen, 2009; Demirag et al., 2011). Some scholars have investigated the key factors influencing the compensation amount and have proposed simplified methods to calculate compensation according to different situations of early termination (Kim et al., 2011; Flyvbjerg et al., 2002). However, compensation for early termination has long been controversial due to the lack of reasonable and fair calculation methods, which has resulted in the two parties falling into endless disputes and huge economic losses. Therefore, negotiating compensation for early termination of BOT projects is significant for designing highway concession contracts.

The objective of this paper is to present a model that quantifies the value of early termination compensation to improve the decision-making methods for both the host government and the private sector in regards to buyback negotiation. First, we provide a literature review of the existing early termination studies for BOT projects. Second, three assumptions are proposed to construct the bargaining-game model with complete information, of which the influences of investing in a new road by the government and traffic demand changes of the early terminated projects on the two parties' payoffs are taken into consideration. Then, we present the solution to the proposed model and propose 3 properties. Finally, a real case, the Wutong Mountain Tunnel in China, is discussed to illustrate the application of the proposed model.

2. Literature review

Projects terminated in the construction phase can be regarded as build-transfer (BT) projects; therefore, the compensation approaches of these projects are similar to the buyback of BT projects. The early termination of BOT projects generally occurs in the operation phase. In practice, several projects, such as the National Physical Laboratory (House of Commons, 2006), Skye Bridge (Moles and Williams, 1995; Whitfield, 2007) and Channel Tunnel (Ho, 2006) in the UK and the Route 91 Express Lanes (Xiong and Zhang, 2014) and Camino Colombia Toll Road (Tollroadsnews, 2003) in the USA, were confronted with contract termination. The frequent occurrence of early termination is considered to be one of the key factors hindering the popularization and application of the BOT scheme (Valipour et al., 2015; Wang and Zhao, 2014).

When terminating a BOT project, accurate identification of the influential factors is not only the required negotiation competence for both the government and private sector (Havila et al., 2013) but also the foundation of determining the burden-sharing and reasonable compensation. The critical factors causing early termination include three types: (1) government default events mainly refer to corruption and fraud, voluntary termination by the public sector, such as a policy change, and government violation of the exclusive clauses in the BOT agreement (Habets, 2010; Iossa et al., 2007); (2) private sector default events mainly refer to negative impact on the environment caused by the project (De, 2001; Roy et al., 2014), poor quality and cost overruns (Belassi and Tukel, 1996; Fortune and White, 2006), poor financial capacity and experience (Papaioannou and Peleka, 2006), defective design (Martins et al., 2011), construction time delay (Li et al., 2005) and illegal activity (Talus, 2009); and (3) non-default events mainly refer to force majeure (Delmon and Delmon, 2010), including natural disasters and political factors, like war and terrorist attack, law risks (Iseki and Houtman, 2012), like modifications of law and policy and obsolete and incomplete legislation, and public opposition (Moles and Williams, 1995; Whitfield, 2007; Zou et al., 2005).

There are three responsibility allocation categories for early termination: responsibility should be allocated to the public sector, to the private sector or shared between the public and private sectors. Under the condition of non-default, the responsibility should be shared, while under the condition of default, the responsibility should be allocated to the breaching party (Habets, 2010; Iseki, 2010; Li et al., 2005).

As the essential problem of negotiation for early termination, compensation for early termination should be determined by the principle of fairness and punishment (Wang and Tiong, 2000). Based on an investigation of Australian PPPs cases, Irwin and Mokdad (2010) proposed that for government default, the government should fully compensate the private sector and lenders for their losses; for private sector default, the compensation is normally the market value of the project; and for force majeure, the government normally pays an amount related to the private sector’s debt or the book value of its equity. In addition, for some European PPPs, the duration of notice periods, expected future value, termination reasons and gravity of default should be considered in early termination compensation, which must be paid proportionally and assessed separately in every case (Talus, 2009). The calculation guidelines for early termination for BOT projects in Korea indicate that compensation during the operating period depends on the cause of default: for default by the private sector, it is based on the depreciated value of the actual private investment; for default by the government and force majeure, it is based on the weighted average of the sum of the depreciated value and the expected future profit in the remaining operation period (Kim et al., 2011).

Several approaches have been proposed to determine the compensation for early termination. Alonso-Conde et al. (2007) developed a valuation model for early termination compensation using real options theory and illustrated it using the Mel-
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