

INVESTMENTS AS REAL OPTIONS²

ABSTRACT

Opportunity (optional) approach to capital investment appraisal represents, completely new theoretical and methodological framework for investment analysis. Compared to traditional, discount cash flow (DCF) model of analysis, the optional approach provides opportunity for valuation and managing flexibility, i.e. possibility of approaching (amending the previous decisions) in compliance with market changes. Risk and uncertainty are inevitably following the capital investment. Therefore, the importance of optional approach to investments is also that it provides possible better "treatment" of risks in the investment analysis, and also more rational allocation of resources, accordingly. This approach should be of more interest to the Countries in transition, considering the limited financial sources as well as risk and uncertainty are emphasized.

Key words: investment opportunities, financial option, real option, net present value, flexibility, risk, uncertainty.

1. Introduction

Capital investment appraisal represents a specific model of valuation interactions of benefits and costs within defined period of project. The results of valuation represent a base for making positive and negative investment decisions. Every appraisal model should quantitatively argue the acceptance (not acceptance) of investment project.

Under traditional (conventional) models for appraisal we will consider standard discount cash flow (DCF) analysis models, i.e. all the models of valuation that do not consider the opportunity costs (benefits) on the base of investment in some project. Conventional models are, therefore: model of net present value (NPV), model of internal rate of return (IRR), annuity model, model of payback period, and the profitability index (P_i). Model of net present value can be considered as representative model for valuation, and for the other models it could be said that they are "inferior

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comparing to NPV model” (L. Trigeorgis, 1996). Consequently, the omission of traditional valuation models will be examined as per example NPV. This will not, for sure, bring to the doubt the validity of conclusion about conventional model of valuation, in the whole.

Under opportunity approach we will consider appraisal that include not only direct benefits (costs) on the base of investment, but also indirect effects of investment (open, “cancelled” investment opportunities - options). Therefore, the opportunity approach analyses investments as chances which appear in certain moment and never repeat in the same shape (similar to the life circumstances, Dixit, K.A.).

Both approaches (models) to the capital investment appraisal will be tested through the questions: “How the manager should make decisions: whether and when to invest in a new project, facing uncertainty of future market opportunities?” (K.A. Dixit,, S.R. Pindyck, 1994). Therefore, the mentioned question would be the starting point for traditional and opportunity appraisal of approach to capital investment (“test question”).

2. Traditional versus opportunity approach

In this part of the paper we will examine the traditional DCF methods of evaluating capital investments and compare it with the modern optional approach.

Conventional models of valuation start with assumption that the investment is reversible (that investments somehow could be returned and costs compensated if it happens that the market conditions are worse than they were assumed), or if the investment is irreversible and it presents the chance that appears now and never again (if the company does not invest now, it will lose that chance forever). Although, it is true that some investments belong to one of these two categories, it is not the case with majority of investment. Therefore, we can state that this basic approach is mostly wrong. We can already conclude that traditional models of valuation do not provide answers to “test question”, as they do not consider the importance of the right moment for starting the project (“timing investment”), or possibility of postponing the moment of starting the project. As the investments are always (more or less) risky, than the possibility of postponing them and collecting the additional information necessary for valuation of investment efficiency, can significantly reduce the risk (uncertainty), increase flexibility and therefore have a significant impact on complete investment decision.

Valuation of flexibility is, however, completely “far from” conventional models of appraisal. Except time flexibility (possibility to postpone starting the project), technological, market, financial flexibility cannot be assessed by applying the traditional models, even though they can significantly have impact on the value of investment project (flexibility has a value), therefore, also on a complete investment decision (especially in the conditions of high risk and uncertainty). Ignoring flexibility, traditional approach to the measure of investment cannot value the possibility of adapting investment to the newly created conditions of exploiting project (rigid

approach). Besides, traditional approach observes the project statically and in a strict determined (defined) way. Expected cash flow and discount rate are not static categories, they are changeable over time, and consequently the NPV project is changeable, as well. Therefore, project that has a negative NPV today can have positive NPV in future. (A. Damodaran, 2004).

