The research on application of real option theory on investment decision of real estate project

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Abstract: Real option theory is increasingly becoming a hot research field among the scholars. In this paper, the author first analyzes the shortcomings of traditional net present value method in investment decision of real estate project, then introduces real option theory and compares it with net present value method. On this basis, potential kinds of real option in investment decision of real estate project are analyzed, and a case study on comparing real option theory with net present value method is carried out. Finally, the author draws a conclusion that real option theory has advantage in the uncertain environment in investment decision of real estate project.

Key words: real option, net present value, real estate, investment decision

1 Introduction

Net Present Value (NPV) method is traditional investment decision method of real estate project. This method could appraise the feasibility of investment project according to the size of project’s NPV. However, there are several imperfections in using NPV method to make investment decision of real estate project. These imperfections are listed as follow:

(1)The first imperfection is that NPV method presumes the data of future profit measured by cash flow could be forecasted, that is to say the future profit is certain, and regards the consequence analyzed from forecasted data as investment fact. All those make a false appearance that investment decision under the uncertain condition becomes investment decision under the certain condition. At the same time, NPV method assumes that uncertainty will reduce the value of the investment project. However, due to the long period of real estate development, the large scale fund of real estate project and the fierce variation of the market price, the future profit of real estate development is highly uncertain. Meanwhile, if the developer could apply the flexible management strategy to run this high uncertainty, the value of investment project may be increased.

(2)The second imperfection is that NPV method presumes investment decision is a current decision which means “invest right now, otherwise never invest” and this decision has nothing to do with the possible new information after the decision. However, during the practical decision of real estate investment, the choice of the investment opportunity is somewhat flexible. Before getting further information, the decision could be postponed. It is very common model such as deferred development, development by stages and rolled development. Obviously, the NPV method neglects the investment flexibility of real estate developer, and also neglects deferred decision could bring more value for developer due to more decision information.

(3)The third imperfection is that NPV method presumes once the developer decides to invest; they must continue to invest until the project’s end. This presume ignores the developer decision initiative, the unceasingly change about project information and the uncertainty of project technology. In fact, as time goes on, the investment environment and the cash flow of project are changing unceasingly. When the project is carried out, the developer has opportunity to take some soft tactics such as expanding project, shrinking project, abandoning project and converting the use of the project, and doesn’t stick to invest until the end of the project.

Due to the fierce competition of real estate market, real estate development would face more and more uncertainty. Because traditional NPV method ignores the value of uncertainty in appraising the feasibility of investment project, it always underestimates the value of much uncertainty implied in
investment project. However, the real option theory could discover the value of uncertainty and make it one part of the value of investment project. Therefore, it’s very important to apply the real option theory on investment decision when investment project would face high uncertainty during real estate development.

2. Real option theory

2.1 Notion of real option theory

Option is a special kind of contract agreement, it endows the possessors the right to buy (option which is expected to rise) or sale (option which is expected to fall) a kind of property at a fixed price on a given date (European option) or at any time before a given date (American option). Since the famous Black-Scholes option pricing formula solved the pricing problem of the financial option[2], the financial option market and the pricing theory of option have gotten considerable progress. Aiming at the imperfection of traditional \( NPV \) method in investment decision, Myers, the man who first formally put forward the idea of real option[3], realized that the option pricing theory could be used to conduct the investment decision on real property project. Real option, similar to the finance option, is a selectable right of real property investment at the uncertain condition. Compared with the traditional investment decision method, the idea of real option doesn’t focus on the forecast of the single cash flow, but the uncertainty of the project, and describes the probability distribution condition of the future cash flow with the language of probability. Therefore, real option is really an extend that the financial option theory expands on the real property investment, a method of thinking drawing the rule of the financial market into enterprise’s internal strategy investment decision, a valuable tool to improve the strategy thinking.

In the process of investment decision with real estate project, if the real option theory could be applied to fully excavate the potential real option, the \( NPV \) of investment project couldn’t be underestimated, which makes a correct appraise on the value of investment project. If the investment right is considered as real option, according to the real options theory, the value of the real estate investment project could be divided into two parts[4]: one part is the value which doesn’t conclude the value of real option, which is just the \( NPV \) in the traditional investment decision method; the other part is the real option value of the investment project. As a result, after drawing into the real option theory, the value of the investment project can be formulated as follow:

\[
\text{Project’s Value} = \text{NPV of Traditional Method} + \text{Option Value of Project}
\]

2.2. Contrast between real option theory and \( NPV \) method

Since the real option theory eliminates the imperfections of the \( NPV \) method, and truly reflects the internal flexibility and uncertainty of the project[5]. Therefore, under the highly uncertain condition, real option theory is a better project investment decision method. The main distinctions between the real option theory and the \( NPV \) method are listed on table 1.

