

# The Application of Real Option Method for Investment Decision of Real Estate Project

Zhen Wang<sup>1, a</sup>

<sup>1</sup>Shaanxi vocational & technical college, No.1 Xiyangwan Xi'an, China

<sup>a</sup>kkkbff@126.com

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**Abstract.** With accelerated marketization process of the real estate, its effect in stimulating and stabilizing the market economy becomes more and more large. Because market development of the real estate is less well-developed, investment manias of real estate prick up the risk of investment. Therefore, the use of scientific decision method which conforms with the regulations of real estate industry has important meaning. The characteristic and pricing model of real options method are analyzed in this paper, and it is introduced into the investment decision of real estate project to discuss advantages of the evaluation method in the real estate investment projects. The real option theory in development project of real estate which is used to modify defects and shortcomings of the NPV method in theory fully embodies the flexibility value of decision makers. Accordingly, investment decision of this kind of project is more scientific and reasonable, and it has not only important theoretical value but also higher guiding significance to actual work. Decision makers view the problem of investment decision of real estate from different aspects and improve the profitability of the project. And the investment risk is reduced to be conducive to operate reasonably development project of real estate.

## Introduction

Real option is the generalization and use of the financial options concept on the physical assets. Stewart Myers pointed out: profit earned by the cash flow which is incurred in an investment project comes from the use of assets that are owned currently and the opportunity of future investment, that is, the right obtained by enterprises is the physical assets or investment plans can be obtained and sold in the future at a certain price, and the price of this right are calculated by use of option pricing model, and investment of physical assets can be evaluated with method which is similar to the evaluation of general financial option[1-3]. The concept and the research method of real option are applied to decision of real estate investment project in recent years, this is mainly due to that the characteristics of the real estate investment project are adjusted with real option method.

## The application of real option method for investment decision of real estate project

**The real option problem of real estate investment project.** The real option problem of real estate investment project can be summed up in the following three aspects: ①The determination of the development scale of real estate investment project. Decision-makers need to study the scale of development in the real estate investment project and solve the one-time and multiperiod problem of development, and by selecting the appropriate development scale they accurately grasp the dynamic development of project and timely modify project plan, so that achieves the goal which is promoting the value of project. That is involved phased development option, option of expansion investment, option of contraction investment, abandoned option and option of growth in the enterprise in the project. ② The selection of development time of real estate investment project. Different from traditional investment theory, real option thinks that the optimal development timing of the real estate development project is that the total value of a project is equal to the sum of the direct investment value and option value for real estate investment projects. And according to related laws and

regulations of real estate development in our country, real estate developers can decide the development time within two years after they acquire land. The problem of delayed investment options is how to choose the time point [4-7]. ③ The selection of development mode of real estate investment project. Decision makers need to select the development mode with aiming at the flexible market environment in the development process to realize the maximization of profit, and this problem of real option at here is the conversion of option[8-10].

**The physical model of pricing of real option.** The problem of investment decision of real estate project is solved by real option method and binomial tree model and black-scholes pricing model are mainly used. Now black-scholes pricing model is only introduced as follows, the model is shown in formula (1), (2) and (3). Its basic assumptions are that arbitrage opportunity is not exist in the market, the trading asset or waiver does not produce any transaction costs and taxes, it is the European call option and dividend is not payed, the stock price is continuous and obeys the lognormal distribution.

$$C = Se^{-\delta(T-t)}N(d_1) - Xe^{-r(T-t)}N(d_2) \quad (1)$$

$$d_1 = \frac{\ln(S/X) + (r - \delta + \sigma^2/2)(T-t)}{\sigma\sqrt{T-t}} \quad (2)$$

$$d_2 = d_1 - \sigma\sqrt{T-t} \quad (3)$$

And, normal distribution is showed with  $N(d_1)$  and  $N(d_2)$ .  $N(d_1)$  and  $N(d_2)$  denote respectively values of cumulative probabilities when variables are less than  $d_1$  and  $d_2$  under the standard normal distribution.

