Evaluation of Enterprise Failed Project Resources Based on Real Options

Ye Jianmu, Lan Yongfeng
School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070
(E-mail: jianmuye@yahoo.com.cn, 1lanyongfeng@163.com)

Abstract In the business activities, there are a lot of failed projects. Failed project resources need to be re-optimized urgently. Because there are many uncertainties in business activities, traditional evaluation methods cannot correctly assess the value of failed project resources. Real options can be used to solve this problem. This paper presents a real options model in valuation of failed project resources in enterprise. This model solves the appraisal value of resources in failed projects of enterprises, especially the value of the resources in need of improvement.
Key words Enterprise failed projects; Resources in enterprise failed projects; Real options; A real options model in valuation

1 Introduction

Statistical data indicate that the success rate of enterprise projects is not too high, and more than one third of the projects are completely failed. Because of the large number of failed projects, there are also a large number of failed project resources in the mean time. It is imminent to assess the value of the failed project resources and re-use them.

After studying domestic and abroad research, we can learn that most research has focused on the causes of failed projects and counter measures, and there are many achievements, which apply theories and methods of operations research and other relative research, in the project resource allocation and scheduling, etc. But there is little research in assessing the value of failed project resources. At present, there are many researches in the tangible and intangible assets valuation at domestic and abroad. Norman G. Mille and Sergey Markosyan[1] divide the asset evaluation theoretical research into the following four phases on the basis of abroad literatures. In the first phase, major study focuses on real estate valuation, and the main three approaches of this stage are market comparison approach, income approach and cost approach. The main representatives are Richard Ely, Homer Hoyt, and Arthur Weimer, etc.; in the second phase, the study is in the course of theoretical improvement. It is represented by Richard Ratcliff and Leon Ellwood, of which Richard Ratcliff firstly proposes the market value and Leon Ellwood introduces the debt and equity analysis approach. The third phase is the expand stage and innovation stage. This phase introduces DCF (discounted cash flow method), and electronic calculators are widely used. The main representatives are Paul F.wendt and James Amold Graaskamp. In the final phase, the main change is the application of the multiple regression method. In China, (Yan Shaobing 2001) published an article named How Values Perceive the Meaning of Market and Market Value, it has studied the concepts and the amount of the market value[2]; (Jiang Nan 2002) published an article named re-recognition of basic objectives of asset evaluation and study the fair value and market value, first proposed the concept of fair value of asset evaluation in the paper, it is defined as the basic objectives of asset evaluation. He analyzes fair value of accounting and asset valuation, and studies the relations and differences between fair value and market value of asset evaluation and pointed out that it belongs to price category[3]; (Wang Chengjun 2002) published an article named Market Value of Assets Valuation ,and he expounded the meaning of the market value of the assets assessment in the text[4]; Yang Chunpeng, (Wu Haihua 2003) published an article named Real Options Approach to the Value of Patents Right ,and discussed the application of the pricing of real options theory in the franchise, intangible asset evaluation and other fields[5]; (Liu Zeshuang, Zhang Dan 2009) published an article named Study on the human capital investment model based on real options, and utilized the real options approach to assess the human capital value[6]; (Zhan Huirong, Peng Long 2009) published an article named Assess the Value of Patents Based on Multiple Real Options, and used the multiple real options to assess the valuation of the patent[7]; (Xiao Lan 2010) published an article named Study on the Option Pricing of Operating Leasing Fixed Assets, and utilized the real options method to assess the pricing of fixed assets under operating[8].

We can know by the review that the approaches to assess resources are market comparison approach, income approach, cost approach, and Real Options approach, etc. Although real options

approach is widely used, it is rarely used for assessing the value of failed project resources. Therefore, this paper uses real options approach to assess the value of failed project resources.

2 Real Option Model to Assess the Value of Resources in Enterprise Failed Projects

2.1 Connotation of resources in enterprise failed projects

2.1.1 Definition and classification of Resources in Enterprise Failed Projects

Resources in enterprise failed projects are all kinds of inherited assets after the failure of enterprise project. These assets maybe have no reuse value, may be directly applied to other projects, but also may be adapted to achieve its value.