<table>
<thead>
<tr>
<th>comparable item</th>
<th>( NPV ) method</th>
<th>real option theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>value of uncertainty</td>
<td>Uncertainty may reduce investment value of project.</td>
<td>Uncertainty may improve investment value of project.</td>
</tr>
<tr>
<td>tactics of handling risks</td>
<td>Reduce or elude risks.</td>
<td>Use risks to exploit chances.</td>
</tr>
<tr>
<td>value of future information</td>
<td>The value of future information is limited.</td>
<td>The value of future information is high.</td>
</tr>
<tr>
<td>function of manager</td>
<td>Only admit the visible profit and cost, while ignore the value of managers’ flexible management strategy.</td>
<td>Admit the visible profit and cost, meanwhile attach great importance to the value of managers’ flexible management strategy.</td>
</tr>
<tr>
<td>characters of the decision</td>
<td>Consider the content of decision is clear and fixed, and once be carried out, it wouldn’t be</td>
<td>Consider decision is influenced by future information and managers’</td>
</tr>
</tbody>
</table>
amended and renewed, and decision is rigid
decision. capacity of making decision, and
decision is flexible decision.

times of the
decision current decision and only
time’s decision. dynamic decision and many
Times’ decision.

3. The application research of real option theory on the investment decision of real estate project
3.1 Types of real option hidden in the investment decision of real estate project

Usually, when the investor selects the investment project, he would own the real options coming from three aspects such as the characters of investment project, investor’s flexible management strategy and contract agreement the investor creates. According to the characters of real option and real estate development itself, the real options hidden in the investment decision of real estate project are divided into six basic types (seen in table 2), and different real estate investment project contains different real option, sometimes one project may contain some real options at the same time.

<table>
<thead>
<tr>
<th>Option names</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>the Option to Defer</td>
<td>Investor has right to delay project Investment in order to solve current uncertain factors of project.</td>
<td>When developer faces highly uncertain investment decision, he has right to delay decision until uncertainty becomes clear.</td>
</tr>
<tr>
<td>the Option for Change Scale</td>
<td>In the future, if project would has good profit, investor has right to increase investment scale of the project.</td>
<td>When the price of the real estate market raises or the cost of development falls, investor has right to expand investment scale in order to get a better profit.</td>
</tr>
<tr>
<td>the Option to Contract</td>
<td>In the future, if project wouldn’t has good profit, investor has right to contract investment scale of the project.</td>
<td>When the price of the real estate market falls or the cost of development raises, investor has right to shrink the investment scale in order to reduce investment risks.</td>
</tr>
<tr>
<td>the Option to Abandon</td>
<td>If the profit of project couldn’t make up for it’s cost, or the market condition goes bad, investor has right to give up investment.</td>
<td>When the profit of the real estate project couldn’t make up for construction cost, developer could transfer the developed land or stop investing in order to control lost.</td>
</tr>
<tr>
<td>the Option to Switch</td>
<td>In the future, investor has right to switch investment decision among several choices.</td>
<td>If housing market becomes well, Developer has right to switch business house into residential housing in order to achieve better profit.</td>
</tr>
<tr>
<td>the Option to Grow</td>
<td>After investor has succeeded in initial investment project, he has right to get some new opportunities of investment in future.</td>
<td>Developer may purchase land in order to store for developing on large scale when the price of real estate market will raise in the future.</td>
</tr>
</tbody>
</table>

3.2. The applied case of real option theory in the investment decision of real estate project
3.2.1 Background material of the case

A real estate developer will make a investment decision to decide whether purchasing a urban land. This land would be developed by two phases, the first phase of development would be at the beginning of the first year, and the second phase would be at beginning of the fifth year. Assume the developer has two kinds of possibility to develop the land: (1)He only could get the investment right of the first phase; (2)He not only could get the right of
the first phase, but also get the right of second phase. The cash flow of two investment models forecasted by the developer is seen in figure 1 and figure 2. The developer pays 500 million yuan on transferring cost of the right of using the land and constructing cost at the beginning of the fifth year. From the end of the first year to the end of the fourth year, the income of selling the house after paying taxes is 100 million yuan, 200 million yuan, 300 million yuan, 100 million yuan. At the second phase, the developer pays 1500 million yuan on transferring cost of the right of using the land and constructing cost at the beginning of the fifth year. From the end of the fifth year to the end of the eighth year, the income of selling the house after paying taxes is 300 million yuan, 600 million yuan, 900 million yuan, 300 million yuan. Assume the capital cost of the real estate development is 20 percent ($K=20\%$).

