Science, Engineering & Education,8, (1), 2023, 114-119

How to Use Real Options in Project Evaluation

Radostin Boyadzhiev

Department of Economy and Management,
University of Chemical Technology and Metallurgy, Sofia, Bulgaria

Received 02 July 2023, Accepted 29 September 2023

ABSTRACT

An option is a financial instrument that gives the opportunity, but not the obligation, to sell or buy a given financial asset, under predetermined conditions. When used for real (tangible) assets, then we are talking about a real option. The present paper will examine the advantages and disadvantages of using real options in the evaluation of investment projects. The analysis will be presented as a comparison with traditional discounted cash flow methods. Net present valu (NPV) and other discounted cash flow methods are based on the presumption that expectations for the period of the investment project cannot be changed in the future. So once made, the investment decision remains unchanged. In contrast, real options enable these expectations to be viewed as time varying. This allows managers to be more flexible in their investment decisions.

Keywords: investment, finance options, real options.

INTRODUCTION

Discounted cash flow model

In theory and practice, the discounted cash flow method is used to evaluate investment projects. Essentially, the value of a project depends on its ability to generate future revenues. It is assumed that the investor is mainly interested in the project's ability to generate revenue in the future and therefore its value depends on the discounted cash revenue. The main factors on which the value depends are the magnitude of the future cash flows and the discount rate chosen.

A key indicator for measuring the economic efficiency of investment projects is the net present value (NPV). In practice, the model shows whether the sum of the present value of future cash revenues covers the sum of the present value of investments made.

$$NPV = \sum_{t=0}^{m} \frac{I_t}{(1+k)^t} + \sum_{t=m+1}^{n} \frac{C_t}{(1+k)^n}$$

where it is the investment costs incurred to implement the project and C_t - net income in the year t of normal operation of the project; k - the firm's cost of capital as a fraction of 1.

Criteria for project implementation is a maximum positive value of the indicator.

NPV > 0 - the project is profitable and can be accepted;

NPV < 0 - the project is not profitable and is rejected;

NPV = 0 - the project is on the borderline.

**Correspondence to: Radostin Boyadzhiev, University of Chemical Technology and Metallurgy, 8 Kliment Ohridski blvd., 1797 Sofia, Bulgaria, E-mail: radostin@uctm.edu*

Table 1. Advantages and disadvantages of NPV [1].

Advantages of indicator	Disadvantages of the indicator
The use of the method leads to an increase in the investor's wealth	The method is very sensitive to the discount rate used
Reflects the different cost of money over time	It is possible for a project to be both rejected and accepted at different discount rates
Covers cash flows over the economic life of the project	Accepted more difficult by investors who prefer to work with relative rate of return indicators
It is possible to evaluate a package of projects by summing the NPVs of the different projects	

An essential assumption in NPV is that the intermediate income is invested at a rate of return equal to the cost of capital.

The use of net present value is an established model in practice that has significant advantages. It is associated with the investor's main objective - increasing his wealth. It also belongs to dynamic indicators - it reflects the cost of money over time and considers all cash flows generated by the project.

The main disadvantage can be pointed out as the dependence of the result on the chosen discount rate. This can lead to the same project being accepted at one rate and rejected at another. If we use the weighted average cost of capital, then the project itself becomes dependent on the financing structure we have chosen.

We should also mention another problem, namely the inability to incorporate project risk into the valuation. This problem can be solved in part by using a risk-adjusted discount rate. This option may lead to impaired results due to the strong correlation between the NPV and the chosen discount rate.

Financial options

Financial options trading developed tremendously in the 20th century. They are used in risk management and for speculative purposes. They represent the right, but not the obligation, to sell or buy an asset at a particular price and time. Important features of options are:

- Strike price - this is the price at which the asset can be bought or sold;
- Option period - indicates the period during which the option right can be exercised;
- Premium - the price paid for the right to exercise the option.

Financial options can be considered depending on whether they give the right to buy (call option) or sell (put option) an asset. Depending on the maturity, they are divided into:

- American type - the option can be exercised at any time before maturity;
- European type - the option can only be exercised at maturity;
- Bermuda type - the option can be exercised on several specified dates.

The Black-Scholes model is used for option valuation. It is developed based on stochastic processes. The binomial model uses the same logical framework but is more simplified. It is associated with the work of William Sharpe [2] and especially Cox, Ross, & Rubinstein [3].

Real options

The term real options are used by Myers to refer to the application of financial option theory to non-financial assets [4]. As with financial options, real options give the right, but not the obligation, to acquire and use an asset (to make an investment).

