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Research of Investment Evaluation of Agricultural Venture Capital Project on Real Options Approach

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Abstract

Under the current agricultural conditions of shortage of funds, the traditional evaluation methods, such as the net present value (NPV) method, do not account for flexibility or uncertainty. Real Options Approach (ROA) rises from the doubt of NPV method, and can make up for it in evaluating agricultural venture capital projects. This thesis analyses the limitations of the traditional evaluation methods and the significance of Real Options Approach to investment evaluation of agricultural venture capital projects, and illustrates the application of Real Options Approach to investment evaluation of agricultural venture capital projects with Binomial Option-Pricing Model and Black-Scholes Option-Pricing Model.

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Keywords: Real Options Approach; Investment evaluation of agricultural venture capital project; Net present value method; Binomial Option-Pricing Model; Black-Scholes Option-Pricing Model

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1. Introduction

From the traditional point of view, venture capital seems difficult to apply to the agricultural field. It is generally believed that agriculture is closely related to people's lives, mainly being used to resolve the people's food, clothing and other issues, so agriculture is not a venture investment. However, after 2000, the situation is changing. The upgrading of agricultural industry is increasingly prominent, which not only makes agricultural investment opportunities increased, but also provides good investment value for agriculture. Investment evaluation is the most important part of the venture capital operations and also an important prerequisite for the success of investment operations. That is to say, we must pay attention to the investment evaluation of agricultural venture capital project. Although the net present value (NPV) method is widely used for making investment decisions, a disadvantage of NPV method is that it does not account for flexibility or uncertainty. Real options approach (ROA) rise from the doubt of NPV method, and can make up for it in evaluating agricultural venture capital projects.

Based on the financial option theory, which is a very common and useful tool in financial and commodity markets, ROA has been developed greatly. Financial option is the right, not the obligation, to buy or sell a stock at a given price within a certain period of time. If the option is not exercised, the only loss for it is the price of the option, but the upside potential is considerable. As far as real options, they are referred to as "real" because they usually pertain to tangible assets, such as capital equipment, rather than financial instruments. ROA is treating investment opportunities and the different types of managerial flexibility as options and valuing them with option valuation models. Taking into account real options can greatly affect the valuation of potential investments. Oftentimes, however, valuation methods, such as NPV, do not include the benefits that real options provide^[1].

ROA is a comprehensive and integrated solution to apply options theory to value real investment projects to improve the decision-making process. Real Options, generally including growth option, defer option, switch scale option and abandon option, is related with different kinds of investment situations in business.

At present, ROA has been extended to a considerable number of applications. The practice of real options approach has played a positive role in enriching the theory of real options. Therefore real options, just as the same as financial options, is not only the right to investment, but also gradually become a kind of investment philosophy. Although real options theory is increasingly used in industry, it has not been applied in the investment evaluation of agricultural venture capital project. But, as will be argued below, agricultural venture capital project is ripe for this methodology.

2. The Significance of ROA in Investment Evaluation of Agricultural Venture Capital Project

At present, the approach to investment evaluation of agricultural project is NPV method. It is a traditional evaluation method used in the discounted cash flow measurement methodology, whereby the following steps are undertaken: The first step is to calculate the expected free cash flows that result out of the investment; The second step is to discount for the cost of capital; The final step is to subtract the initial investments, and the end result is NPV. If the NPV of a prospective project is positive, it should be accepted. However, if NPV is negative, the project should probably be rejected.

What are the limitations of NPV when evaluating agricultural investment project? NPV is not flexible and only uses information available at the time of the decision. It does not account for changes to the projects after the initial decision being made. Try real option analysis instead if you want to get around this problem.

2.1 ROA Takes Account of the Value in Future of Agricultural Venture Capital Project.

NPV method only emphasizes that a prospective project must be positive. The traditional discount cash will not recommend to embed an option to expansion which is expected to be negative^[2]. But the expansion is an option, not an obligation. However, in fact, not all agricultural venture capital projects could make a profit immediately, because the sustainable development need to be considered. For example, if the agricultural project of seed-improvement, as a long-term project, succeeds, it will greatly improve the food production and increase farmers' income. Real options approach can make up for the deficiencies of NPV, which greatly enhance the accuracy of investment decisions.