3.2.2 Use the traditional $NPV$ method to appraise whether the investment project is feasible

If only getting the first phrase right of developing the land, then:

$$NPV = \sum_{t=0}^{4} (CI - CO) (1 + K)^{-t} = 444 - 500 = -56 ($\text{million} \cdot \text{yuan}) < 0$$

If getting two phrases’ right of developing the land, then:

$$NPV = \sum_{t=0}^{8} (CI - CO) (1 + K)^{-t} = -56 - 81 = -137 ($\text{million} \cdot \text{yuan}) < 0$$

Since the $NPV$ of two models is negative value, therefore, according to the traditional $NPV$ method, the developer should not purchase the land to develop the real estate project.

3.2.3 Use the real option theory to appraise whether the investment project is feasible.

If the real estate developer uses the real option theory, that is to say, when the future price of real estate market would be confirmed to rise and the developer could obtain profit from the project, the developer would invest the project on the second phrase at the beginning of the fifth year. As a result, investing a negative $NPV$ project at the first phrase would like to pay cost for selling the option, which would make the developer has the right and not the obligation to obtain profit from the investment opportunity at the second phrase. The developer should pay the cost of 56 million yuan (which is the $NPV$ of the project at the first phrase) in order to obtain the option of growth at the second phrase, and the more uncertainty of future price of the real estate market, the higher the value of the option. Therefore, the project could essentially be seen as the option of growth, its exercise price is 1500 million yuan which should be paid as transferring cost of the right of using the land and constructing cost at the beginning of the fifth year at the second phrase. The cash flow of the project at the second phrase could
be discounted to the beginning of the first year, which could be counted as follow:

\[
V_0 = \sum_{i=5}^{8} (CI - CO) \cdot (1 + K)^{4-i} \cdot e^{-4K} \\
= \left( \frac{300}{(1 + 20\%)^4} + \frac{600}{(1 + 20\%)^3} + \frac{900}{(1 + 20\%)^2} + \frac{300}{(1 + 20\%)^1} \right) e^{-4 \times 0.2} = 598.5\text{ million yuan}
\]

Assume in this project that Black-Scholes model parameters are as follow:

- Cash flow's discount value of the project \( V_0 \) = 598.5 million yuan;
- Exercise price \( E \) = 1500 million yuan;
- Standard deviation \( \sigma \) = 0.35;
- No risk interest rate \( r \) = 10%;
- Expiration rate \( t \) = 4 years.

The value of the growing option \( C \) in the project could be counted according to Black-Scholes model as blow:

\[
C = V_0 \cdot N(d_1) - E e^{-rt} \cdot N(d_2)
\]

in this formula

\[
d_1 = \frac{\ln\left(\frac{V_0}{E} + (r + \frac{1}{2} \cdot \sigma^2) t\right)}{\sqrt{\sigma^2 \cdot t}}
\]

\[
d_2 = d_1 - \sqrt{\sigma^2 \cdot t}
\]

The result is:

\[
d_1 = \frac{\ln\left(\frac{598.5}{1500} + (0.1 + \frac{1}{2} \times 0.35^2) \times 4\right)}{\sqrt{0.35^2 \times 4}} = -0.39
\]

\[
d_2 = -0.3911 - \sqrt{0.35^2 \times 4} = -1.09
\]

\[
N(d_1) = N(-0.39111) = 0.5 - 0.1517 = 0.3483
\]

\[
N(d_2) = N(-1.09111) = 0.5 - 0.3621 = 0.1379
\]

\[
C = 598.5 \times 0.3483 - 1500 e^{-0.1 \times 4} \times 0.1379 = 208.46 - 138.66 = 69.80\text{ million yuan}
\]

the expanding NPV = traditional NPV + real option value \( C \) of the invested project

\[
= -56 + 69.8 = 13.80\text{ million yuan} > 0
\]

After considering the real option value of the invested project, the expanding NPV of the project is positive number. Obviously, the traditional NPV method underestimates the value of the invested project.

Therefore, according to the real option theory, the real estate developer’s tactic for the project is:

(a) If only getting the first phrase right of developing the land, the developer should give up the project;
(b) If getting two phrases’ right of developing the land, the developer should first purchase the land to develop the project. Four years later, if the future price of real estate market would be confirmed to rise and the developer could obtain profit from the project, the developer would develop the land on the second phrase at the beginning of the fifth year; if the future price of real estate market would be confirmed to go down and the developer couldn’t obtain profit from the project, he should give up the right of developing the land at the second phrase.

4 conclusion

In brief, the real option theory could better deal with the uncertainty problems during project investment decision of real estate development. The real option theory would bring about a revolutionary reform in the field of real estate investment decision.

References