There are different types of real options:

- Waiting option - projects where it is possible

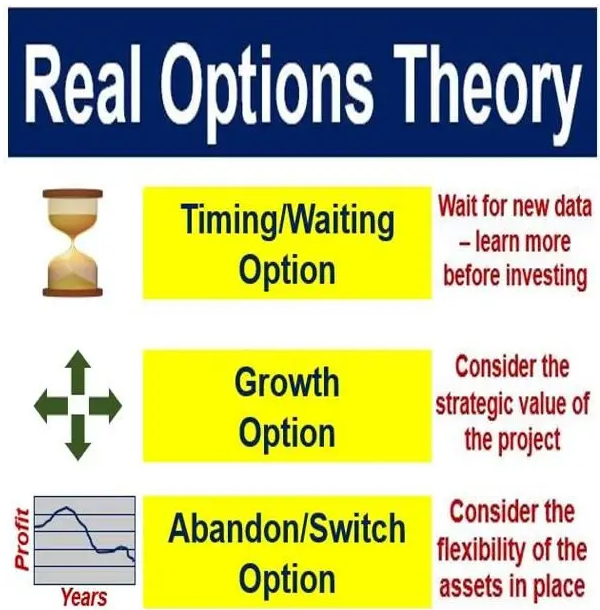

Fig. 1. Real options theory [5].

to defer the investment;
- Scale option - projects where it is possible to reduce or increase the scale of the project;
- Abandonment option - evaluates the possibility to terminate the project;
- Switch option - the ability to switch from one mode of operation to another.

The use of real options allows a more active position in the management of the company's investments. The net present value excludes the possibility of management influencing the project once implementation has been undertaken. Real options allow flexibility in decisions. Many projects give management this option, but in NPV this flexibility is not reflected in the calculations.

The figure shows the different projects and the decision options open to management. In the case of projects with the possibility to postpone the investment, the investor is given the opportunity to obtain additional market information before making the investment. This allows projects that are rejected by the traditional net present value (NPV < 0) indicator to be reconsidered. For a project with high uncertainty of future cash flows and the option to postpone the investment decision, it is possible that the analysis through real options may lead to a positive value. This would be due to the flexibility offered by the investment project. It consists in the fact that the management can delay its decision and obtain information about the market development and with the new data make a justified investment decision. Of course, for the time the project is not implemented, income is lost, but with the new information the volatility of the investment is reduced.

Real options for abandonment or switching make it possible to account for flexibility in the way assets are used. For example, in projects that allow an investment to be terminated if unfavorable circumstances arise, we have a real option to abandon the project. These are usually agreements where the investor can exit without penalty.

In investment projects that allow switching from one technology to another, we have a typical switching option. Here flexibility is the choice to switch from the chosen technology to another when circumstances change, to extract maximum value. The two examples of real options assess the

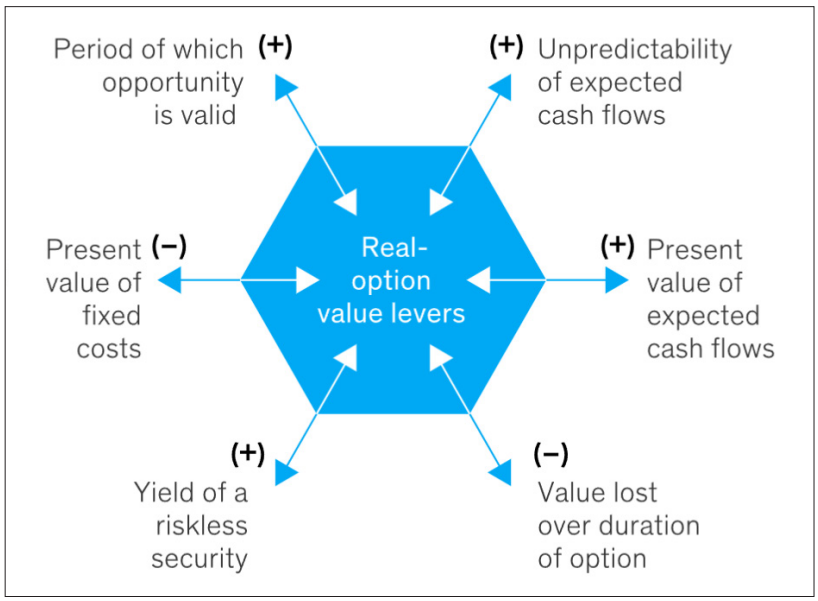

Fig. 2. Value of real option [6].

flexibility of the assets. When conditions change, they allow the investment (assets) to be redirected and used differently.

Let's consider a project that enables the company to expand its operations, given market development and favorable conditions. Another example is the research of new technology and in its successful commercialization enables the development of production with innovative products. In this case, future cash flows will be many times higher than the initial investment. In the cases presented, we have a real scale/growth option. It allows the company to take advantage of the circumstances and consider the strategic value of the project. It is the availability of such options that lead to a higher valuation by analysis through real options than the use of NPV.

On Fig. 2 graphically is presented six main pillars determining the value of the real option and their influence. They can also be seen as levers on which management can focus their attention when managing them.

