交通建設 BOT 計畫權利金計收模式之建構

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摘　要

民間參與交通建設已成為國內重大交通建設之主要推動方式，惟政府主辦機關在公告徵求民間投資時，往往面臨權利金如何訂定之困擾。甚至，與投資人議約談判時，亦未能清楚掌握權利金之底限，而造成權利金訂定之不合理。基此，本研究以政府角度為主，兼顧投資者投資報酬與融資者正常償債之要求下，建立一套數學規劃模式，俾基於計畫之財務模型，計算特許年期內之分年最適權利金額度。

由於本研究之分年最適權利金額度乃係依據上述數學規劃模式及計畫之財務模型計算而得，並無簡單明確之計算公式可循，實難作為招商公告或議約簽約之基準。因此，本研究另依據一般權利金常用之計收基礎（營運收入、運量、總收入、稅前利潤）及計收方式（一段式、二段式、多段遞增式、多段遞減式），加以組合成十六種收取方式。另亦考慮無計收基礎之收取方式，包括分年收取固定金額及一次收取固定金額等兩種，合計十八種收取方式。將此十八種權利金收取方式代入上述之數學規劃模式，可求解該收取方式下之分年最適權利金額度。此外，鑑於交通建設計畫之自償性不足問題，本研究亦提出政府給予補貼下之權利金計收模式，包括政府給予營運補貼（特許年期內分年給予補貼）及資本補貼（特許年期期初給予投資補貼）等兩個模式，以資因應。

為驗證本權利金模式之可行性及各收取方式之適用性，本研究設計三個簡例，其財務特性分別為自償率大於 1、自償率約為 1 及自償率小於 1 不等，並利用情境分析及敏感度分析探討各收取方式之差異。另外，若案例需要政府補貼的話，亦可算出政府補貼須補貼之金額。最後，本研究以台北市某座停車場 BOT 計畫為實例應用，結果顯示在十四種權利金計收方式（由於本案例無附屬事業收入，因此，以總收入或以營運收入為基礎之計算結果均相同），以稅前利潤為基礎之多段遞增式最佳，與不限收取方式之分年最適權利金額度，低於 38%。另以模擬分析探討未來運量變化下（假設運量呈常態分配，標準差為平均值之 20%），依本模式計算所得之權利金收取額度，未能符合投資者及融資者要求之比例。結果顯示，有 13%之比率低於投資者之投資報酬要求，有 24%之比率低於融資者 1.2 之償債比率要求。

關鍵字：BOT 計畫、權利金計收模式、數學規劃模式

Royalty Models for the BOT Projects of Transportation Infrastructures

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Abstract

Private participation has already become a major financial impetus in promoting the construction of transportation infrastructure in Taiwan. However, the government agencies involved often find it difficult to set the royalty when putting out requests for private investment. At times, during the process of negotiation with investors, it is almost impossible for the agencies to sign a reasonable royalty without recognizing the bottom line of the royalty. Basing on this, we propose a mathematical programming model, from government's point of view, considering certain rate of return for investors and debt redeeming requirements for financiers, in order to calculate optimal annual royalty during the concession period based on the financial model of the BOT project.

Since the optimal annual royalty is calculated based on abovementioned mathematical and financial models, there is no simple and clear formula can be used as the basis for invitation for bidding and negotiation for signing contract. Consequently, this study further considers some frequently used premium bases (farebox, ridership, total revenue, profit) and collecting methods (one segment, two segments, multi-segments with ascendant slopes, multi-segments with descendent slopes) to develop a total of sixteen distinct royalty collection combinations. Besides, two non-premium-based collecting methods are also considered, that is, annual fixed amount royalty and lump sum royalty, to make a total of eighteen royalty collection methods. Incorporating these eighteen methods into above royalty model, the optimal annual royalty for each collecting method can be determined. Moreover, for the cases with insufficient self-liquidating ratio, this study also proposes two models for royalty collection which government provides subsidies, including operating subsidy (annual payment during concession period) and capital subsidy (one-time payment in the beginning of concession period).

In validating the feasibility of our model and the appropriateness for various collecting methods, we design three exemplified BOT projects, with their self-liquidating ratios greater than 1, less than 1 and equal to 1, respectively. And then we employ scenario analysis and sensitivity analysis to discuss the differences among these methods. In additions, the needed subsidies provided by government are also calculated. Finally, a case study of a BOT project of parking building in Taipei is conducted. The result shows that of the fourteen royalty methods (since there is no subsidiary revenue for this project, the methods based on the premium of farebox and total revenue are all the same), the method of multi-segments with ascendant slopes based on pre-tax profit is optimal. However, the royalty calculated by this method is still 38% less than the annual optimal model’s. A simulation analysis is also conducted to explore the amount of royalty fluctuations under uncertainty environments (assuming that annual patronage is distributed as normal distribution with standard deviation equal to 20% of its mean value of that year). The result shows that there are 13% situations falling below the rate of return required by investor and 24% situations falling below the ratio of debt service coverage required by financiers.

Key Words：BOT、Royalty Models、Mathematical programming