

Evaluation of Implementing Strategies for DOTO Expressway

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1. Introduction

Recently, the Japanese government has changed a policy about expressway development since happening of economic crisis. The government attempts to privatize expressway agencies to limit the budgets while expects that the expressway networks should be completed.

The problem is especially serious in Hokkaido, where many expressways project are still required to complete the expressway network. DOTO expressway project, which using to connect east and west side of Hokkaido, is stopped and revised by the government. Nevertheless, various strategies to proper implement the project has been proposed to Hokkaido government. The strategies include method for reducing cost by limiting a standard of the expressway, and the amount of subsidy.

In term of efficiency, it should be considered in the evaluation process that poor projects could be deferred. Thus, it is important to re-evaluate the expressway projects by providing the right that each expressway section could be deferred. As a result, DOTO expressway project are evaluated using Real Option Approach.

2. Strategies for Implementing DOTO Expressway

Presently, the DOTO expressway section Chitose-Yubari and Tokachishimizu-Ikeda were completely constructed, while the section Yubari-Tokachishimizu and Honbetsu-Kushiro were already started the construction but the project has been stopped to revise the decisions. The location of the DOTO expressway project can be shown in Figure 1.

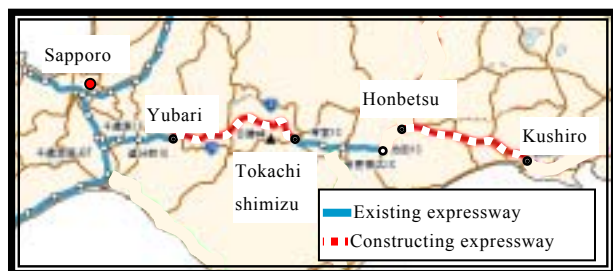


Figure 1. Overview of DOTO Expressway project

Due to traffic demand for intercity expressway in Hokkaido is not so high, many strategies have been proposed to make the expressway network in Hokkaido feasible. The implementing cost for the expressway is attempted to be decreased by reducing the standard of the expressway. The toll rate, which affects the traffic demand in expressway, is also taken in to account. As a result, four strategies are proposed to be used for expressway projects in Hokkaido in this study.

- 1) Four lanes expressway with normal toll
- 2) Two lanes expressway with normal toll
- 3) Two lanes expressway with toll for covering maintenance cost
- 4) Two lanes expressway without toll

3. Evaluation Process using Real Option Approach

Assumptions used in the evaluation process are shown in Table 1.

Table 1. Assumptions in Evaluation Process

(in billion yen)	Yubari - Tokachishimizu	Honbetsu - Kushiro
Distance	81 km.	84 km.
Construction time	12 years	6 years
Construction cost	283.5	252
Yearly maintenance cost	3	3.25
Based year	Year 2002	
Project life (yrs)	40	
Social discount rate	4 %	

The simulation procedure to adopt ROA for evaluation of DOTO expressway is shown in Figure 2.

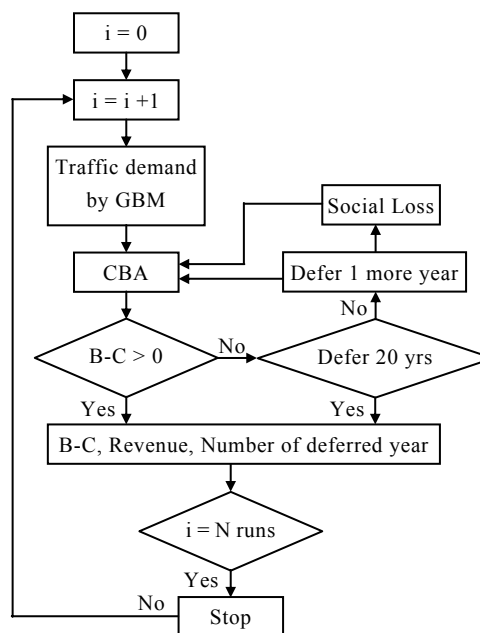


Figure 2. Procedure in the evaluation process

(1) Modeling Uncertainty in Traffic Demand

The annual growth rate for yearly traffic demand is predicted by using Geometric Brownian Motion (GBM) with drift rate as shown in [1].

$$\frac{\Delta Q}{Q} = \mu \Delta t + \sigma \varepsilon_t \sqrt{\Delta t} \quad [1]$$

where, Q : yearly traffic demand

μ : constant annual growth rate for traffic demand

σ : standard deviation of annual growth rate

ε_t : normal distributed random variable $N(0,1)$

(2) Option to Defer the Construction of an Expressway

The advantages by providing the right to defer the construction of an expressway accrue from potential to limit loss when the project is unbeneficial. Moreover, the government also can use the construction budget from the deferred project to invest in others useful projects. Thus, the money from taxpayers is not sunk in the unbeneficial project. Deferring for maximum of 20 years is set up to be the life of the option to defer the construction.

