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Study on Investment Value of Civilian Airport under Government Guarantee Based on Computer Simulation

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Abstract: Government guarantee of the civil airport industry can add to the project option value. The author considers there are three kinds of government guarantee, which include minimum government guarantee, bilateral government guarantee and restricted competition and have used tools to calculate the impact of government guarantee on project value by online simulation. A case of Hongqiao business jet base is studied in order to prove these three option models.

Key words: Government guarantee, investment value, MATLAB, computer smulation, civilian airport

INTRODUCTION

The greatest concern for the investors of civilian airport infrastructure is to be able to achieve the expected economic benefits. When the actual value is lower than the predicted value, the original decision might lead to errors (Leung and Hui, 2005). The investment may be difficult to recover or the recovery period will be extended from the view of the options. In addition to the value of the project that is based on the time value under traditional decision-making methods, the project also includes a flexible value from project management as well as the value of uncertain information (i.e., value of flexibility in management). The value of the project is the sum of the present value of cash inflows and the project flexibility value (Heald, 2003). Traditional methods assume that the asset value of the investment projects will be reduced with the increased uncertainty (Khadaroo, 2008). Also, real options theory states that uncertainty will increase the value of the project if managers can make effective business decision. Investment in civilian airport infrastructure has a huge one-time investment and a long payback period (Grimsey and Lewis, 2005). Accordingly, project uncertainty must be fully considered, including market uncertainty and the uncertainty of the construction costs.

THEORETICAL ANALYSIS OF GOVERNMENT GUARANTEE

Government guarantee is the most widely guarantee way of private investors participating in the infrastructure construction. Reasonable government guarantee is the key factor to promote the success of PPP model (Froud and Shaoul, 2001). In developing countries, imperfect political and economic system, low level of the government credit and the fluctuation of exchange rate are the main risk factors of successful PPP project. Want to realize the PPP mode of the target and the original intention, funds and technical service for private investors in infrastructure projects, providing government guarantee has become an important means to reduce the project risks, which makes capital and technology of private investor effectively serve to the infrastructure (English *et al*., 2010). For example, government guarantee can reflect in stable interest rates, sound laws and regulations, stable political system and so on.

The government guarantee of PPP project mainly reduces the risk and ensures certain income level of investors, transportation infrastructure project vehicle tolls, aircraft taking off and landing fees is the only source of income, the reasonable security of government can inhibit the potential risk of rising price to protect the interests of consumers (Akintoye *et al*., 2003). But because of the existence of information asymmetry between government and private investors, if government does not provide sufficient guarantee to stimulate the secured party to improve the service level, it will brings about low level of social welfare and cannot achieve the expected goal of government scale.

CASE STUDIES

In Shanghai, October 2006, Shanghai Airport Authority and Australia's Hawker Pacific Business Aviation Development Co., Ltd., which makes the Shanghai business jet base project, signed a memorandum of cooperation and entered into a substantive start-up

phase. The total investment of the joint venture was 175 million yuan and the registered capital was 120 million yuan. The Airport Group invested 61.2 million yuan, accounting for 51% and Hawke companies invested 58.8 million yuan, accounting for 49%. According to the estimate of the feasibility study report, a one-time payment of all ground facilities, lease costs and 50% of the land lease costs, the part of the rent totaling to approximately 1.0255 billion; and additional 50% of the land lease fee costs (53 million yuan in 20 years), which totally accumulates to approximately 1 billion.

ESTABLISHING THE OPTION MODEL OF GOVERNMENT GUARANTEE

This section will take a certain proportion of measurement of aircraft taking off and landing as guarantee amount, this ratio is set to m, Q^e_t represents prediction of official machine movements in year t, Q^r_t represents actual movements of official machine in year t, Q^G_t represents guarantee movement of official machine in year t, t = n+1,..., T, Q^C_t represents the highest flights of the government guarantee (it is a certain proportion of measurement of aircraft taking off and landing, the ratio is set to b, $(1<b<+\infty)$, when $Q^R_t<Q^G_t$, the government will give item company a certain proportion of the difference between actual movements and guarantee movements, this ratio is set to s, when $Q^R_t<Q^C_t$, the government will obtain a certain percentage of extraction of extra income, this percentage is set to w.

