Assessment of the Expected Effect of Portfolio of Projects When Using Real Options

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Abstract. The subject of this research is the process of assessment of an expected effect of projects portfolio with using of real options. The following methods are applied: real options and assessment of the investment project through the cost of the real option, discounting of cash flows, synthesis and mathematical modeling. Novelty of article is the systematization of main types of real options and formalization of computing of the expected effect of realization of portfolio of projects in conditions of risk and uncertainty with use of real options. Results of a research are: main types of real options are systematized and the formula for computing of the expected effect of realization of portfolio of projects in which it is shown that calculation of cost is being built in a portfolio or projects of real options, the additional long-term expenses related to using of these options and decrease thereof the general risk of projects and a portfolio in general allows to increase objectivity of such calculations is offered. Conclusions: in the analysis of real options, the real assets is having as basic, it is often impossible to apply settlement formulas to financial options as they significantly differ. Systematization of main types of real options allows to expand the range of the application of management decisions. Use of more objective formula of calculation of the expected effect of realization of projects portfolio with using of real options allows to increase efficiency of projects insurance in conditions of risks and uncertainty and to use additional opportunities for more effective development of a company.

1. Introduction

The methods of the classical analysis of an investment project involving passive management (using an action template laid down at the initial stage of its implementation) do not take into account the possible occurrence of synergic positive effects. Thus, classical methods underestimate investment opportunities, ignore the fact that the manager can change the initial management and/or investment decisions based on new information [1, 2]. Such an opportunity must be predicted. Analysis of the project from the point of view of the concept of real options is a search for additional options [3-6]. The use of real options can change the offers of the company and the range of products.

In general, option theory distinguishes two groups of additional features contained in the project. The first of them is the possibility of changing the project parameters over time: expanding (reducing) the project, changing the sources of raw materials, refusing to implement the project after receiving additional information, etc. The second group of features characterizes the external side of the project: the implementation of one project makes possible to implement another project, which it would be impossible without completing the first.
2. Problem Statement

In practice (in conditions of uncertain environmental conditions and many of the internal parameters of the project), different cash flow options can be implemented and, accordingly, different performance estimates could be obtained, which complicates the process of forming and substantiating managerial and/or investment decisions by traditional methods. A significant problem is predicting the whole complex of effects, positive and negative, as well as the probabilities of scenario implementation.

The cash flow discounting method (CFD) indirectly assumes that a company holds real assets, not taking into account the real options that could be embedded into them, and which can be used to gain a competitive advantage. That is, the TIR is static and "conservatively" analyzes the investment situation, not taking into account the possibility of changing in managerial and/or investment decisions, for example, in the course of the project. Such capabilities require several scenarios for its implementation. However, scenario analysis using conventional approaches does not solve the problem of taking into account dynamic changes in RIO (real investment object) and uncertainty in the external environment. Therefore, at last, an averaged version is adopted, showing how the uncertainty of the project implementation would be taken into account in accordance with the established assumptions. The use of the CFD leads to the fact that during the implementation of the project it can be difficult to abandon the actions planned in the business plan, in the direction of obtaining of new opportunities for more effective implementation of the project and the development of a company as a whole.

3. Research Overview

One of the most significant direction in the creation of more adequate investment research tools, taking into account the potential flexibility of managerial and/or investment decisions can be the method of real (embedded, hidden) options (MRO) [7-8].

The real options’ analysis method is widely used in evaluating of large strategic projects, R&D projects [9]. When solving this class of problems, the project implementation scenarios are analyzed, each aspect of which, depending on circumstances external to the project, can bring to the damage or an additional economic effect. At the same time, there are greater opportunities for obtaining, as a result of the implementation of projects, increased economic benefits and breakthrough technical solutions or damage compensation means, considered as a set of real project options.

