Valuation of Public Guarantees with Real Option: New Istanbul Airport Example

Emrah DURMAZ
Department of Aviation Management
Iskenderun Technical University, School of Civil Aviation
Hatay, Turkey
emrahdurmez@anadolu.edu.tr

Únal Battal
Department of Aviation Management
Anadolu University, Faculty of Aeronautics and Astronautics
Eskişehir, Turkey
ubattal@anadolu.edu.tr

Abstract— Every area of life contains a certain amount of uncertainty and risk. Infrastructure investments are long-termed, large-scaled and high-demand risk contained. Infrastructure investments, which were traditionally carried out with public funding in the past, are now executed through public-private partnerships (PPP). The most important success criteria in implementation of PPP is optimal risk sharing between the two parties. In this respect, the public sector has been offered some kinds of public guarantee mechanisms in order to reduce and share the risk and make project more attractive for private sector. Thus, private sector participation can be achieved in the projects by this way.

The real option (RO) method, which is considered as a new valuation method, helps decision makers to value investments within the context of flexibility. There are several studies suggesting that the RO analysis should be used as a complement to traditional methods under certain circumstances and conditions such as long lifecycle, uncertain demand etc. which perfectly addresses airport investment. In the literature, some researchers analyzed PPP investments with real option aspect. But most of them focused on highways and power plants. Government revenue guarantees in airport PPP projects have never been examined before. Motivated by this absence, this paper focuses on revenue guarantees in airport PPP projects. It is aimed to investigate how the RO method can be implemented in guarantee mechanism by taking New Istanbul Airport (NIA) as a case in which government offered revenue guarantee, which covers only international departing and transfer passengers’ airport service fee, to the private party of the project.

Keywords- Public-Private Partnership; Real Option; New Istanbul Airport; Public guarantee

I. INTRODUCTION

The RO approach is the pricing model of financial options that are adapted to the real assets. On the basis of this approach, the argument that flexibility is a value against the uncertainties in projects [1]. The concept of option can be defined as the right to make decisions in the future against future uncertainties [2]. Contrary to traditional approaches, the RO approach emphasizes the role of managers in managing investments and argues that managerial flexibility should be taken into account in the valuation of investments [3;4].

Infrastructure investments are usually long-term investments and contain many uncertainties such as exchange rate risk, demand risk and cost risk. Infrastructure for the public sector means economic, social and humanitarian benefit [5]. Today, the PPP application is seen in many infrastructure investments. However, if infrastructure investments are realized in partnerships with the private sector, these investments should also be financially feasible. Otherwise, the private sector’s interest and participation to these projects will not be possible. The benefits of this collaboration has been emphasized as much as some other issues which have been pointed out in many studies. It is emphasized that one of the most important conditions for a successful PPP implementation is that the risks are shared between the two parties correctly [6;7;8].

The public sector has used various guarantee mechanisms in PPP infrastructural investments from past to present both as an element of risk sharing and in order to motivate private sector participation to infrastructure investments [9]. The most common use of these guarantee mechanisms is the revenue guaranteed mechanisms as they affect both the demand risk and credibility of the project. In this guarantee mechanism, the public authority guarantees some part of the revenue obtained from the project to the private sector stakeholder. If the private sector stakeholder earns below the guaranteed level during the operating period of the project, the public sector declares that it will pay the difference. Of course, revenue guarantee is not an obligation but right. This mechanism provides flexibility to the private sector participant against uncertainties in the project. It is possible to see and model this flexibility as an option during the valuation process [6;10].

The purpose of this study is valuating public revenue guarantees, which is a risk sharing application in public-private partnership in airport investments, within the RO approach and finding the effect of the revenue guarantee on
the project value. In the study, a conceptual framework covers the RO and PPP issues was first introduced, then some important information was shared from the NIA project. Finally, valuation process for revenue guarantee in NIA project, was presented.

II. REAL OPTION

It is possible to define the RO as a systematic solution approach using financial theories, econometric analyzes, management knowledge, decision making and statistics, based on option theory in a dynamic environment in which managerial flexibility promise value against uncertainty. The concept of uncertainty, risk and managerial flexibility constitute the basis of the RO approach [3;11]. The basic input of the RO approach is uncertainty. According to this approach, uncertainty leads to opportunities. The capacity of resolving uncertainties in the future is a fundamental qualification that allows businesses to create value from uncertainty. Figure 1 illustrates the relationship between uncertainty and option value.