Option value model under minimum government guarantee: If actual movement of aircraft taking off and landing is lower than guarantee, item company can execute put option, which received a subsidy of $(Q^g_t-Q^R_t)P_t$·s:

$$SF_i=\begin{cases}0, & \text{if } Q_t^R \geq Q_t^G\\ (Q_t^G-Q_t^R)\cdot P_t\cdot s & \text{if } Q_t^R \leq Q_t^G\end{cases} \quad (1)$$

Option value model under bilateral government guarantee: Bilateral government guarantee for company performs a double barrier option. Based on minimum guarantee of aircraft taking off and landing, the government takes measure to limit high profit which is not reasonable. The government sets a certain proportion as the highest aircraft movements based on the prediction of aircraft taking off and landing, when the aircraft movements in year t is higher than the set level, the government extracts part of the extra revenue of $(Q^R_t-Q^C_t)P_t$·w:

$$SF_i=\begin{cases}(Q_t^R-Q_t^C)\cdot P_t\cdot s & \text{if } Q_t^R \leq Q_t^G\\ 0, & \text{if } Q_t^G \leq Q_t^R \leq Q_t^C,\\ (Q_t^R-Q_t^C)\cdot P_t\cdot w & \text{if } Q_t^R \geq Q_t^C\end{cases} \quad (2)$$

Option value model under restricting competition: The original business jet base often maintains competitive advantage in the operating period that is embodied in the mathematical model, which means additional revenue should be extracted by the government. This is as shown by the following Eq:

$$SF_i=\begin{cases}0, & \text{if } Q_t^R \leq Q_t^C,\\ (Q_t^R-Q_t^C)\cdot P_t\cdot w & \text{if } Q_t^R \geq Q_t^C\end{cases} \quad (3)$$

Here, we report the impact of the restriction competition on project value under the initial aircraft movements, aircraft movement's growth rate and other factors based on the Charles model. Investors have a call option. The benchmark rate of return is 7.15%, according to the feasibility study report. Although, estimating is difficult, here we make an estimate of initial movement of the business jet in feasibility report for numerical calculation (Table 1). According to the 'feasibility study report of shanghai business jet base', the growth rate of business jet movement changes along with time.

Due to the project construction and early operation time, which is an important stage for official machine development, in the first stage, the growth rate reached 15%. After the year 2017, the construction of business jet projects goes into operation in China, although these bases are geographically far away from each other. However, they have a certain influence on the project, therefore, after the year 2025, the growth rate will drop to 10% and the growth of official machine movements will go into a stable stage because of the project design capacity. Based on prediction of the growth rate of official machine movements, during the operational period, the growth rate and the volatility of aircraft movements is shown in Table 2.

Table 1: Probability distribution of initial movements

Variable	Distribution	Growth rate	Standard deviation
Initial movements	Lognormal distribution	0	14%

Table 2: Growth of business jet movements

Operating years	Mean	Standard deviation
2009-2016	14%	11.4%
2017-2024	8%	6.45%
2025-2029	1%	1.74%

Table 3: Simulation results of subsidy from government under minimum security

Statistics	Simulation times	Mean	Standard deviation
Numerical	1000	236.67	23085.51

The jet base income cannot be directly calculated through the car goods flow as well as the air cargo station or highway project. The income of the official machine base is divided into three parts. Firstly, the income of FBO (Fixed Base Operator), in which the revenue of this part includes parking service, channel service, ground service and agency services. All kinds of income from services can be calculated by a public frame time multiplied by the service rate. However, the volume of four different business services is often different and the most basic service is the stopping service and channel service. When the development of these two kinds of service becomes mature, it can drive the development of ground services and agency services. Secondly, the income of MBO (Maintenance Base Operator), the revenue and income of this part includes repair income, spare parts sales income, subcontracting income and warehouse management income. Thirdly, management and charter income, this can be divided into small, medium and large machine charters. During the operational period, the same number of parking services brings about different service incomes, which is due to the different stages of development. In general, in the initial stage of development, aircraft parking services brings about a low income. However, during the development of the later operational stages, due to the rich service content and improved quality, aircraft income will increase, which is brought about by parking service. To a certain extent, income caused by each aircraft is fixed at a certain level, but the operating costs will rise because of various factors. The rate is shown in Table 3.

RESULTS OF CALCULATION

Option value under minimum government guarantee: Figure 1 is distribution diagram of expenditure of government subsidies, when the set ratio of government guarantee is 0.75, the lowest subsidies of government security to official machine movements is possibly an average of 2366700 yuan, compared with the calculation of the net present value, the subsidies expenditure is smaller, project value of investment value is = 2282.93+236.67 = 2519.6 (million). During the operation period, if the actual aircraft movements have large deviation with the benchmark of official machine movements, actual results will have great difference from the simulation results. In practice, there are many ways to achieve the function of government minimum guarantee, such as preferential tax can not only improve the attractiveness of the airport to investors, but also can reduce the risk of the civil airport during the operation of the project.