An increase in the present value of expected cash flows has a positive impact on real options. This can also be defined as a basic management guideline regarding option management.

Waiting cost is an interesting criterion in real option. Its decrease increases the value of the option and vice versa. If we can defend against competitor entry, then we can assume that the standstill price is low. Conversely, we can speak of a high cost if a competitor enters before us and achieves high benefits from doing so.

An increase in the risk-free rate of return would lead to a decrease in the net present value due to an increase in the weighted average cost of capital. In the case of real options, we have an inverse relationship. That is, as the rate increases, the value of the option increases. This is determined that an increase in the rate will lead to a decrease in the present value of the option exercise price. In principle, management has no ability to influence this leverage of the option value.

We can increase the option value by reducing the present value of the fixed costs. Directing management's attention to operating costs and the opportunity to reduce them can usually be achieved through economies of scale or economies of scope. In the case of the former, cost reduction is a consequence of increased production. Fixed costs per unit of output are reduced because of their spread over a larger

number of units. Economies of scope apply when average costs are reduced because of the increase products in production. Thus, we can assume that economies of scale are achieved but based on producing more products. Care must be taken because diseconomies of scale are possible. Achieving the opposite effect - increasing average costs.

How uncertainty affects the value of the real option. In the case of net present value, as uncertainty increases, its value decreases. In making the investment (in its full amount), the company accepts both the possibility that the net present value will be lower than expected and the possibility that it will be higher. This is because of the symmetry of the uncertainty and therefore of the expected cash flows. Once the investment has been undertaken, the firm has little ability to influence the outcome.

With real options, we are talking about the exact opposite. As uncertainty increases, so does value. This seems like an absurd claim and difficult for an investor to grasp. It is the reduction in the uncertainty of future cash flows that can ensure the expected value is received. With real options, the investor can invest a small portion initially. This provides the opportunity to obtain additional information and to assess whether the expected cash flows will be upward or downward. This is where the essential difference between the two methods - real options and net present value.

Increasing the option period helps to increase its value through the time-risk relationship. As the period increases, so does the uncertainty and hence the value of the real option.

CONCLUSIONS

The use of real options allows the investor to evaluate the flexibility (different options) offered by a project. When using traditional methods such as net present value they are not subject to evaluation. This is why we can expect that the NPV value will be lower than that obtained by real options analysis. If the project offers no flexibility, then we would expect the two values to be equal. We can assume that the net present value is a specific variant of the real options.

The use of real options can be applied to capital budgeting, innovation management and strategic management.

It is possible to use real options analysis to achieve a more proactive and adaptive management of investment and innovation in a changing environment. The firm has the opportunity to use various leverage (excluding the return on the risk-free asset) to increase option value. Management can also be more responsive to the changing environment and new circumstances.

Through real options, uncertainty takes on a new paradigm. It moves from avoiding at all costs to a management tool that can be used to increase value. This provides greater opportunities in investment management. This is why it is quite possible to reject a project at net present value and accept it through real options analysis.

It all sounds very positive, but we must also describe a few difficulties in using this new approach. First, we can fall into the trap of attributing additional value to investment projects that have been rejected by NPV. By this I mean, in order to justify an investment (despite a negative net present value), we can attribute flexibility (and therefore additional value by real options) to it when the project does not offer such. That is, a misunderstanding of what constitutes a real option and the possibilities of accounting for flexibility.

The second serious problem is the complexity of investment analysis. It is possible to get into the frame that complicating the procedure leads to worse results. This may be caused by the complexity of the analysis and mathematical calculations. We must admit that the net present value gives a relatively easy and quick possibility to obtain an estimate of the investment (compared to real options). Also, a major advantage is the relative simplicity of the procedure and the possibility to automate the NPV estimation.

Using real options gives a different and

more complete picture of investment projects. Considering the different options implies better management and therefore higher returns. From a theoretical point of view, more opportunities are undoubtedly offered by real options analysis, but in practice the investor may face additional difficulties. Moving real options from a predominantly theoretical setting to a dominant practice will be a long process with a hard to predict outcome.

REFERENCES

1. I. Georgiev, Basics of investing, Sofia, Academic Press - UNWE, 2013.
2. W.F. Sharpe, Investments, Prentice-Hall, 1978.
3. J.C. Cox, S.A. Ross, M. Rubinstein, Option pricing: A simplified approach, Journal of Financial Economics, September 1979, 229-263.
4. S. Mayers, Determinants of corporate borrowing. Journal of Financial Economics, 1977.
5. MBN: Market Business News. Source from https://marketbusinessnews.com/financial-glossary/real-options-theory-definition-meaning/, Available 29 June 2023.
6. M. M. Keith Leslie, Source from: https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/the-real-power-of-real-options, Available 29 June 2023.