C—the value of the call option;

S—the price of the underlying stock;

X—exercise price of option;

(T-t) —Period of validity of the option;

$N(x)$  —the cumulative distribution function of standard normal distribution;

r—the risk-free interest rate;

$\sigma$ —volatility of the price of the underlying stock.

**The determination of pricing parameters for investment decision of real estate with the real option method.** As the physical assets the real estate has certain particularities, and the parameters of the real estate development projects should be modified for investment decision of real estate with the real option method. The following shows that how variable pricing of real option is modified in real estate investment decision. By applying the real option method variable pricing parameters of real option are modified to make the investment decision of real estate project with the real option method, the results are shown that: ① the value of the underlying stock S is determined by using present value of expected cash flows for the real estate; ② exercise price of option X in the real estate can be got by discounting according to the corresponding cost data in the cash flow statement of project; ③ the execution deadline T of real estate can be determined according to the possessing deadline of ownership or operating life of land, and it is commonly two years; ④ the risk-free interest rate r can choose the interest rate of government bonds in the short-term as the risk-free rate in the real estate; ⑤ volatility of the price of the underlying stock  $\sigma$  can be estimated take advantage of the standard deviation or variance of historical price in the real estate market; ⑥ the value leak rate of the assets  $\delta$  in the real estate can be calculated by the formula (4).

$$\delta = r \times A + i \times B \quad (4)$$

And, r—the recent loan interest rate;

i—the growth rate of construction and installation's cost;

A—the ratio of land cost for total cost of project investment;

B—the ratio of construction and installation's cost for total cost of project investment.

## Empirical analysis

**Project overview.** Now a development project of real estate is Chosen in Chongqing to make the decision analysis respectively with the traditional NPV method and real options method. This project located in Chongqing Jiulongpo district is mainly the high residence and covers an area of 28560 square meters. Construction area of this residence is 55398 square meters, and the volume rate is 1.94. The living facilities of the current area have been perfected gradually, and district planning has good prospect. The average price of high residence is set at 7200 yuan per square meter with reference to the prices of houses at the same location. Concrete cost of development project is shown in Table 1.

Table 1 The cost estimation table of development project

unit : 10,000 yuan

number	Cost	Total investment	Remarks
1	the cost of development project	42089.62	
1-1	land cost	23920.22	
1-2	engineering cost of early stage	866.96	
1-3	construction and installation's cost	12355.33	
1-4	engineering cost of infrastructure	656.62	
1-5	cost of public facilities	560.88	
1-6	tax	1808.61	
1-7	non-recurring expense	1918.00	$\Sigma (1-1:1-5) * 5\%$
2	period expense	4217.23	
2-1	administration expense	1150.80	$\Sigma (1-1:1-5) * 3\%$
2-2	financial expense	1072.10	land cost*60%*7.47% (bank rate is 7.47%)
2-3	selling expense	1994.33	sales income *5%
3	total	46303.85	

**The analysis of investment decision with the NPV method.** According to the development scale of the project, the development of the real estate market in their area and the related engineering specification, the market holding capacity is analyzed. The assumption of development speed of this project is that the total working period of project is 3 years, the construction period is 1 year, land cost is invested at the beginning of year, construction investment is invested at the end of year, after the completion sales progress is 65% in the first year, and that is 35% in the second year. According to the investment estimation and development progress, the cash flow statement of all the capital in the feasibility analysis report of the investment project is taken to analyze and illustrate, as Table 2.

Table 2 The cash flow table of all capital of investment project

unit : 10,000 yuan

number	project	operation period			
			2011	2012	2013
1	cash inflow	0	0	25926.26	39884.62
1-1	sales revenue	0	0	25926.26	39884.62
1-2	other	0	0	0	0
2	cash outflow	23920.22	22035.52	1814.83	2791.93
2-1	construction investment	23920.22	22035.52	0	0
2-2	sales tax and extra changes	0	0	1555.57	2393.08
2-3	land value increment tax	0	0	259.26	398.85
3	net cash flow	-23920.22	-22035.52	24111.43	37092.69

Note: the based earnings ratio of project is 14%.