So far, there is no a unified framework on the classification and definition of resources in the academic community, and it is accepted that enterprise resource can be divided into two major categories, tangible assets and intangible assets. In addition, there are other classifications. After learning these classifications, this paper makes the following several categories of resources in enterprise failed projects.

1) The resources can be classified into natural resources, socio-economic resources and technical resources by resource nature. Natural resources are those resources, which provide material, natural conditions and natural ecosystems after interaction for human survival and development. Social and economic resource, also known as social and human resource, is a socio-economic factor which directly or indirectly plays a role in the production. Technical resources include two aspects: one is knowledge concerned with solving practical software problems; the other is knowledge of equipment, tools and other hardware to solve these practical problems.

2) According to resources form, the resources can be divided into assets tangible and intangible assets. Tangible assets refer to assets that have physical substance. Narrowly, Tangible assets usually refer to fixed assets and working capital of enterprises. Broadly, Tangible assets include all the production elements including general corporate funds, resources, products, equipment, fixtures, plant, human resources information etc. Intangible asset refers to identifiable non-monetary asset, which is not owned or controlled by enterprise. Intangible assets mainly include patents, non-patented technology, trademarks, copyrights, land-use rights, and franchise and so on.

3) By the way of their reuse, the resources may be classified into direct use of resources and resources in need of rehabilitation. Direct use of resources refer to resources that can be directly applied to other projects, such as the mature scientific technology that is gradually accumulated in failed project; resources in need of rehabilitation refer to resources that can be directly used, but can be used after some kind of transformation, such as the production lines or equipment which will be applied to the production of different products.

2.1.2 Real option characteristics of resources in enterprise failed projects

Real options' basic characteristic mainly includes the following aspects: 1) it does not have the public option bargain price 2) the current price of the underlying asset is very difficult to determine 3) it has the multiple uncertainty 4) the term of validity of real options is fluid 5) the price to carry out the option is fluid.

Resources in need of reconstruction in enterprise failed projects do not have public option bargain price, and the current price is also very difficult to determine. When the enterprises handle resources in need of reconstruction, they possibly give up using the resources, also possibly give up after certain investment, or don't use the resources until the market condition is good. And this process has many uncertainties. Moreover the term of validity and the price to carry out the option change all the time. These characteristics are very similar to the real options characteristics.

In consideration of the similarities between resources in need of reconstruction in enterprise failed projects and financial options, we can construct a corresponding real option. A financial option gives investors a right, which is that you can pay a predetermined price to get a kind of specific asset at certain specified period of time; a company having resources in failed projects also has this right, which is that the company can get the right to use project resources after payment of certain costs. Resource in need of reconstruction in enterprise failed projects is equivalent to the underlying asset of financial options, the cost of resources improvement is equivalent to the strike price of the option, the time of resources improvement is equivalent to the maturity date of option, the uncertainty of resources improvement is equivalent to the size of derivatives risk in options. Specific correspondence shows in Table 1:

Table 1 Correspondence between Financial Options and Resources in Need of Improvement in Enterprise Failed Projects

Financial options	Resources in need of improvement in enterprise failed projects
The current price of the underlying asset S	Related discounted present value of cash inflow I
Commitment value of options X	Related discounted present value of cash outflow O
The maturity date of option T	Expected usable time T
Standard deviation of the value of the underlying asset σ	Expected value fluctuation of resources in enterprise failed projects σ
Risk free rate r	Risk free rate r

There are several instructions in Table 1:

1) Related discounted present value of cash inflow refers to the discounted value of net operating cash inflow after improving and making use of the resources in need of improvement in enterprise failed projects when other conditions is unchanged .

2) Related discounted present value of cash outflow refers to the discounted value of cash outflows after improving and utilizing resources.

3) Risk-free interest rate can be the interest rates of government debt, and they also can determine the interest rate according to the situation of the enterprises themselves and in combination with their historical information.

4) Expected usable time can be obtained from the history, and the new company can refer to the situation of the same industry.

5) Expected value fluctuation of resources in enterprise failed projects can be obtained from historical data. Likewise, the new company can refer to the situation of the same industry.