2.2 ROA Focus on Irreversibility of Investment in Agricultural Venture Capital Project.

NPV method has such a hypothesis that the investment is reversible, and the investment can not be delayed. But in reality, the majority of investment projects are irreversible. This is one of the major theoretical flaws of NPV

method. Real options approach reputes that, in most cases, although the investment is irreversible, investment could be postponed. Many uncertainties in the environment may eventually be eliminated.

2.3 ROA Carries on the Decision-making from Dynamic Angle.

NPV method ignores the strategic value of projects, such as the opportunity to expand into a new market, to develop natural resources or technology. By taking this method, administrators will have to consider questions from the static angle, and think that the cash flow of investment is fixed, only make decision whether to accept the investment immediately or not. On the contrary, ROA carries on the decision-making from dynamic angle. What ROA obtains is the expansion of NPV, which include traditional NPV and the value of options. Taking the project of converting cultivated land into forests for example, its current NPV may be negative, but it is very important for improving the ecological situation, adjusting the industrial structure.

2.4 ROA Takes into Consideration the Flexibility of Agricultural Venture Capital Project.

NPV method does not allow for the management flexibility that is often present. Many investment opportunities have options embedded in them and the traditional NPV misses this extra value because it treats investors as passive. However, by using ROA, administrator can adjust value by reacting to changing conditions. For example, they could expand operations of the project if the outlook seems attractive, while reduce the scope of activities if the future outlook is unattractive. When considering uncertainty and managerial flexibility, NPV does not properly capture the non-linear nature of the cashflow distribution or the changing risk profile over time. In fact, the agricultural reproduction process is the process that the social economy reproduction and the nature reproduction are interwoven, so the benefit of agricultural project has the big instability. ROA takes into consideration the flexibility of agricultural project investment, which conforms to the characteristic of agriculture venture capital project evaluation.

3. Steps of ROA to Investment Evaluation of Agricultural Venture Capital Project

Three critical steps to consider when application of real options approach to investment evaluation of agricultural venture capital projects:

3.1 To Recognize the Real Option of Agricultural Venture Capital Project

There are many factors to be considered when real options approach is applied, therefore, it is indispensable to recognize the real options from agricultural project investment. In many cases, agricultural venture capital projects includes more than one decision-making, accordingly the application of real options approach includes a series of options. Furthermore, the process to make profit by investment of agricultural projects obviously has different stages, which makes the investment decision-making dynamic and forms a lot of options. Actually, from the point of view of real options, a considerable part of the value in investment evaluation of agricultural projects consists of the integration of options.

3.2 To Choose a Correct Option-Pricing Model in order to Calculate the Value of Option

The step after recognizing the real option of investment evaluation of agricultural project is to choose a correct option-pricing model, to determine the inputs of the model and to calculate the value of option. In this thesis, Black-Scholes Option-Pricing Model and Binomial Option-Pricing Model are taken for example. Different measurement should be chosen according to different cases.

3.3 To Calculate the Result

Real Options are not a replacement for NPV method, but a project's total value should encompass both NPV and Real Options.

Value of project = Traditional NPV + Value of Real Option

An administrator makes the decision according to the value of project, but not the traditional NPV. That is, if value of project is positive, it should be accepted. However, if value of project is negative, the project should probably be rejected.

The last step of application of ROA is to make a decision on projects, to decide if superaddition of investment is feasible, to see if possible to make more positive use of uncertainty. After several repetition of the process above mentioned, we can finally increase enormously the value of investment to agricultural venture capital projects. To sum up, real options approach offers a new point of view on investment evaluation of agricultural projects.

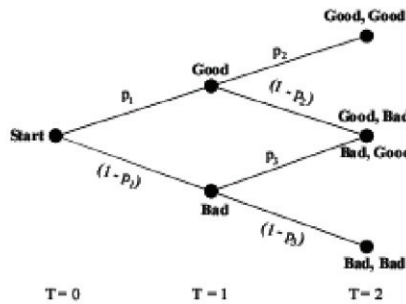
4. Analysis of Application

This thesis illustrates the application of Real Options Approach to investment evaluation of agricultural venture capital projects with Binomial Option-Pricing Model and Black-Scholes Option-Pricing Model.