From the Table 2, according to the computational formula of the net present value as formula (5):

$$NPV = \sum_{t=1}^n \frac{(CI - CO)_t}{(1 + i_c)^t} \quad (5)$$

The net present value of project is received as the  $NPV = 340.59$ .

Then according to the standard of traditional investment decision, namely  $NPV > 0$ , the project should be developed. But the profit of the project is less to be unable to effectively resist the risk that will exist in the actual situation. The flexibility and strategic value of the project are ignored for the traditional NPV method, and in the uncertain environment it is necessary to adopt the real options method to analyze the value of project for further.

**The analysis of investment decision of real options method.** ①The type of real option in the case. After the land is purchased developers of real estate have buffer period of two years according to the relevant policy, namely the development opportunity is alternative at any time within 2 years. But in addition to delay option, compound option, such as conversion option and phased development option may also be contained in the phase. Considering the smaller investment scale of the project and the probability of phased development, phased development is regardless to constitute the delay option of project. And considering the availability of data, we use the B-S model to analyze as follows. ②The determination of real option parameters. The present value of cash inflow in the cash flow table of project is taken to calculate value of  $S$  by using detailed figures. The value of  $S$  is 46870.40 yuan according to formula (6).

$$S = \frac{25926.26}{(1.14)^2} + \frac{39884.62}{(1.14)^2} = 46870.40 \quad (6)$$

The present value of cash outflow in the cash flow table of project is taken to calculate value of  $X$  by using detailed figures. The  $X$  is 46530.55 yuan according to formula (7)

$$X = 23920.22 + \frac{22035.52}{1.14} + \frac{1814.83}{(1.14)^2} + \frac{2791.93}{(1.14)^3} = 46530.55 \quad (7)$$

The due time is 1.5 years. The land use right of the project is obtained in March 2010 and is formally developed in January 2011. The book-entry treasury bonds (three years) of 2.90% in 2010 is taken as the risk-free interest rate. The volatility rate of commercial housing prices of Chongqing in 2002-2009 is selected as volatility rate of development project value in this article; the specific calculation process is shown in Table 3. So,  $\sigma$  is 14.66%.

Table 3 The average price of commercial housing of Chongqing city in 2002-2009 and calculation of volatility rate

Time(year)	Average price(yuan/ square Meter)	$(S_i - S_{i-1})$	$u_i = \ln(S_i / S_{i-1})$	$u_i = \bar{u}$	$(u_i - \bar{u})^2$
2002	1985.02				
2003	1844.85	0.9294	-0.0732	-0.2136	0.0456
2004	2066.70	1.1203	0.1136	-0.0268	0.0007
2005	2265.75	1.0963	0.0920	-0.0484	0.0024
2006	2576.16	1.1370	0.1284	-0.0120	0.0001
2007	3643.15	1.4142	0.3466	0.2062	0.0425
2008	5185.16	1.4233	0.3530	0.2126	0.0452
2009	5303.23	1.0228	0.0225	-0.1179	0.0139
			$\bar{u} = 0.1404$		$\sum = 0.1504$

According to the estimation table of project land cost for total cost of project investment is 51.66%, construction and installation's cost for total cost of project investment is 26.68%, loan rate is 7.47% and the growth rate of construction and installation's cost is 6%. So the dividend yield every year  $\delta$  is 5.46%.

③ The calculation of the option value. According to formula (1), (2) and (3), when  $d_1 = -0.0038$  and  $d_2 = -0.1308$ , the value of option is 18.4404 millions. The value of project is expansive net present value is 2184.63 millions. Therefore, the development investment of real estate has great value of investment to be developed.

## Conclusion

The real option theory in development project of real estate which is used to modify defects and shortcomings of the NPV method in theory fully embodies the flexibility value of decision makers. Accordingly, investment decision of this kind of project is more scientific and reasonable, and it has not only important theoretical value but also higher guiding significance to actual work. Decision makers view the problem of investment decision of real estate from different aspects and improve the profitability of the project. And the investment risk is reduced to be conducive to operate reasonably development project of real estate.

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