2.2 Real options model of resources in enterprise failed projects

In 1973, Black -Scholes option pricing model (B-S option pricing model) was proposed, and people finally found a practical option pricing method. Although the first option appears in the financial field, it is more widely used in investment appraisal. B-S option pricing model is as follows:

$$C_0=S_0[\mathrm{N}(d_1)]-Xe^{-rct}[\mathrm{N}(d_2)]=\mathrm{S}_0[\mathrm{N}(d_1)]-\mathrm{PV}(X)[\mathrm{N}(d_2)] \quad (1)$$

$$d_1=[\ln(S_0/X)+(r_c+0.5\sigma^2)t]/\sigma\sqrt{t}=[\ln(S_0/\ \mathrm{PV}(X))]/\ \sigma\sqrt{t}+0.5\sigma\sqrt{t} \quad (2)$$

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

where: C_0 is the current value of call option, S_0 is the current price of underlying stock, N (d) is the probability when the standard deviation of normal distribution is less than d, X is the price to carry out the option, e is equivalent to 2.7183, rc is risk-free interest rate, t is the time before expiration (years), ln (S_0/X) is the natural logarithm of S_0/X, and σ^2 is the variance of equity returns.

Based on the above analysis, the options model of resources in enterprise failed projects is as follows:

$$C_0=S_0[\mathrm{N}(d_1)]-Xe^{-\mathrm{rct}}[\mathrm{N}(d_2)]=\mathrm{S}_0[\mathrm{N}(d_1)]-\mathrm{PV}(X)[\mathrm{N}(d_2)] \quad (4)$$

$$d_1=[\ln(S_0/X)+(r_c+0.5\sigma^2)t]/\sigma\sqrt{t}=[\ln(S_0/\ \mathrm{PV}(X))]/\ \sigma\sqrt{t}+0.5\sigma\sqrt{t} \quad (5)$$

$$d_2=d_1-\sigma\sqrt{t} \quad (6)$$

where: C_0 is the option value of resources in enterprise failed projects, S_0 is related discounted present value of cash inflow, N (d) is the probability when the standard deviation of normal distribution is less than d, X is related discounted present value of cash outflow, e is equivalent to 2.7183, rc is risk-free interest rate, t is the time before expiration (years), ln (S_0/X) is the natural logarithm of S_0 / X, andσ^2 is expected value fluctuation of resources in enterprise failed projects.

3 Case Studies

To illustrate the application of the model, simplified case is given as follow. A company is a computer hardware manufacturer. At the end of 2004, the management of the company forecasted that a high-end mobile storage device had a huge space for development, and planned to introduce the technology to produce this kind of equipment.

In consideration of that the growth of the market will take time, the project will process in two

phases.

The first production is in 2005, and the company invested 10 million Yuan at the beginning (at the end of 2004). The production capacity of the company is 1 million Yuan. The first period is 5 years, and operating cash flow after tax at the end of 2005-2009 was 200,300,400,400,400 million Yuan. After Putting into production, market demand is not as good as expected. And the present value of total cash flow from operations is 9,601,300 Yuan. As it is shown in table 2:

Table 2 Distribution of Cash Flow in the First Phase of the Project

Time（end of the year）	2004	2005	2006	2007	2008	2009
Operating cash flows after tax		200	300	400	400	400
Discount rate（10%）		0.8333	0.6944	0.5787	0.4823	0.4019
The present value of cash flow after tax from operations		116.67	208.33	231.48	192.90	160.75
The combination of the present value of cash flow after tax from operations	960.13					
Investment	1000					

The first phase of the project did not meet the established minimum rate of 10%, and we can conclude that it is failed. The reason is that the market is downturn. The project machinery and equipment were left. They can be adapted to other projects. Of course, enterprises can sell them, and it is known that it is unable to find the value of similar equipment. If we directly sell them, the price is 6 million Yuan. If the enterprise transform the device and apply them to new projects, companies should put in 20 million Yuan, of which the cost of the improvement in equipment (Re-engineering cost) for the recycling is 3 million Yuan. It is estimated that after 5 years, the annual net cash flow from operations after tax is 600 million Yuan. The discount rate is 10%. The industry is highly-risky, and future cash flows are uncertain. Their standard deviation was 35%, which was assessed by the authorities. The specific data is shown in Table 3.