In comparing with CFD, the use of MRO in the analysis of projects allows to evaluate the opportunities available to the company in monetary terms, and the investment and other risks that arise during the implementation of projects, in order to maximize the efficient use of limited (which is evident) investment resources [10]. Uncertainty remains, but management can adapt over the time to a changing situation [11]. Thus, MRO allows to make more effective managerial and/or investment decisions in the future in accordance with the incoming new information, evaluating them even at the stage of initial analysis of the project effectiveness. The use of real options when managing a company reduces the importance of compiling costly "accurate" forecasts, and allows to orientate greater efforts towards identifying alternative ways of developing a company.

4. Purpose of the Study

The method of evaluating of an investment project through the value of a real option is often used in conditions of significant uncertainty in growing market conditions [6]. For example, to increase the efficiency of forming a real portfolio of projects, when developing of each of specific projects is included in the investment portfolio, and the portfolio as a whole, it is advisable to evaluate and take into account real options for RIO.

The purpose of this study is a formalization of the computing of the expected effect of the implementation of a portfolio of projects in conditions of risk and uncertainty using real options.
5. Methods of Research

Computing and accounting of the cost of real options for real projects is an important mechanism for increasing the efficiency of forming the investment portfolio of a company. The quantitative assessment of the project plays a key role in making an investment decision. For this assessment, the concept of real options uses the same indicators as the classical theory, however, the concept of real options allows to quantify additional opportunities available in the project and, thereby, include them in the calculation of its value, and also take these possibilities into account when comparing the quantitative parameters of projects during the formation of an investment portfolio.

The evaluation of projects using the real options method is based on the assumption that any investment opportunity for a company can be considered as a real option: the right to create or acquire (sell, return) an asset for a certain time.

6. Findings

Let’s try to analyze the most relevant real options when introducing high-tech innovations in a company.

1. Real options for continued investment are applied if a company, which is carrying out projects with negative net present value (NPV), justifies this with their strategic importance [6, 12-14]. In companies operating in the high-tech industry the following situation often arises: even if the project does not provide the minimum of the required profitability, the company can receive its own cash flows and a real "call" option for the next real investment project.

In conditions of the objective uncertainty concerning future investments in a second real investment project, they can generate income, or they can lead to failure. Uncertainty provides the value of a real option to continue investing, allowing to invest in an investment project, if it is profitable and abandon it, if the investment does not generate income.

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This real "call" option is a real source of strategic value, allowing to invest in a real investment project No. 2, if it is profitable, or to abandon it if the investment does not bring income. Based on the negative NPV, the implementation of a real investment project should be abandoned. But one should take into account and evaluate the strategic value of a real option from the implementation of project No. 1, which includes the opportunity to take a place in the market and get a contract for the production of other products (services), i.e. implementation of project No. 2. Improving the market situation will compensate for the negative NPV of project No. 1. That is, the cost of the option for subsequent investment takes into account the occupied niche of the company in this sector. In turn, the implementation of project No. 2 will give a real option to project No. 3, etc. Thus, the value of a real option to continue investing shows how profitable the possibility of subsequent investment can become with a high degree of uncertainty and fast growth in the market of products (services).

2. A real (technological) option for developing of new innovations depending on the effect of the created scientific and technological backlog in the form of products of intellectual activity (intangible assets) [15] allows managers to increase the value of the company, expanding opportunities for it or reducing losses. This option is split into 3 types:

a) positional option (involves small investments, but in several technological areas to insure against the situation when the main direction chosen by the company does not justify itself economically),

b) intelligence (used if the company can develop the technology, but still it’s vague to what extent the market will perceive it), and

c) a "bridge" option (consists of short-term and small investments in unknown market niches for using the gained experience when creating breakthrough technologies or technologies in promising market niches that appear as the company develops).
When assessing this method, the amount that the investor paid for the right to own this option, represents an investment in an innovative project related to the improvement and refinement of existing products, and the launch of new generations of products in technological areas in which the company already has strong market positions and image. The cost of further investments necessary for the implementation of this project is the price \( P_0 \) that the investor determined at time \( t \); \( P_1 \) is the amount of conditional profit from the project that the investor receives at time \( T \). If it is sometimes advisable for the investor to realize \( P_1 \leq (P_0 + i) \), an option to partially cover the initial costs of R&D [6]. When deciding on the choice of option type, it must be borne in mind that the option itself is useless if the project is not associated with high risk.

