# Research of Investment Evaluation of Agricultural Project on Real Options Approach

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**Abstract:** This paper focuses on the significance and steps of real options approach to investment evaluation of agricultural projects, and analyses an example. Real options approach offers a good solution on the uncertain problems that traditional net present value method can not solve and provides a new way out for the business strategy in the uncertain environment and flexibility of management on agricultural project investment.

**Keywords:** Real options approach, Investment evaluation of agricultural project, Net present value method

## 1 Introduction

China has large population but shortage of resources. Under the current agricultural conditions of shortage of funds, how to improve the economic benefits and capital utilization of agricultural project is particularly important. We must pay attention to investment evaluation of agricultural 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 projects.

ROA has been developed based on the financial option theory, which is a very common and useful tool in financial and commodity markets. A financial option is the right to buy or sell a stock, but not the obligation, at a given price within a certain period of time. If the option is not exercised, the only loss is the price of the option, but the upside potential is large. 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 effect the valuation of potential investments. Oftentimes, however, valuation methods, such as NPV, do not include the benefits that real options provide.

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

At present, ROA has been extended to a considerable number of applications. This practice of real options approach has played a positive role in richening the theory of real options. Therefore real options are as the same as financial options, 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 project. But, as will be argued below, agricultural project is ripe for this methodology.

## 2 The Significance of ROA in Investment Evaluation of Agricultural 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: Firstly, calculating of expected free cash flows that result out of the investment; Secondly, discounting for the cost of capital; Lastly, subtracting 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. NPV factors in risk by using a single discount rate, but in reality choices in the future concerning the project will likely change its payoffs and risk. 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 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. But the expansion is an option, not an obligation. However, In fact, not all agricultural investment projects could make a profit immediately, because agricultural projects have to consider the sustainable development. For example, the agricultural project of seed-improvement, a long-term project, if it succeeds, it will greatly improve the food production and increase farmer's income. Real options approach can make up for the deficiencies of NPV, greatly enhance the accuracy of investment decisions.

## 2.2 ROA Focus on Irreversibility of Investment in Agricultural 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 repute that, in most cases, although the investment is irreversible, investment could be postponed. Many uncertainties in the environment may eventually be eliminated. Considered deferment of investment decision-making, there will be more changes in value.

## 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. This method considers the question from the static angle, and thinks that the cash flow of investment is fixed, only makes 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 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. Management can add value by reacting to changing conditions, eg by expanding operations if the outlook seems attractive or reducing 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 cash flow distribution or the changing risk profile over time. In fact, the agricultural reproduction process is the process which 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 project evaluation.

# 3 Steps of ROA to Investment Evaluation of Agricultural Project

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

## 3.1 To Recognize the Real Option of Agricultural 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 projects includes always 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 paper, we take Black - Scholes model for example. There are several necessary inputs to make a correct option valuation. The version of the model presented by Black and Scholes was designed to value European options. The value of a call option in the Black-Scholes model can be written as a function of the following variables: Strike price of the option, Current value of the underlying asset, Life to expiration of the option, Volatility of the underlying asset and Risk-free rate of interest. Variables of Black - Scholes Model in both agricultural project and call option are as Table A.

**Table A: Variables of Black - Scholes Model**

| Agricultural Project | | Call Option |
|---|---|---|
| Initial investment cost | K | Strike price of the option |
| Present value of income | S | Current value of the underlying asset |
| Time to the decision date | t | Life to expiration of the option |
| Volatility of the expected free cash flows | δ | Volatility of the underlying asset |
| Benchmark interest rate | r | Risk-free rate of interest |

**3.3 To Calculate the Result on the Basis of NPV**
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
We make 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 super addition 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 projects.
It's necessary to point out that, except Black-Scholes Model, there still are other pricing models such as Binomial Option Pricing Model, which means we have choice to adapt different measurements according to different cases. To sum up, real options approach offers a new point of view on investment evaluation of agricultural projects.

# 4 An Example

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 table B:

**Table B: Basic Data of the Project**

| Counting period of Project | 12 years |
|---|---|
| Annual sales revenue | 60 million yuan |

| Annual production cost | 40 million yuan |
|---|---|
| Benchmark interest rate | 10% |
| Volatility | 0.2 |

Decision-making process by traditional NPV method :

Present value of income =(60,000,000-40,000,000)*(P/A,10%,12) +12,000,000*(P/F,10%,12)

=20,000,000*6.814+12,000,000*0.319

=140,108,000

NPV=140,108,000-141,000,000=-892,000

NPV is negative, the project should be rejected.

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%

$$d_1 = \left[\ln(S/K) + (r + \delta^2/2)t\right] / \sqrt{\delta^2 t}$$

$$= \left[\ln(140,108,000/141,000,000) + (0.1 + 0.2^2/2) \times 2\right] / (\sqrt{2} \times 0.2) = 0.83$$

$$N(d_1) = 0.7967$$

$$d_2 = d_1 - \sqrt{\delta^2 t} = 0.73 - 0.2 \times \sqrt{2} = 0.55$$

$$N(d_2) = 0.7088$$

$$C = SN(d_1) - X/e^{rt} N(d_2) = 140,108,000 \times 0.7967 - 141,000,000/e^{0.1 \times 2} \times 0.7088 = 29,799,437.15$$

Value of project = Traditional NPV + Value of Real Option =-892,000+29,799,437.15=28,907,437.15

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

It is to indicate 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. The value shows just because of the flexibility and the option. The positive value means we should hold the option of this project investment, wait to invest, but not abandon the project simply.

## 4 Conclusion

As 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 project hereby 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. In 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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