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Risk Decision Analysis of Commercial Real Estate

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ABSTRACT

With the increasing of construction of logistics parks, it is essential for commercial real estate project to study on risk decision to avoid redundant and blind construction. Based on risk essence, the paper analyses the attitude of investment decision-makers on risk benefits. Finally, the paper improves the expected utility theory and applies the prospect theory to risk decision of commercial real estate project to provide scientific and objective basis for Project Investment Decision.

Keywords: Commercial Real Estate; Project Investment; Risk Benefit; Prospect Theory; Risk Decision

1. Introduction

The commercial real estate is a multidisciplinary and multi-industry comprehensive and cross complex with wide coverage and high technology content. Its structure is complicated and uneven with strongly relevance with each other, which makes the construction of commercial real estate have characteristics of large investment capital, long development period, high technical requirements, many influencing factors, long-term effects and others. Therefore, the construction of commercial real estate is complicated system engineering, and the manager will face many risk factors and decision problems from the project approval to the delivery and use of project.

For an uncertain event, the previous researches emphasize that the manager should adopt correct risk analysis and decision methods. Therefore, theoretical methods on this aspect are becoming more and more improved and have been applied in practice to some extent. However, practices indicate that one successful risk decision depends on that whether the decision maker will chose reasonable risk analysis methods and decision methods, as well as on the decision maker's personal attitudes on risk, his personal experiences, ability, characters and other factors. However, the latter factors are seldom involved in past researches on risk decision methods.

2. Nature of Risk

In investment activities, when the investors make risk decisions, most of them pursue the risk benefits under uncertain conditions, i.e. unexpected excessive benefits and unexpected loss of benefits which might be borne. Quantitatively, the risk benefits will be reflected as the positive and negative differences between the benefit bodies' expected benefits and actual benefits.

Therefore, the risk decisions are usually made on the basis of risk benefits, and we will discuss the nature of risk in the following paragraphs.

When people analyze decisions, the nature of risk is risk benefit. Therefore, in actual investment activities and all decisions are around benefit. If there is no expected benefit, few investors will make risk decisions, therefore risk is risk benefit in nature. In past definition of risk, people used to emphasize the uncertainty of risk losses.

In Economic Risk Theory, Wu Ming thinks that in the production and circulation of commodities, all kinds of unexpected (uncertain) factors might cause differences between the commodity producers and marketers' actual benefits and expected benefits, bringing opportunities or possibility for them to suffer economic risk losses or obtain extra benefits. In Risk Benefits Theory, Ma Yan defines the nature of risk as: ① The fundamental reason for making risk decision is the uncertainty of benefits. ② The risk itself is the change process of uncertainty of benefit. ③ The results of risk process are results of uncertain benefits. ④ The risk avoidance originates from the uncertainty of benefits[1].

Risks exist objectively, which are only different in different construction projects on certain degree. However, even for one given investment project, and the size and degree of risk are certain, different decision makers of commercial real estate construction might choose different risk decision modes due to their different risk benefit preferences. At the same time, we can say that the amount of unexpected extra benefits that risk decision makers hope to obtain and amount of unexpected benefit

losses that risk decision makers are ready to bear have primarily determined the construction direction and mode of commercial real estate. Therefore, after risk analysis, it is necessary to dig the risk decision makers' risk benefit preferences and effects. Only making risk decisions from the angle of the investors has concrete application value.

The famous Nobel Prize Winner in Economic Sciences Arrow has divided people's attitudes towards risk into three types: risk preference type, risk aversion type and risk neutrality type.

Here in this article, to facilitate the theoretical analysis, the attitudes of risk benefit main bodies are divided into three types:

The preference type refers to that the risk decision makers have great hope on the relatively higher risk gain in commercial real estate construction activities, and to fulfill this hope, they are ready to take great risks while neglect the risk losses.

The aversion type refers to that the decision makers in commercial real estate construction might obtain risk gain, but as long as certain risk exists, they are willing to obtain the risk benefits for correspondent part of risk, rather than bearing the risk losses.