Although RO is an old commercial practice, in today's sense, RO Analysis is a financial option adapted to real assets. Black and Scholes [13], Cox et al. [14] have carried out pioneering studies on this adaptation. The underlying power of this approach has created a great expectation, especially in the academic field. But adaptation to the business world has been slower than expected due to the fact that the first studies on the RO approach have focused more on technical modeling than on the real option [3]

![Figure 1. Uncertainty and option value](image)

In today's economic conditions, the Net Present Value (NPV) approach, which is based on Discounted Cash Flow (DCF), is the most widely used method in the past and today for decision makers in project valuation [12]. Perhaps the most important issue with regard to the DCF approach is determining the discount rate to be used [15]. An investment that is not profitable even with very small manipulations of the discount rate can be seen as if it is worth investing in. For this reason, the most critical variable in DCF approach techniques is the discount rate. In fact, one of the biggest dilemmas encountered in implementing the methods used in the DCF approach is which discount rate can be used [11]. The Risk Neutral Valuation or Equivalent Portfolio Approach is used in valuation with RO approach. In the Risk Neutral Valuation approach, the risk of expected cash flows or revenue from the investment is already reflected in the valuation of the project by using the probability distribution. In this respect, there is no need to determine discount rate. In this approach, all cash flow is discounted with risk-free interest rate [16].

In current practices for investment decisions, a single, non-objective estimate, which is related to future cash flows and based on traditional discounted cash flows, is used. In addition, while investment decisions are evaluated in traditional approaches, decisions are made by predicting a single development and result. In the RO approach, the probability distributions of cash flows and multiple cash flows are taken into account [3]. Definite and unchanging investment decisions can, of course, be taken in environments where the short-term uncertainties and risks are relatively non-existent. However, this situation is not valid for long-term and integrated investments with strategic purposes. In previous studies [6;9;10], it has been emphasized that traditional valuation methods are inadequate in the valuation of PPP projects. These guarantees give flexibility to the projects against the uncertainties in the projects and this flexibility should be valued with the RO approach.

III. GOVERNMENT GUARANTEE MECHANISM IN PPP: NIA CASE

PPP is a project to build and operate roads, ports, railways, airports, schools, communication infrastructures and environmental facilities, which are traditionally built and operated by the public sector, with private sector with regards to concerns such as creativity, budget, quality and productivity [17]. The main point that PPP distinguishes from traditional methods is that cooperation with the private sector continues not only during the construction period but also the operating period. It cannot be said that PPP will always be successful. Of course, certain conditions are needed to obtain the expected success of PPP. Critical success factors in PPP can be listed as follows [8]:

- Public support and political commitment,
- The experience and knowledge capacity of relevant public institutions due to the complex structure of PPP,
- Open dialogue channels and effective coordination between stakeholders during the development of the PPP project,
- A well-structured tender process,
The risk sharing from critical success factors is very important. PPP projects are exposed to different risks at different stages. Sharing these risks, according to certain criteria and principles between the two parties, plays an important role in achieving the expected outcome of the project [6;18]. The main motivation of the state guarantees presented as PPP projects is ensuring a predetermined minimum revenue level to the private sector stakeholder when the demand for the project and, thus, the revenue generated are not enough to risk the project. Public guarantees are perceived as the most effective way to reduce revenue risk in PPP projects and the availability of public guarantees make the project attractive to the private sector [19]. Undoubtedly, excessive state guarantees can create a heavy burden on the public budget. On the other hand, the lack of public guarantees at the required level may cause that can lead to the private sector not taking any interest in the project, in other words, On the other hand, the lack of public guarantees at the required level may cause to no private sector offer to project, in other words, no private sector interest to project [10;19].

The NIA project is the project with the highest tender price in Turkey’s PPP implementations. The initial cost of the project is estimated to cost about 7.5 billion EUR. The private sector partnership of the project will meet 20% of this cost with equity. Due to the size of the investment, DHMI, the public stakeholder of the project, gave the project revenue guarantee. The revenue guarantee in the project covers only passenger service charge (PSC) revenue. DHMI gave revenue guarantee of 525 million EUR per year during 12 years, totaling 6.3 billion EUR to the private sector partnership undertaking the project. In addition, this revenue guarantee includes only international and international transit passengers’ service charge [8]. In the NIA tender specification, passenger service fees are also predetermined. According to this [20]:

1. Domestic passenger service fee-3 EUR
2. International passenger service fee- 20 EUR
3. International Transit passenger service fee- 5 EUR