4.1 Analysis of Application by Binomial Option-Pricing Model

The binomial option-pricing model is currently the most widely used real options valuation method. The binomial option-pricing model describes price movements over time, where the asset value can move to one of two possible prices with associated probabilities. Figure 1 represents the binomial option-pricing model process through a decision tree.

Figure 1 The Binomial Option-pricing Model^[31]



Since an option represents the right but not the obligation to make an investment, the payoff scheme to the option-holder is asymmetric. A brief study of the decision tree shows that time and the range of outcomes are key to option value.

The following formula to compute the expectation value is applied at each node:

Binomial Value = [p × Option up + (1-p) × Option down] × exp (- r × Δt), or

$$f = e^{-r\Delta t} [p f_u + (1-p) f_d]$$

1

where

2

An example is taken to analyze of application by Binomial Option-Pricing Model.

It is supposed that the present value of an agricultural venture capital project is 2 million yuan. There are two possibilities in annual operating. One possibility is that the value of the project is in growth by 8%, which is based on the present value. Another possibility is that the value of the project is in negative growth by -6%. Investors can sell the project at the price of 1.8 million after 2 years. A risk-free interest rate is 5%. The question is what the value in the right to sell the project is.

This is a typical real option, We use Binomial Option-Pricing Model for it.

Unit: 10,000 yuan

	198.72		0
216		C ₁	
200	203.04	C	0
188		C ₂	
	176.72		3.28

$$P = (1.05 - 0.94) / (1.08 - 0.94) = 0.786 \tag{3}$$

$$C_1 = 0 \tag{4}$$

$$C_2 = (0.786 * 0 + 0.214 * 3.28) / 1.05 = 0.668 \tag{5}$$

$$C=(0.786*0+0.214*0.668)/1.05=0.136$$

6

That is to say, the value of the right to sell the agricultural venture capital project is 1360 yuan. When administrators make a decision, they must take it into account.

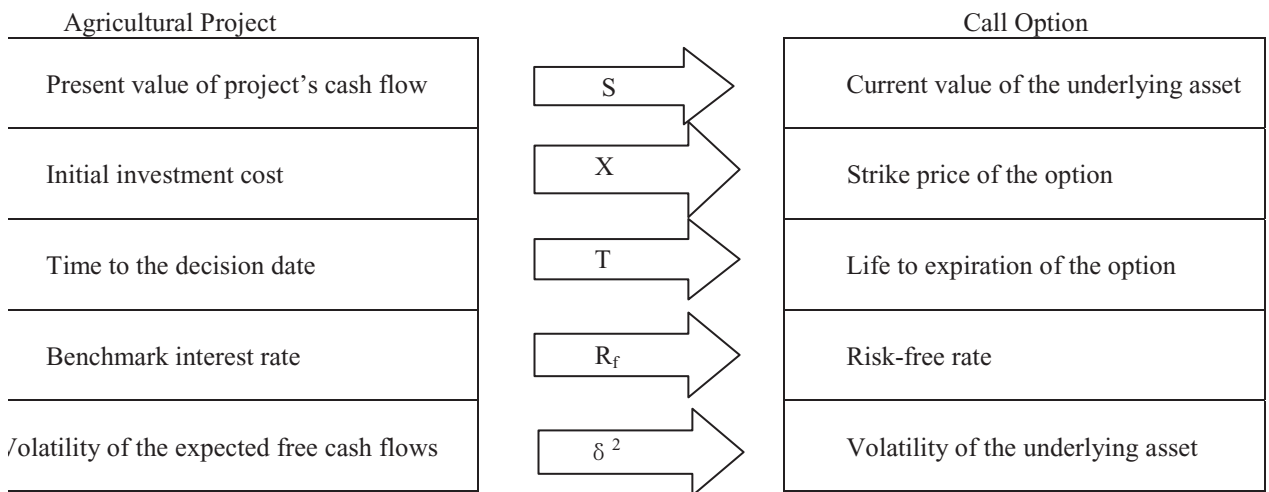
4.2 Analysis of Application by Black-Scholes Option-Pricing Model

The widely known Black-Scholes Option-Pricing model is a narrow case of the binomial model .The drivers of option value can be condensed into five simple inputs^[4]:

- (1) Current value of the underlying asset (S)
- (2) Strike price of the option (X)
- (3) Time to expiration (t)
- (4) Risk-free interest rate (R)
- (5) Variance in the value of the underlying asset (δ^2)

Conveniently, these variables can be translated directly into investment evaluation of Agricultural Venture Capital Project. (Figure 2.)

