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A single DEA-based indicator for assessing the multiple negative effects of project risks

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Abstract

Risk assessment is an important phase in project risk management. In general, the negative effects of project risk factors can be reflected in multiple aspects, such as cost overruns, schedule delays and poor quality. In this paper, we first explain why data envelopment analysis (DEA) can be used as the tool to rank the negative effects of project risk factors, and then propose how to use DEA to evaluate the negative effects of project risk factors and rank project risk factors by using a single indicator. It could be helpful to identify key risk factors for further risk response. A numeric example is employed to illustrate the proposed method. The results show that our method can be good used to measure the negative effects of project risk factors. It could provide decision making support for project managers in risk response decision.

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1. Introduction

Risk management is an important topic and has been widely studied and applied in many areas [1-3]. In the development of projects, risk might appear from all aspects of projects [4]. They often have negative effects on projects, such as cost overruns, schedule delays and poor quality may appear [5]. For the purpose of ensuring project success, project risk management (PRM) has been attracting wide attentions from practitioners and academic scholars. Generally, PRM includes three phases [6]: risk identification, risk assessment and risk response. This study focuses on the second phase named risk assessment. Because the negative effects of project risk factors are reflected in multiple aspects, it is hard to rank project risk factors according to their negative effects. For example, there are two risk factors A and B. Risk factor A has the larger negative effect on schedule

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and cost than that of B, but it has the smaller negative effect on quality than that of B. As a result, it is hard to rank them.

Traditional methods on risk assessment include integrative-based method [7], zonal-based method [8], optimization-based method [5, 9] and others [10]. However, all of these methods can't evaluate the project risks with multiple negative effects.

This paper proposes a data envelopment analysis (DEA)-based method for assessing the multiple negative effects of project risks by a single indicator. DEA is an effective tool for evaluating the relative efficiencies of decision making units (DMUs) with multiple inputs and outputs without knowing production functions. It is firstly proposed by Charnes et al. [11], then numerous studies have been proposed from the perspectives of both methodology [12-15] and application [16-19]. In this paper, we first present the concept of DEA for explaining why DEA can be used to rank project risk factors with multiple negative effects, and then propose the DEA-based method for assessing the negative effects of project risk factors. It could be helpful to identify key risks for further risk response.

The rest of this study unfolds as follows. In section 2, we introduce the concept for assessing the effects of project risks based on DEA. Method for project risk assessment is proposed in section 3. In section 4, a numeric example is employed to illustrate the proposed method. Concluding remarks are given in section 5.

2. The DEA concept for assessing the effects of project risks

As shown in Fig. 1, suppose Y_1 and Y_2 represent two positive outputs. Points A, C, D and E are four decision making units (DMUs). From the perspective of DEA, DMUs A, C and D consist of the efficient frontier. All points located on the envelopment surface are called efficient. DMU E is inefficient and its DEA efficiency can be calculated as OE/OB . Apparently, a DMU would be more inefficient (its DEA efficiency score is small) if it is further away from the envelope surface.

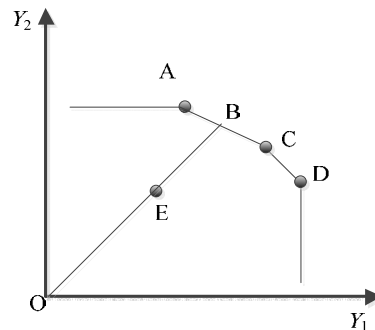


Fig. 1. Concept of DEA for project risk assessment

From the perspective of project risk assessment, Y_1 and Y_2 can be viewed as two kinds of negative risk effects, such as cost overruns, schedule delays and poor quality. Points A, C, D and E are four identified risk factors. Consequently, the DEA efficiency score can be seen as the indicator for assessing the effects of project risk factors. It should be noteworthy that the outputs are negative risk effects in PRM. Thus the smaller DEA efficiency score is, the smaller negative risk effect would be. In other words, project managers should pay more attention on risk factors who have large DEA efficiency scores.

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