The neutrality type refers to people between the above-mentioned two types of people. When making risk decisions on commercial real estate construction, they are neither willing to take risks to obtain risk benefits, nor passively avoid the risk gain, but they take neutral attitudes, usually choose a neutral value between the risk benefit and risk loss.[2]

3. Expected Utility Theory

The risk benefit attitude refers to the decision maker's subjective attitudes towards risks, which is insistent with people's utility concepts. Therefore, the risk attitude can be measured with the utility. The "utility" under general meaning refers to psychological satisfaction or satisfactory degree that people produce since they own or use certain articles. In this article, the decision maker's subjective sense on risk benefit is called as "utility". In the rectangular coordinate system, if the horizontal coordinate X refers to risk benefit (risk gain +RR, risk loss-RR), and the vertical coordinate refers to the Utility U of risk results (x), we can draw the risk utility curve.

Different risk decision makers' risk benefit preferences cause the diversity of different decision makers' utility functions and the utility curve might differ in thousands of ways. The above-mentioned three types of people who have different attitudes towards risk benefits must have three different utility concepts. If these different utility concepts are reflected on the utility curve, we can draw three different utility curves, see **Figure 1**.

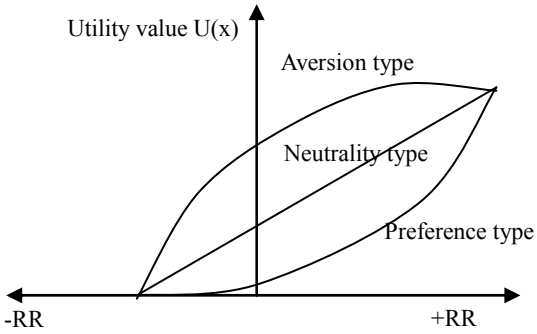

Figure 1. Utility curves of different risk preferences.

Through comparison of three curves in the figure we can see that: faced with risk decision, people who disgust risk benefits are relatively sensitive to risk losses, while react to risk gain slowly. They do not seek huge profits, but try to avoid risks. On the contrary, people who prefer risk benefits are relatively sensitive to risk gain, while react to risk losses slowly. They are bold to pursue risk benefits. The risk benefit neutral's decision-making behavior is between the above-mentioned two. They hold neutral attitudes towards risk benefits, will neither excessively pursue risk gain, nor excessively avoid risks.

4. Application of Prospect Theory in Risk Decision in the Commercial Real Estate Investment Construction

4.1. The Prospect Theory has Improved the Utility Theory

The above analysis is just under ideal conditions, while in actual commercial real estate construction activities, the risk decision makers' attitudes towards to risk benefits are not unchangeable. They might belong to risk benefit preference type when faced with certain risk, or belong to risk benefit aversion type when faced with other risks. In same investment activity, some people might prefer the risk gain completely, while they do not consider the risk losses. At the same time, no people will consider the risk gain without aversion of risk losses. People's basic objectives for risk decision are: how to reach the most satisfactory risk gain at the time or reducing the risk losses minimally as possible. In reality, what about most people's risk benefit preferences and utility. In the following paragraphs, we will discuss these issues with the introduction of Prospect Theory.

Since 1970s, a great number of empirical researches have indicated the complex of people's decision behaviors, and new theoretical analysis is in urgent need to guide people's decision behaviors. The 2002 Nobel Prize Winner in Economic Sciences Dainiel Kahneman and Amos Tvrsky have officially put forward the new Prospect Theory on risk decision in 1979 on the basis of

complex of people's decision behaviors and in combination a great number of with their own psychological researches. [3]

The Prospect Theory has effectively combined the psychological researches and economical researches, revealed the decision mechanism under uncertain conditions and developed a new research field. Based on a great number of empirical researches, the Prospect Theory has raised lots of valuable laws. Generally, there are three basic laws in the Prospect Theory: (a) most people belong to risk avoidance type when faced with gain; (b) most people belong to risk preference type when faced with losses; (c) people are more sensitive to loss than to gain.

Through the above analysis and application of it into Utility Theory, in the article we get the utility curves of most people's risk benefit preferences as demonstration in **Figure 2**:

Curves of most people's risk utility functions are "S" type, therefore, we can see that most people belong to risk aversion type when faced with risk gain, while belong to risk preference type when faced with risk losses. They are more sensitive to risk loss than to risk gain.