Figure 2 Variables of Black - Scholes Model



This thesis takes an example to analyze of application by Black-Scholes Option-Pricing Model.

A production-line expansion project of dehydrated vegetable: The total investment (that is, the initial investment costs) is 141 millions yuan, in which 129 millions yuan in fixed assets, 12 millions yuan in liquid capital. Assuming that the salvage value of fixed assets is estimated to be 0, and the project will have been at the leading level in countrywide in two years. Basic data of the project such as the following table:

Basic Data of the Project

Counting period of Project	Annual sales revenue	Annual production cost	Benchmark interest rate	Volatility
12 years	60 million yuan	40 million yuan	10%	0.2

(1)Decision-making process by traditional NPV method:

$$\begin{aligned} \text{Present value of income} &= (60,000,000 - 40,000,000) \times (P/A, 10\%, 12) + 12,000,000 \times (P/F, 10\%, 12) & 7 \\ &= 20,000,000 \times 6.814 + 12,000,000 \times 0.319 \\ &= 140,108,000 \end{aligned}$$

$$\text{NPV} = 140,108,000 - 141,000,000 = -892,000 \quad 8$$

NPV is negative, the project should be rejected.

(2)Decision-making process by ROA:

In present case, the project keeps ahead within two years in countrywide, which means owing a defer option.

According to Black - Scholes Model, variables are as follows:

Current value of the underlying asset (S)=Present value of income=140,108,000

Strike price of the option (K)=Initial investment cost=141,000,000

Volatility of the underlying asset (δ)=Volatility of the expected free cash flows=0.2

Life to expiration of the option (t)=Time to the decision date =2

Risk-free rate of interest (r)=Benchmark interest rate =10%

Taking the inputs into the following Model:

$$c = SN(d_1) - Xe^{-r(T-t)}N(d_2) \quad 9$$

$$d_1 = \frac{\ln(S / X) + (r + \sigma^2 / 2)(T - t)}{\sigma\sqrt{T - t}} \quad 10$$

$$d_2 = \frac{\ln(S / X) + (r - \sigma^2 / 2)(T - t)}{\sigma\sqrt{T - t}} = d_1 - \sigma\sqrt{T - t}$$

$$\text{Namely, } d_1 = \ln(140,108,000/141,000,000) + (0.1 + 0.2^2 / 2) \times 2] / (\sqrt{2} \times 0.2) = 0.83 \quad 11$$

$$N(d_1) = 0.7967$$

$$d_2 = 0.73 - 0.2 \times \sqrt{2} = 0.55$$

$$N(d_2) = 0.7088$$

$$C = 140,108,000 \times 0.7967 - 141,000,000e^{-0.1 \times 2} \times 0.7088 = 29,799,437.15 \quad 12$$

$$\begin{aligned} \text{Value of project} &= \text{Traditional NPV} + \text{Value of Real Option} & 13 \\ &= -892,000 + 29,799,437.15 \\ &= 28,907,437.15 \end{aligned}$$

Value of project is positive, so it should be accepted.

It indicates that value of this project is positive, which does not mean that this project may be accepted and invested immediately. The reason is that the value of real options (that is 29,799,437.15 Yuan) comes from the detention investment. Namely, in the above value assessment, we make a hypothesis that the investor can retard this investment at any moment in term of two years. This result shows the value of taking the flexibility and the option in to account. The positive value means we should hold the option of this project investment, wait to invest, but not abandon the project simply.

5. Conclusions

In conclusion, real options approach offers a new point of view to investment evaluation of agricultural project. It takes consideration of uncertain factors, forecasts the value of opportunity. The application of real options approach on investment evaluation of agricultural venture capital project helps government, investors and operators get ideal benefit by reducing maximally risks. But, in the meanwhile, the application of the theory of real options approach is not subject to denial of traditional approaches. On the contrary, it keeps the reasonable essence of the traditional method and serves it as a basic, breaks through inherent limitation of the traditional method, makes investment decision-making more reasonable and brings the idea renewal of investment decision-making theory.

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