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GENERAL PRINCIPLES OF APPLICATION OF THE REAL OPTIONS VALUATION IN INVESTMENT ANALYSIS

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The article describes the general principles and proves the expediency of application of the real options valuation as an important tool for effective management decision making in investment analysis of projects. There are specified shortcomings of the discount method, which are particularly evident in conditions of uncertainty. The authors have studied the possibilities of using the Black-Scholes model for calculating the value of real options. There are also studied the application conditions of the real options valuation, their types, and there are analyzed the advantages and disadvantages of it; the scope of its practical application is substantiated too.
Keywords: the real options valuation, the Black-Scholes model, investment projects, investment analysis, discount methods, uncertainty, management flexibility.

Introduction. Under conditions of the market economy the successful operation and development of the company is largely determined by its reasonable investment policy aimed at ensuring the choice and implementation of the most effective forms of investment.

For efficiency evaluation of investment projects we usually use indicators, the calculation of which is based on the concept of discounting, namely the net present value (NPV), the profitability index (RI), the discounted payback period (DPP), the internal rate of return (IRR). It should be noted that these figures were suggested by the UNIDO method, first published in 1978, which became the internationally recognized standard for evaluating investments and the enhancement tool of technical and economic solutions.

However, today's economic realities have necessitated the development and growth of new valuation models of investment projects, especially innovation-oriented ones.

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Discount methods are often criticized because of their limitation, mainly caused by the impossibility to take into account the flexibility of management decision making during the project implementation, which is especially evident in conditions of considerable uncertainty [1, p. 9; 2, pp. 19–29; 3, p. 227; 4, p. 175]. It is known that the ability to respond quickly to the variability of the environment is perhaps the most important component of effective management of modern enterprises. The real options approach is one of the most promising methods, which allows solving a number of problems during the investment analysis of projects. Over the last decade it is considered as the most important scientific achievement in the sphere of evaluation of investment projects, assets and business [2, p. 29].

Analysis of recent researches and publications. The fundamental principles of real options approach were developed and worked out by the following foreign scientists: A. Damodaran [5], W. Sharpe, G. Alexander, J. Bailey [6], F. Black, M. Scholes [7], T.Copeland, P. Keenan [8], V. Antikarov [9], T. Luehrman [10], R. Merton [11].

An important contribution to the development of the theory of real options and its practical application was made by L.L. Grytsenko, A. A. Gubar [1], A. A. Gusev [2], Ya. S. Vytvytskyi [3], I. V. Novykova [4], I. G. Tkachuk, M. M. Bilyi [12], M. O. Limitovskyi [13], A. Sh. Ziyatdynov [14], N. Bruslanova [15], G. F. Abramov, K. A. Malyuga [16].

Previously unsettled problem. Despite the fact that the option models were studied by the native and foreign scholars, Ukraine has no experience in wide use of real options approach in the investment analysis and valuation of assets. Therefore, the practical application of the method requires further fundamental researches.

Main purpose of the article. The purpose of this article is to highlight the general principles of the real options valuation for ensuring its practical usage for the analysis of investment projects under the conditions of uncertainty.

Results and discussions. As a result of summing up of the practice of investment analysis we have found that discount methods underestimate the real cost of the projects because they involve only one technique of their implementation and do not involve the possibility of changing management decisions during implementation of projects, i.e. the opportunity of management to respond to any negative changes and to minimize their losses.

It is known that discount methods are based on the assumption that uncertainty always leads to a reduction in project costs. That is, the greater the uncertainty the greater the risk, the higher the discount rate and, consequently, the lower efficiency of the project. But we have investigated that the attitude to uncertainty has changed in the current economic environment – it is regarded not only as a factor of potential threats that leads to losses, but also as a factor of the possible growth: according to the theory of risks the greater danger leads to more favorable opportunities.