For example: one investment company is faced with two commercial real estate investment program (A is on hotel, B is on office building), and the company's funds are only enough for investment on one of the two. Through risk analysis, the probability to gain RMB 10 million Yuan through Program A is 1, while probability to gain RMB 20 million Yuan through Program B is 0.5 and the probability to gain no benefits is also 0.5. Though the expected value of the two Program is same, most decision makers with choose Program A, which indicates that faced with rise gain, most decision makers belong to risk aversion type. If the decision maker of the investment company is faced with the two following decisions, probability to loss RMB 10 million Yuan through Program A is 1, probability to loss RMB 20 million Yuan through Program B is 0.5 and the probability to suffer no loss is also 0.5. The expected value of the two decisions are same, while most decision makers choose Program B, which indicates that faced with risk loss, most decision makers belong to risk preferences.[4]

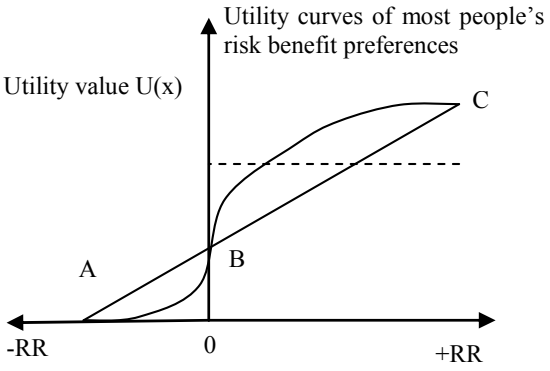

Figure 2. Utility curves of risk benefit preferences.

In actual risk decisions, the loss and gain are not absolute. People avoid risk when faced with gain, while prefer risk when faced with loss. However, the Prospect Theory also indicates that the loss and gain are in relative to the reference point. If people's viewpoints on assessment of things change, change people's risk attitudes will also change.

For example, when the investment company is faced with the above two investment decisions, if the probability to gain RMB 20 million Yuan through Program A is 1, while the probability to gain RMB 30 million Yuan through Program B is 0.5 and the probability to gain RMB 10 million Yuan through Program B is also 0.5. At this time, if the profit goal of the investment is relatively low, for example RMB 10 million Yuan, it seems that the company can gain extra RMB 10 million Yuan through Program A, while the company can either just reach its gain goal or gain extra RMB 20 million Yuan through Program B. It seems the company will gain no matter adopting Program A or Program B. at this time, most employees are unwilling to take risks and they will choose Program A. On the contrary, if the company goal is relatively high, for example RMB 30 million Yuan, then the company will either gain less RMB 10 million Yuan through Program A, or will just reach the goal or gain less RMB 20 million Yuan through Program B. At this time, the company will suffer loss through both programs; most employees will take risks to choose the risk investment Program B thinking that they might reach the goal. Therefore, the investment risk decision maker can completely change employees' attitudes towards risks through changing of their profit goals.

Therefore, the above case indicates the importance of utility function, and the utility values of same expected value are different under different environments or different reference points.[5]

4.2. Application of Prospect Theory

The utility curves of different risk decision makers are different, even the same risk decision maker might produce different utility curves due to different environments. However, in this article, we only discuss the application under utility curves of most investment decision makers.

The utility function curves can be gathered through questionnaire surveys, inquiries, psychological tests and other methods, among which the most common abroad is the Von Neumann Method.

This method was raised Von Neumann and Oskar Morgenstern in the book The Theory of Games and

Economic Behavior that they jointly issued in 1944. According to this method, the deterministic profit and loss value equal with the risk expected profits and loss are obtained through psychological tests, which are used as standards for one-time decision. Generally, this method is also called as standard gamble method, the NM Method for short.

It generally includes two steps to determine the utility functions through the NM Method: the first step is to determine two risk benefits values as the reference points and the utility values of the two points. Generally 1 is used to indicate the maximum utility value of optimal result, 0 indicates the minimum utility of worst result. The second step is to determine the utility values of all other benefits between these two extreme risk benefits. According to the NM Method, the determination of utility value is on the basis of concept of equivalence point and others. The decision maker should choose from the following two programs.

Program A: gain risk benefit X1 through probability p, at the same time, gain benefit X2 through probability 1-p, and the correspondent given utility values are respectively U(X1) and U(X2).