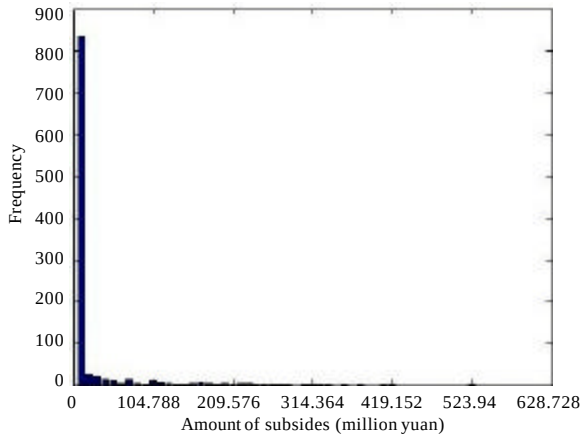

Fig. 1: Amount of subsidies under minimum government guarantee

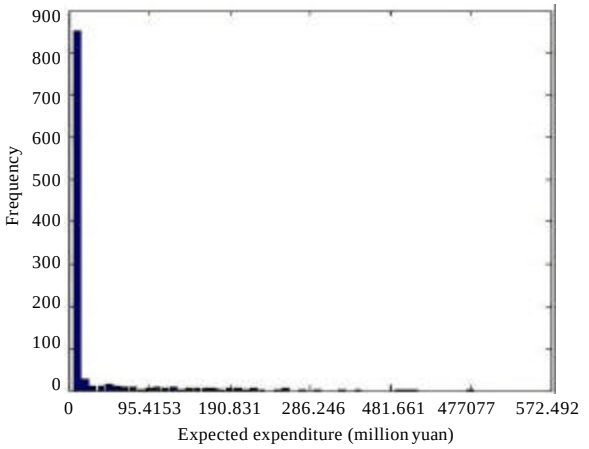

Fig. 2: Expected expenditure of government under bilateral government guarantee

Option value under bilateral government guarantee: As is shown in Fig. 2 and 3, when the ratio of government minimum guarantee is 0.75, subsidy coefficient is 0.3, the maximum restriction ratio is 1.3, the percentage of extraction is 0.3, under bilateral guarantee, the expected expenditure is an average of 2366700 yuan, the expected income of government is an average of 3720500 yuan. From the of view option, through bilateral guarantee, the government obtains two kinds of real option, the put option value is 2366700 yuan, the call option value is 7440400 yuan, a difference of 5073700 yuan. It can

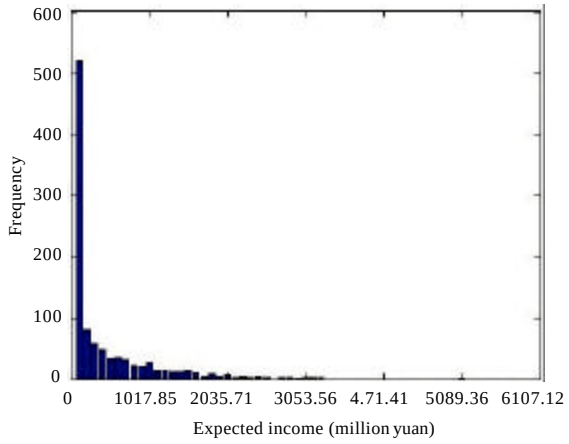

Fig. 3: Expected income of government under bilateral government guarantee

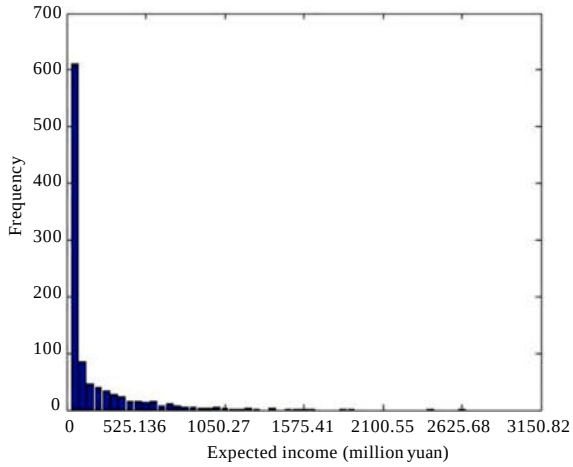

Fig. 4: Government revenue under restricted competition

Table 4: Simulation results of government revenue (subsidy) under bilateral security

Statistics	Simulation times	Mean	Standard deviation
Numerical	1000	507.37	14075.72

Table 5: Simulation results of government revenue under restricted competition

Statistics	Simulation times	Mean	Standard deviation
Numerical	1000	928.81	61579

be seen that under above ratio of guarantee and restriction, the beneficiary is government (Table 4).

Option value under restricting competition: In the case of restricting competition, according to the government contract pumping ratio (0.4) and government restriction on competition ratio (1.3), the government revenue is 9.2881 million yuan (Fig. 4). If the government contract pumping ratio and government restrictions on competition ratio changes, the government revenue will change correspondingly (Table 5).

CONCLUSION

The topic of the real options method investment is on the forefront of academic research in the field of decision-making in infrastructure project. Theorists on the real options approach was discussed more, but less was discussed regarding the enterprise application level. Regarding the options value of the civilian airport infrastructure, we think that government guarantee of the civilian airport industry add to the project option value. The author has used MATLAB simulation and calculated the Hongqiao business jet base case to prove option pricing in the enterprise and the impact of government guarantee on the project value by mathematical model and online simulation.

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