Traditional models, except the above mentioned, consider only direct effects of investment. It means that positive NPV needs to start the project, and negative NPV indicates non-acceptance of the project. In other words, value of the project as per traditional approach is simply difference between present value of returns and present value of investment(s) (costs), without "accompanying effects" (indirect effects) of investment. Therefore, when starting some projects investor loses the possibility of investing in some other project(s). This means that lost returns (due to missed investment opportunity (opportunities) in some other project(s)) represent opportunity cost of investment, which cannot be absolutely (mustn't be) ignored. From the other hand, by investing in the project, some additional possibilities of investment are opening. As these possibilities (options) are more significant, the project is more flexible and more valuable and vice versa.

As the project is more flexible, then it's more worth and vice versa. Therefore, as per opportunity approach, the value of the project is considered widely and represents: difference between direct benefits and costs of the project (NPV), corrected for total cancelled (open) options, after starting the project. Therefore, for real appraisal of investment efficiency, the opportunity approach is inevitable. Opportunity approach will turn into the traditional approach (results of the valuation for these both approaches will be identical), unless there is no the opportunity interest (costs) starting the project (that is more theoretical than practical possibility), i.e. for the type of investment "now or never".

Neglecting the opportunity possibilities (costs), focusing on efficiency of the project and ignoring correlation between the projects and circumstances (isolated approach to the project) makes conventional models very rigid. If the investment is considered as "isolated" it may look like non-economical, even though it has potential for creating opportunities that enables company to take over some other (more profitable) investment in the future, which may have strategic interest for the whole company. The best example is the investment in research and development, which are taken, mainly, due to creating good opportunities for future investments (development).

Opportunity approach is a consequence of observing investment opportunities as financial options (derivative securities). Namely, option (call or put) represents right (and not obligation) of purchasing or selling some securities, as per advanced determined price.

Following the logic of financial option, investor has opportunity (right, and not obligation) to invest in some project. If he invests, he realizes that option. If the investor does not start the project option stays only as unused right. Therefore, as per opportunity approach the problem of the investment efficiency appraisal gets to the

question: “When and how the owner (investor) of the option (investment opportunities) can use that possibility (right)?” As the minimum call option price is 0 (zero) (J.E. Elto, J.M. Gruber, 1995), i.e.

$$C = \text{Max} (S-X, 0),$$

Where:

C = the call option price,

S = the stock price,

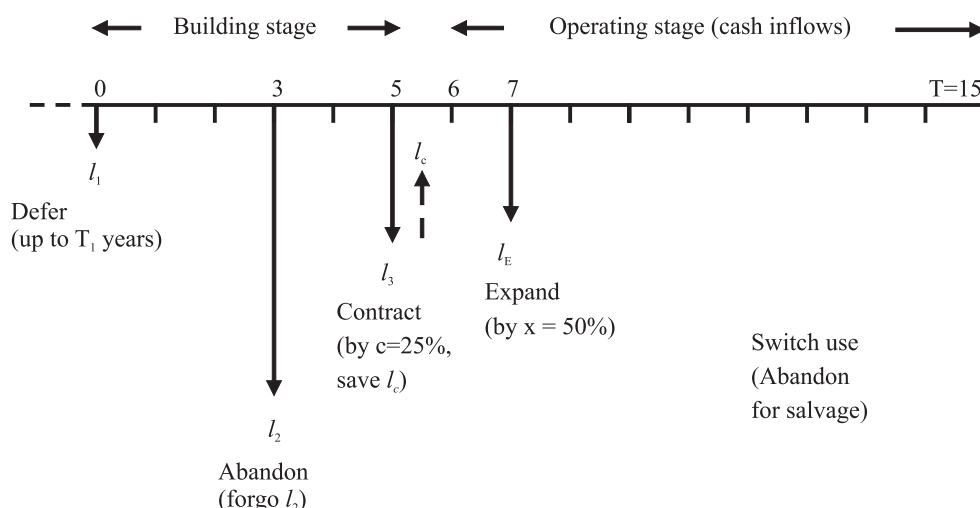
X = the option’s exercise price.

than investment opportunity (opportunities), cannot reduce the value of the project (minimum value is equal to zero). Therefore, the valuation of the real options follow the logic of the valuation financial options (both real and financial option present right, but not obligation). In other words, the value of real options (investment opportunities) is always positive, or minimum is equal to zero and, as such, can only increase (but never reduce) value of the investment project. More additional possibilities, which are offered to investor, therefore, make investment project more flexible and valuable (every open option has its value). Flexibility has a price, which must be considered in appraisal of investment efficiency. However, conventional models have no appropriate “tools” for flexibility valuation. By conventional models, the flexibility is completely ignored, and as per that approach, it has no impact on value of the project.