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Therefore, the real options approach is increasingly used in the areas of activity with a high level of uncertainty, which has a significant impact on effectiveness indicators of a project and costs of companies, for evaluation of investment projects effectiveness and their assets. From a theoretical point of view, this method is a further development of problem-solving methodologies of the time factor.

The word «option» means opportunity. A real option means an opportunity to change the development of the investment project in the future for improvement of its effectiveness in case of appearing of new development alternatives or new information concerning the conditions of the project implementation [5, pp. 117–145; 6, pp. 646–672]. So the consideration of the project from the point of view of real options involves accounting of additional possibilities under the conditions of uncertainty, which are left out of account for the classic investment analysis.

The theory of real or management options is a combination of economic, financial and scientific management regulations and different approaches to forecasting cash flows including the level of income uncertainty, cash flows, the level of investment costs in various stages of investment projects implementation [2, p.3; 3, p.64]. The most important feature of this method is its ability to include highly dynamic changes of the environment in which the companies operate at the present stage of economic development.

The calculation of the real option value is made according to the Black-Scholes model [2-12], developed for evaluation of financial options such as "call" options, according to the following formula:

$$V = S \cdot N(d_1) - X \cdot e^{-rt} \cdot N(d_2), \tag{1}$$

where V is the real value of the option;

S is a current assets value (for a real option it is the risk-free rated cost of cash flows the company receives as a result of implementation of an investment opportunity);

X is the strike price of an option, i.e. future investment costs;

e is a number that is the basis of the natural logarithm (a rounded off value is 2.71828);

r is the risk-free rate of return;

t is the time prior to expiration of the option exercise (the possibility implementation, which is contained in the option) or the time before the next decision point;

$N(d)$ is an integral function of the normal distribution, where d_1 and d_2 are defined by the following formulas [11, pp.141–183]:

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$$d_1 = \frac{[\ln(S/X) + (r + \sigma^2/2)t]}{\sigma\sqrt{t}},$$ (2)

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

where σ is a standard deviation of returns for a certain period. For real options it is the volatility of assets, mainly NPV.

If the company has a real option (the ability to change the alternatives of the investment project implementation, to adjust management decisions depending on market conditions or receipt of new information in future), an investment value of the company usually increases.

The extent *Vopt* exceeds the asset value during the assessment of the real option if the assets are not supported by a real option *V*, and it is evaluated as a measure of real option efficiency (λ):

$$\lambda = Vonц - V.$$ (4)

It should be noted that the real options method can be applied at all stages of implementation of the investment project, namely during its development and planning, during its evaluation, at investment and operational stages, if the change of conditions requires the development and adoption of new management solutions [1, p.10].

We have analyzed that the application of the real options approach in evaluation of investment projects is appropriate under the following conditions [1, p.13; 2, p.39; 13, p. 470; 15]:

– the project is carried out under conditions of considerable uncertainty;
– uncertainty directly affects the cost of the project;
– it is possible to adopt flexible management decisions when the new information on the project appears;
– effectiveness of the project greatly depends on the decisions taken in the course of its implementation (during evaluation of the project by discount methods the NPV is negative or close to zero);
– management strategies are realistic and feasible;
– management is rational during implementation of the chosen strategies.

The lack of even one of these conditions results in a depreciation of the real option [2, p. 39].

According to the opportunities the investor has we have distinguished the following types of real options [1, pp.10–11; 2, pp.87-94; 4, p.176; 13, pp.364–390; 14, p.146; 16, p.3]:

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– an option for choosing the best moment to start investment – the possibility to postpone the time of investing before the reliable information and more favorable market conditions emerge;

– a growth option provides additional possibilities that may appear after initial investment. Therefore, investment at an early stage of the project is a prerequisite for the development of other interrelated projects;

– a zoom option is the possibility to increase or decrease production after the first results of the project implementation are obtained;

-   a withdrawal option is the possibility of refusing to invest the started project, which turned to disadvantage, or if actually received cash flows do not meet the expectations. In this case, leaving the project avoids further losses and the withdrawal option increases the output value of the project;

-   complex options are combinations of different types of options that may arise in stages and their value depends on fulfillment of other options.