Table 3 Distribution of Cash Flow in the New Project

Time（end of the year）	2009	2010	2011	2012	2013
Operating cash flows after tax	600	600	600	600	600
Discount rate（10%）	1	0.9091	0.8264	0.7513	0.6830
The present value of cash flow after tax from operations	600	545.46	495.84	450.78	409.8
The combination of the present value of cash flow after tax from operations	2501.88				
Re-engineering cost	300				
Investment	1700				

According to the options model of resources in enterprise failed projects, we can deduce: S_0= 2501.88, PV(X) = 2000, t=5, σ=35%, and r_c =10%.

We can deduce the real option value by making use of B-S model：

$$d_1 = [\ln (S_0/X) + (r_c+0.5\sigma^2)\, t]/\sigma\sqrt{t}$$

$$=[\ln(S_0/\ \mathrm{PV}(X))]/\ \sigma\sqrt{t}\ +0.5\sigma\sqrt{t}$$

$$=\ln (2501.88\ /2000)/\ (0.35\times\sqrt{5}\ ) +0.5\times0.35\times\sqrt{5}$$

$$=0.6774$$

$$d_2 = d_1-\sigma\sqrt{t} =0.6774-0.35\times\sqrt{5} =-0.1052$$

The results can be found in the tables： N(0.67)= 0.7486,N(0.68)=0.7517； N(0.10)= 0.5398,N(0.11)= 0.5438,N(d_1)= N(0.6774)=0.7509,N(d_2)=N(-0.1052)=1- N(0.1052)=1-0.5419=0.4581

We can get the options value of resources in enterprise failed projects:

$$C_0=S_0[\mathrm{N}(d_1)]-X\mathrm{e}^{-\mathrm{rct}}[\mathrm{N}(d_2)]$$

$$=S_0[\mathrm{N}(d_1)]-\mathrm{PV}(X)[\mathrm{N}(d_2)]$$

=2501.88×0.7509-2000×0.4581
=962.46（million Yuan）

This result suggests that if we transform the equipment in the failed project, and then use them for new projects. The value of its options is 9.6246 million Yuan, but if we directly sell it, it cost only 6 million Yuan. Hence the business can make decision for investors according to the value of the options.

4 Conclusions

When the enterprises handle resources in failed projects, they possibly confront many uncertainties. The real option model of Resources in enterprise failed projects proposed by this paper makes business' assessment of the value of the flexible use of the failure of project resources possible. So the business can better make decision for investors according to the value of the options. But in the practical application of the model, and it also need to integrate with non-monetary measures in order to better assess its value.

References

[1] Norman G. Mille, Sergey Markosyan. The Academic Roots and Evolution of Real Estate Appraisal[J]. The Appraisal Journal. 2003, (4)
[2] Yan Shaobing. How Values Perceive the Meaning of Market and Market Value [J]. Chinese Appraisal Journal, 2001, (05) (In Chinese)
[3] Jiang Nan. Re-recognition of basic objectives of asset evaluation and study the fair value and market value [J]. Chinese Appraisal Journal, 2002, (02) (In Chinese)
[4] Wang Chengjun. Market Value of Assets Valuation [J]. Chinese Appraisal Journal, 2002, (01) (In Chinese)
[5] Yang Chunpeng, Wu Haihua. Real Options Approach to the Value of Patents Right [J]. System Engineering Theory and Practice.2002, (06) (In Chinese)
[6] Liu Zeshuang, Zhang Dan. Study on the human capital investment model based on real options [J]. Science Research Management, 2009, (02) (In Chinese)
[7] Zhan Huirong, Peng Long. Assess the Value of Patents Based on Multiple Real Options [J]. Science & Technology Progress and Policy, 2009, (08) (In Chinese)
[8] Xiao Lan. Study on the Option Pricing of Operating Leasing Fixed Assets [J]. Journal of Wuhan Institute of Shipbuilding Technology, 2010, (01) (In Chinese)