If we compare two investment projects: Project A and Project B, which consider two equal cash flows (equal capital investment and the same returns, as per volume and dynamic), i.e. they have the same NPV. However, the Project A has no possibility to expand capacity, i.e. it has no growth option as Project B has. As the growth is a condition for existence, than the availability of Project B makes this project more superior, more valuable and more acceptable comparing to the Project A. Apart from that, growth option can never decrease the value of Project B. In the worst situation, minimum value of Project B is equal to the value of Project A (if the value of growth option for Project B is minimum, i.e. equal to zero).

3. Real options – types and characteristics

We will show different types of real options on the specific example of oil exploiting (L. Trigeorgis, 1996).



Let us assume that the oil company rents out the land, for which there is an assumption it is rich in oil. Starting the project can be postponed until the period $-T_1$ (postponing option is the characteristic of extractive industry). Initiation project requests, first, the definite cost of research, as well as cost of infrastructure, in the amount of $-I_1$. If the results of research are positive, the costs of construction follow $-I_2$. The oil extraction can start only after the construction is completed, i.e. after the last investment (operation phase). If the market conditions become worse during the construction period, the investor has possibility to abandon all further investments that were planned at the beginning. It means that the investor after investment $-I_1$ can give up further cost of investment $-I_2$. Apart from that, the management have opportunity to reduce its activities for $c\%$, saving the amount of $-I_c$, from the last investment amount $-I_3$ (instead of equipment for five wells, can decide to provide equipment for two wells only, due to decrease of oil price).

If, however, market conditions get better (e.g. oil price increases), than the management can realize option of expansion comparing to planned. The growing capacity will require additional investment that is higher than planned for $x\%$ and amount to $-I_c$.

Finally, in any phase of oil extraction, investor can "save" a part of investment by selling residual value of project (e.g. equipment) on the market. The returned funds can be used for some alternative (more profitable) projects.

The above-mentioned possibilities should not be considered, for sure, as the only real options that the management can account for. There are many more other real options,

which in a certain time can be attractive. For example, alternatives are: supply market with crude oil or choose the option of oil refining. Or, just perform oil extraction and let the refining of oil to the big specialized refineries, which due to the positive effect of "scale economy" can "afford" low price, etc. All these open possibilities (options) make the project more flexible and more valuable. In other words, there is more and higher possibility of turning the positive movement on the market into the profit, if the project is more flexible. Or, the possibility of loss and even project liquidation, due to the negative and not planned market changes is smaller, if investor has more opened real options.

4. Valuation of the real options

Since the investment possibilities can be compared with the financial options, as:

- They represent right, but not obligation (as it is with financial options),
- Invested funds in investment are irreversible (the price paid for financial option cannot be returned),
- They cannot have negative value (as the financial options),

than the investment possibilities can be considered as the real options, which value can be defined on the similar way as the value of put or call options.

The value of call option (put options (European type) can be defined by applying Balck Scholes models of valuations:

$$C_0 = S_0 N(d_1) - \frac{X}{e^{rt}} N(d_2)$$

where is $N(d)$ – cumulative normal distribution function, and

$$d_1 = \frac{\ln(S_0 / X) + \left[r + \frac{1}{2}(\sigma^2) \right] t}{\sigma \sqrt{t}}$$

and

$$d_2 = \frac{\ln(S_0 / X) + \left[r + \frac{1}{2}(\sigma^2) \right] t}{\sigma \sqrt{t}}$$

In order to be able to use the mentioned model for valuation of the real options (investment opportunities)³ it is necessary to define analogy of the investment opportunities elements with the elements of European (call or put) options (five elements which represent the value of European options). The elements of the investment opportunities are equal to the following elements of financial options (call options).