Program B: to gain benefit X3 through probability of 100% (X1 <X3< X2).

To determine the equivalence point between Program A and Program B, we can adjust the benefit value X3 of Program B and inquire the decision maker repeatedly, until the utilities of Program A and Program B are equal to the decision maker, that is to say, we have find the equivalence point X3 and made U(X3) =p*U(X1)+(1-p)* U(X2).

Through the NM Method, we can calculate the utility function of risk decision makers' attitudes towards risk benefits, that is to say, express the risk attitudes of decision makers through quantitative mode, thus calculate the expected utility value and determine the optimal program for risk decision. In the following paragraph, we will introduce the concrete application through examples.

One investment company has obtained a plot of good land through competitive bidding, and there are three investment programs for this plot of land: the first one is to construct hotel property. The second one is to construct office buildings, and the third one is to develop combined property, which will be transferred under legal permissions after certain time. The market conditions and risks for each development program are different from those of others and the risk benefits to be gain are also different from others. Through risk analysis, we can get the risk benefits and probabilities for the risk benefits to happen of the above-mentioned three development programs, as demonstrated in **Table 1**, **Table 2** and **Table 3**.

According to principle of NM Method, suppose the maximum utility value of risk gain is 1 under the whole risk environment, which is U (X = 2.5 million) = 1; the maximum utility value of risk loss is 0, which is U (X = -1.0 million) = 0; the utility value of others are determined through the utility curves determined according to the NM Method, we get data as demonstrated in **Table 1**, **Table 2** and **Table 3**. Through data in the tables we can calculate the risk decision maker's expected utility value for three programs and their choices of risk programs. The risk benefit preference utility curves as **Figure 3**:

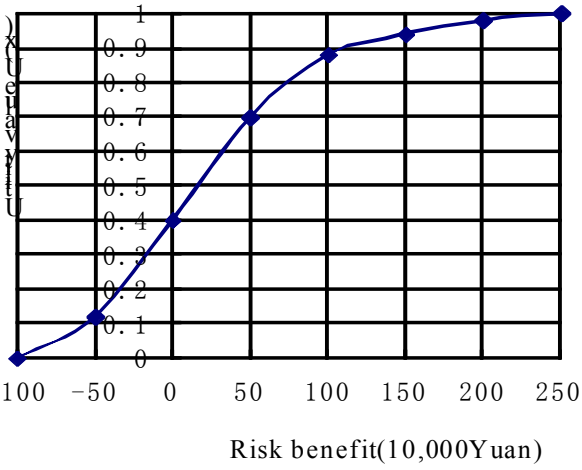

Figure 3. Risk benefit preference utility curves.

Table 1. Risk benefits, probability and utility value in program 1.

Risk benefit (10,000Yuan)	-100	-50	0	50	100	150	200	250
Probability value	0.05	0.05	0.1	0.1	0.15	0.15	0.35	0.05
Utility value	0	0.12	0.4	0.7	0.88	0.94	0.98	1

Table 2. Risk benefits, probability and utility value in program 2.

Risk benefit (10,000Yuan)	-50	0	50	150	200
Probability value	0.05	0.1	0.1	0.55	0.2
Utility value	0.12	0.4	0.7	0.94	0.98

Table 3. Risk benefits, probability and utility value in Program 3.

Risk benefit (10,000Yuan)	100
Probability value	1
Utility value	0.88

Expected utility value of Program 1:

EUV1=0×0.05+0.05×0.12+0.1×0.4+0.1×0.7+0.15×0.88+0.15×0.94+0.35×0.98+0.05×1=0.914

Expected utility value of Program 2:

EUV2=0.05×0.12+0.1×0.4+0.1×0.7+0.55×0.94+0.2×0.98=0.829

Expected utility value of Program 3:

EUV3=0.88×1=0.88

According to the principle of priority to expected utility optimal one, most decision makers choose Program 1 as the optimal program. [6]

Of course, the above statements are just the analysis of decision behaviors that the utility curves of most risk decision maker's risk benefit preferences are obtained according to the Prospect Theory. However, different people have different risk preference utility curves, in reference to the above methods, we can draw the risk utility curves of difference people (risk preference type, risk aversion type and risk neutrality type) according to concrete environments of project investment and difference people's attitudes towards risk, and calculate the expected utility value to guide risk decision-making. Since we cannot determine the utility function curves precisely, the risk management personnel of commercial real estate should not depend much on this method to make risk decisions under circumstance that there is small difference between the expected utilities. However, since the expected utility theory points out people's attitudes towards risk benefits, and their attitudes to measure the risk benefits they face with utility, it's an effective method. This method is not only limited to application in risk decisions in commercial real estate construction, but also can be applied in all project risk decisions.