The real options valuation has several advantages and disadvantages. In particular, we have defined the following advantages [3, pp.65–66]:

– the ability to consider the results of flexible management investment decision making depending on the situation at the most advantageous time;

– the ability to use any assets or resources for evaluation that have optional features;

– there is no need to determine the risks of investing, which are often evaluated on the basis of subjective or expert opinions, when we apply the method.

However, we have also defined the following disadvantages of this method [3, p.66; 4, p. 177; 14, p. 145]

– the complicated calculations of the basic parameters of option models such as the present value of the underlying asset, volatility, and investment costs;

– problems of justifying the risk-free rate of return under the crisis conditions;

– the investor`s less understandability of the method;

– excessive flexibility in management decision-making can lead to confusion and deviation of strategic objectives;

– the application of real option models may require fundamental changes in business activity, such as reengineering of business processes, change of company culture and approaches to business processes in general.

We believe the scope of possible application of this method to be extremely broad, but it is reasonable to use it in science intensive, high-tech areas and in the areas with high costs for marketing and promotion of new products [1, p.13]. Real options are also used for evaluating the projects aimed at the development of new products in the pharmaceutical, oil and gas industry, new state-of-the-art technique for industry, energy production projects, and at the stage of conclusion of mergers and acquisitions agreements [3, pp. 229–244; 14, p.145].

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Conclusions and further researches directions. We think that the application of real options valuation is an important tool for effective evidence-based investment decision-making under conditions of high uncertainty. Implementation of this approach in the practice of investment analysis enables to respond to changing conditions of the project implementation, to develop different scenarios for their implementation and not to miss new opportunities for the development.

In addition to the investment analysis, we offer to use option models for estimating the value of any assets with optional features. We think that they have prospects in investment assessment of resources and intellectual property.

However, we find it important to note that the application of real options valuation without proper justification can lead to erroneous results and faulty decision-making.

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ЗАГАЛЬНІ ЗАСАДИ ЗАСТОСУВАННЯ МЕТОДУ РЕАЛЬНИХ ОПЦІОНІВ В ІНВЕСТИЦІЙНОМУ АНАЛІЗІ

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У статті висвітлено загальні засади та обґрунтовано доцільність застосування методу реальних опціонів як важливого інструменту для прийняття ефективних управлінських рішень в інвестиційному аналізі проектів. Вказано на недоліки методів дисконтування, що особливо проявляються в умовах невизначеності. Розглянуто можливості використання моделі Блека-Шоулза для розрахунку вартості реальних опціонів. Досліджено умови застосування методу реальних опціонів, їх види, проведено аналіз переваг та недоліків методу, обґрунтована сфера його практичного застосування.

Ключові слова: метод реальних опціонів, модель Блека-Шоулза, інвестиційні проекти, інвестиційний аналіз, методи дисконтування, невизначеність, управлінська гнучкість.

ОБЩИЕ ПРИНЦИПЫ ПРИМЕНЕНИЯ МЕТОДА РЕАЛЬНЫХ ОПЦИОНОВ В ИНВЕСТИЦИОННОМ АНАЛИЗЕ

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В статье освещены общие принципы и обоснована целесообразность применения метода реальных опционов в качестве важного инструмента для принятия эффективных управленческих решений в инвестиционном анализе проектов. Отмечаются недостатки методов дисконтирования, которые особенно проявляются в условиях неопределенности. Рассмотрены возможности использования модели Блэка-Шоулза для расчета стоимости реальных опционов. Исследованы условия применения метода реальных опционов, их виды, проведен анализ преимуществ и недостатков метода, обоснована сфера его практического применения.

Ключевые слова: метод реальных опционов, модель Блэка-Шоулза, инвестиционные проекты, инвестиционный анализ, методы дисконтирования, неопределенность, управленческая гибкость.