³ European call option is not the best substitute for real options. It was selected due to its simplicity, to avoid complicated «mathematics». In any case, it accepts the required generalizing in processing these complex problems, and what is important, has «no impact» on reliability and precision of decisions.

INVESTMENT OPPORTUNITY	VARIABLE	CALL OPTION
Present value of a project's operating assets to be acquired →	S →	Stock price
Expenditure required to acquire the project assets →	X →	Exercise price
Length of time the decision may be deferred →	t →	Time to expiration
Time value of money →	r_f →	Risk-free rate of return
Riskiness of the project assets →	σ² →	Var. of returns on stock

Based on the above mentioned it can be concluded that the relation of financial option is analogous with investment (real) option. It means that the standard option pricing method can be used also in the investment analysis, (in the valuation of real option) without limitation.

We will try to use the simplest example to show the possibilities of optional approach usage:⁴

If we assume that the company has option of expanding the capacity (the growth option) with the following elements:

- S = 100,
- X = 105,
- r_f = 5%,
- t = 1 year,
- σ = 50 %.

The value of growth option is calculated in the following way:

$$C_0 = S_0 N(d_1) - \frac{X}{e^{rt}} N(d_2)$$

$$d_1 = \frac{\ln\left[\frac{100}{105}\right] + [0.05 + 0.5 \cdot 0.52^2] \cdot 1}{0.5}$$

$$d_1 = 0.25$$

$$d_2 = -0.24.$$

It comes that N(d₁)=0.5987, and N(d₂)=0.4052

⁴ Examples of the optional approach usage in practice are given in: A.Rovčanin Modern Methods for Evaluation of Capital Investments, page 114 – 120.

Finally, the result is:

$$C = 100 \cdot 0.5987 - \frac{105}{2.71828^{0.05 \cdot 1}} \cdot 0.4052 = 19.7.$$

(The option value is 19.7 % from S value, i.e. ($C = 0.197 \cdot S$)).

5. Conclusion

Investment opportunities (real options) represent non-avoidable element of appraisal of capital investment efficiency. In other words, the appraisal of capital investment efficiency without opportunity approach, or without accepting the real options, is not real and it does not represent reliable base for making the investment decisions. Although, the optional approach brings into the question the value of the basic criteria for the traditional (conventional) methods, but the opportunity (optional) approach does not mean avoidance of the traditional approach, completely. Conventional methods will be increasingly used as a “quick appraisal” of the capital investment efficiency, and less as reliable base for making investment decisions. Besides, some types of investment projects cannot be absolutely considered (accessed) by applying the conventional methods (for example: research and development projects), which represent an extra argument for applying an option access in practice. Following the model (logic) of financial options valuation, it is possible to identify the elements analogy of the financial option and real option, which provides possibility of applying “standard option pricing method” for real option valuation.

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INVESTICIJSKE PRILIKE KAO REALNE OPCIJE

SAŽETAK

Oportunitetni (opcion) pristup vrednovanju kapitalnih ulaganja predstavlja, bez sumnje, jedan potpuno novi teorijsko metodološki okvir investicijske analize. Za razliku od tradicionalnih, discount cash flow (DCF) metoda analize, opcion pristup daje mogućnost vrednovanja i upravljačke fleksibilnosti, odnosno mogućnosti prilagođavanja (korigiranja prvobitnih odluka) u skladu s tržišnim promjenama. Rizik i neizvjesnost neminovno prate kapitalna ulaganja. Stoga je značaj opcionog pristupa ocjeni i u tome što omogućava bolji "tretman" rizika u investicijskoj analizi, a time i racionalniju alokaciju resursa. Ovaj pristup bi trebao biti posebno zanimljiv zemljama u tranziciji, obzirom na ograničenost izvora financiranja kao i naglašenost rizika i neizvjesnosti.

Ključne riječi: investicijske prilike, financijska opcija, realna opcija, neto sadašnja vrijednost, fleksibilnost, rizik, neizvjesnost.

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