The Prospect Theory is the further research of Utility Theory, according to the Prospect Theory: first, people's decision-making process can be divided into two steps: the first step is the occurrence of random event and people's collection and classification of the results of event and related information. The second step is to assess the decision.

Second, the risk decision makers do not care the absolute value of wealth itself, but care the relative variable quantity W of wealth relative to the reference point. This reference point is usually the decision makers' current wealth level, and the decision maker defines the gain and loss in comparison to the reality. However, this reference level might be certain desirable level, which refers to the wealth level that the participators work hard to gain under current given wealth and expected conditions.

Third, the difference between the Prospect Theory and Utility Theory is that the value function is not equal with the utility function. According to the Prospect Theory, people's utility is described through two variables: weighting function and subjective value function. The weighting function $\prod(p)$ describes the impact of change of probability of single event on the overall utility in future Prospect Theory. the subjective value function $V(x)$ directly reflects the relationship between the prospect result x and the size of people's subjective satisfaction. In the Prospect Theory, the value function curve is as demonstrated in **Figure 4**:

In the value function of Prospect Theory, there is one reference point for increase of decrease of wealth, and the position of this point depends on the decision makers' subjective impressions. The value function is notching under the profit domain, while is protruding downwards under the loss domain. What the value function demonstrates is that with the same difference of 5 dollars, the difference of subjective value between 10 dollars and 15 dollars is larger than the difference of subjective value between 10 dollars and 105 dollars. Under circumstance of losses, this nature still exists.

According to the Prospect Theory, people's attitudes towards risks not only depend on the utility function, but is also decided jointly by the value function and weighting function. In this article, we only study the impact of Prospect Theory on risk decisions, and the concrete quantitative methods will be discussed in future study. Through the above-mentioned joint study and application of Prospect Theory and Expected Utility Theory, we can summarize the laws of most decision makers' decisions when faced with risk.

When the commercial real estate construction decision makers makes risk decisions, they are easy to overestimate the small probability events while underestimate large probability events. They usually belong to risk avoidance type when faced with risk gain, while belong to risk preference type when faced with risk loss, and they are more sensitive to risk loss than to risk gain. When the decision maker is faced with risk, he should not only consider the risk utility, but the decision-making is also related to the decision makers' wealth condition, the incentive and restraint system. They consider the relative variable quantity of wealth more. When the investment operation fails, especially is close to bankruptcy,

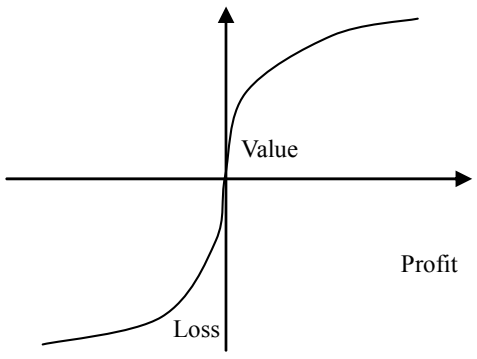

Figure 4. Value function curve.

the decision maker usually tends to take a risk when faced with risk. On the contrary, when the investment operates smoothly, the decision maker usually tends to avoid the risk when faced with risk.[7]

5. Conclusions

The commercial real estate project is characterized by large investment, long period and long-term effect, with relatively big risk. To avoid the reconstruction of commercial real estate project and effectively stop blind construction, it is extremely necessary to study and analyze the risk decision problems of property project. In this article, we introduce the Prospect Theory into the risk decision in commercial real estate investment through analysis of decision makers' risk attitudes and preferences. The Prospect Theory can better reflect reasonable people's decision behaviors under uncertain risk conditions, thus can make the investment decision on commercial properties more scientific and more objective. This theory can also be applied in the risk decision of other investment projects.

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