IV. METHODOLOGY

While the PSC revenue guarantee on the NIA project is being examined with the RO approach, the number of passengers is assumed as the main variable affecting the project value, as in previous studies [1;5;21]. In the NIA passenger forecasts, the data of Atatürk Airport, which will be put to an end for flights after NIA opens, was used. Domestic and international passenger traffic data of Atatürk Airport in 2002-2017 have been used to establish the parameters controlling the Binomial Lattice model. According to this model, the demand for a certain year’s (D) is a function of the demand of the previous year (moving up with a probability p (u) or down with a probability (1-p) (d)). In Equation 1, the demand function in the year (D_t) can be seen according to this model:

\[ D_t = \begin{cases} \frac{D_{t-1}}{u} & \text{with the probability of } p \\ \frac{D_{t-1}}{d} & \text{with the probability of (1-p)} \end{cases} \]

The upshift coefficient (u) and the downshift coefficient (p) of the control parameters of model are derived from statistical information such as the u, d, p values, the average increase rate of past demand data and standard deviation in the model. According to this, on the condition that D_1 is the number of passengers in the year i, v_i is the growth rate for the the year i, v_0 is the average growth rate, standard deviation and variance of the option value of the revenue guarantee will be zero. Similarly, if the revenue of private sector stakeholder exceeds the guaranteed revenue, the private sector stakeholder during t time period and R_t is the guaranteed revenue by the public).

\[ \sigma^2 = \sum_{i=1}^{n} (v_i - v_0)^2 \]

With the variance and standard deviation values found, the model's control parameters u, d and the coefficients of motion and their probabilities are calculated as follows (\( r_i \) is the risk-free interest rate, \( \delta_t \) is the inter-period time in the lattice):

\[ u = e^{r_i \delta_t}, d = \frac{1}{u} \text{ and } p = \frac{(1 + r_i) - d}{u - d} \]

With the help of input parameters found and the function seen in Equation 1, the binomial distribution is created by performing up and down shift during the option time. The generated binomial distribution is evaluated according to the qualification of the option.

\[ G = \sum_{i=1}^{T} \frac{G_t}{(1 + r)^i} = \sum_{i=1}^{T} \frac{\max(0, R_t - R_s)}{(1 + \delta_t)^i} \]

In the modeling of the revenue guarantee by the RO approach, the private sector stakeholder of the project has the right to claim the revenue from the public sector as much as \( R_s \) in the case of \( R_s < R_t \) (\( R_t \) is the revenue of the private sector stakeholder during t time period and \( R_s \) is the guaranteed revenue by the public). Of course, if the revenue of private sector stakeholder exceeds the guaranteed revenue, the private sector stakeholder cannot have any requests and the option value of the revenue guarantee will be zero. Similarly, the mathematical expression of this condition can be seen in equation (5), with t being revenue guaranteed in a t-term [16].
V. EARLY FINDINGS AND FUTURE STUDY

Using the RO valuation approach, the minimum revenue guarantee offered to the private sector stakeholder of the project will be analyzed in regards to the New Istanbul Airport (NIA) project, which is already in the construction phase with PPP implementation. For the NIA passenger forecasts, the data of Atatürk Airport, which will be put to an end its operations after NIA opens, was used and these data are assumed to be valid for NIA. The expected date for NIA to start flights is 29 October 2018. However, it is assumed that NIA's operations will be begun on 1 January 2019 due to the convenience of estimating passenger numbers and calculating. In official passenger statistics, transfer passengers are unfortunately not available in many parts of the world. With regard to this, the transit passenger data in the study of The Hotel Association of Turkey (TÜROB) will be used in the analysis. Another assumption in the analysis is that the number of arriving passengers and departing passengers is distributed equally in passenger traffic. In the study, the data required for binomial lattice is derived from Atatürk Airport data and the results are seen in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upshift-u</td>
<td>1.06865</td>
</tr>
<tr>
<td>Downshift-d</td>
<td>0.93576</td>
</tr>
<tr>
<td>Probability factor-p</td>
<td>0.57889</td>
</tr>
</tbody>
</table>

With the help of the calculated data in the study, the binomial lattice of the international passengers traffic will be built for 2019-2030 covering the NIA revenue guarantee. The generated binomial lattice of the international passenger traffic will be firstly reduced to the departing passenger and then will be separated to international and international transit passengers with the help of TÜROB's data. The PSC revenue for each cell in the binomial lattice will be calculated by multiplying the passenger numbers and the specified PSC fees in the tender specification. The differences between the calculated PSC revenues of less than guaranteed 525 million EUR are calculated and the present values will be found by discounting with risk-free interest rate. Finally, some parameters such as variance, international PSC fee, and international transit PSC fee will be subjected to sensitivity analysis and the effect of these parameters on the value of revenue guarantee will be examined.

REFERENCES