(3) Social Loss from Option to Defer the Construction

When the expressway is deferred, it forces some road users, who have willingness to use expressway, to travel with longer travel time as well as higher cost (higher vehicle operating cost, VOC). Moreover, traffic safety benefit (resulted from saving in traffic accident when user can use expressway) is not gained. This losses are considered to be social loss which can be expressed in [2].

$$SL_i = \sum UB_i - \sum UC_i \quad [2]$$

where, SL_i : Social Loss due to delay investment decision in year i (yen/year)

UB_i : Users Benefits in year i (yen/year)

UC_i : Users Costs in year i (yen/year)

4. Evaluation Results from ROA

(1) Revenue Consideration

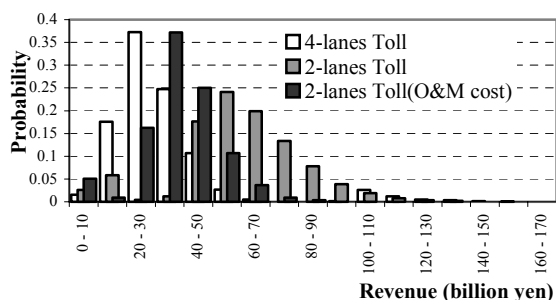


Figure 3. Revenue in Yubari-Tokachishimizu project

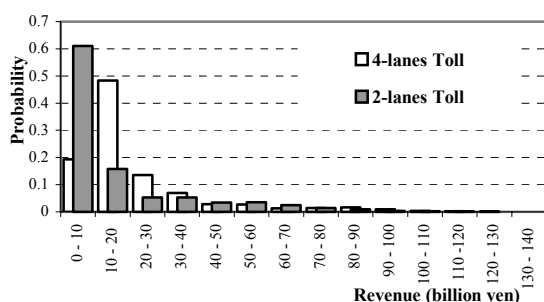


Figure 4. Revenue in Honbetsu-Kushiro project

From the distribution of revenue, the expected average revenues are very low compare to the total investment cost (revenue of lower than 60 billion yen compare to total investment cost of 280 billion yen) for all strategies. In addition, the expected revenue only for 2-lanes strategy in Yubari-Tokachishimizu project is enough to cover the maintenance cost of the expressway.

(2) Benefit-Cost Consideration (B-C)

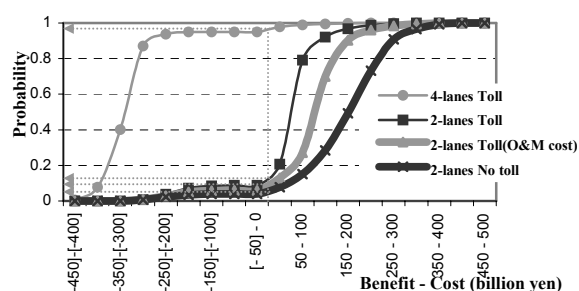


Figure 5. Cumulative Probability Distribution of B-C in Yubari-Tokachishimizu project

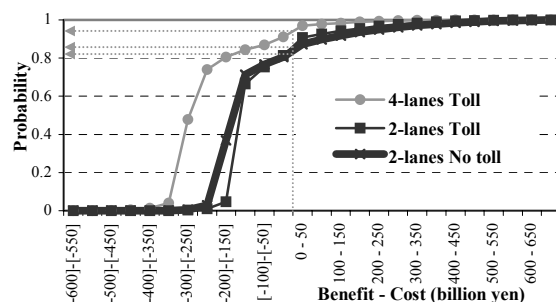


Figure 6. Cumulative Probability Distribution of B-C in Honbetsu-Kushiro project

For Yubari-Tokachishimizu expressway project the project has low risk (more than 80 % chance to be economical) in the 2-lanes strategies, while the risk is very high for 4-lanes plan. However, the Honbetsu-Kushiro project have high probabilities that the project will be uneconomical (less than 15 %) for all strategies.

5. Conclusions and Recommendations

Four strategies are proposed and evaluated using Real Option Approach considering option to defer the construction and social for implementing the DOTO expressway. The results show that the revenue from toll collection in both expressway sections is quite low compare to its investment cost. The project is feasible only in the 2-lanes strategies for Yubari-Tokachishimizu expressway project and infeasible in Honbetsu-Kushiro project. Thus, it is recommended that the Yubari-Tokachishimizu expressway should be constructed as 2-lanes divided road by the JH without any delay and required a subsidy either from the pooling system or the government. The toll should be charged either a normal toll or a toll that can cover maintenance cost when the expressway is operating. The Honbetsu-Kushiro expressway project has to be invested by the government. However, the project is better to be delayed (can be invested at anytime) unless the government wants to face with high risk to invest in the project.

Unfortunately, existing progress of the construction for the DOTO expressway project is likely to be opposite with the proposed recommendations. Thus, the government should take the opportunity that recently the project is stopped for revising the decision to proper developing the expressway network in Hokkaido.