Real options on RIO, encountered in practice, are usually much more complicated than the above example. For example, you can refuse to implement a real investment project at any time, and not just in a single case. The price that you can pay for refusing to implement a real project can change over the time and, as a rule, is not known in advance. In addition, even abandoning the implementation of the project, it is possible to return to it, when more favorable circumstances arise for investment [16]. It is also possible to use exotic and other real options for ARI insurance.

The volatility for holders of real options creates a upward potential, and the option exclude limits losses. As long as the real project has a positive NPV, the company seeks to exercise a real option in order to receive a cash flow. If the last ones are high enough, the company will execute "call" option ahead of schedule.

Therefore, authors provide an updated formula for calculating the expected net present value (NPV) of a project under risk and uncertainty using real options:

\[
NPV = \sum_{i=1}^{n} NPV_i \cdot P_i ,
\]

where for the investment process of acquiring, using and selling the corresponding (j-th) real asset in the period \( t \): \( P_i \) is the probability of the \( i \)-th scenario being realized for \( i = 1,...,n \); \( NPV_i \) is the discounted net income of each of the scenarios considered, defined as:

\[
NPV_i = \sum_{t=1}^{T} \sum_{j=1}^{I_t} \left( R_t \cdot C_{t,j} - S_t - K_t - M_t - \sum_{j=1}^{T} (-m_j - d_j + k_j) \right) \left( 1+E \right)^{-t} ,
\]

where for the process of investing in the acquisition, use and sale of the corresponding (j-th) real asset in the period \( t \); \( R_t \) are the current monetary results achieved at the expense of the real asset; \( C_{t,j} \) is current costs in monetary terms excluding investments (in monetary terms) \( I_t \); \( T \) is the horizon of calculation; \( S_t \) is the value of embedded real options; \( M_t \)—financial liabilities associated with the corresponding real asset, if borrowed funds are used to implement the project; \( m_t \) is the amount of interest payments for servicing borrowed funds during the period \( t \) of the project; \( d_t \) is the amount of the return of the main amount of borrowed funds during the period \( t \) of the project; \( k_t \) is the amount of borrowed funds received during the period \( t \) of the project; \( \tau \) is the period of return of the principal amount of borrowed funds and interest for their servicing during the period \( t \) of the project; \( K_t \) is discounted long-term costs associated with the use of real options, namely: (1) the need to change the organizational culture and approaches to doing business in the company; (2) the periodic review of business plans and, as a result, the possible loss of strategic guidelines due to excessive "flexibility" in making management decisions; (3) the need for objective accounting by the company: (a) the price that will have to be paid for refusing to implement the project and which is usually not known in advance and can change over time; (b) opportunity costs of investment, the value of which is comparable to the value of a real option; (c) the possibility of transforming costs (for advertising, hiring, training and firing personnel, specialized products of the service sector, purchasing equipment, etc.) into irrevocable costs, which will make investing inefficient and irreversible. Caution when investing in a project suggests that this process does not begin until the
project income substantially exceeds the long-term average costs; \( E \) is the discount rate applied by the company.

In general case, this may be the general economic discount rate determined by the Fisher formula:

\[
1 + E = (1 + i) - (1 + \alpha) - (1 + r). \tag{3}
\]

At the same time, the risk of the project, taken into account formulas (1) and (2), when using real options will be lower. The total expected effect (\( \overline{E} \)) for a portfolio of \( L \) projects with real options built into them is calculated as:

\[
\overline{E} = \sum_{i=1}^{L} \sum_{j=1}^{n} \left\{ \sum_{t=0}^{T} \left( \frac{R_{t} - C_{t}^{i}}{(1 + E)^{t}} - \sum_{t=1}^{T} \left( I_{t} - S_{t} - K_{t} - M_{t} - \sum_{t=1}^{T} (-m_{t} - d_{t} + k_{t}) \right) \right) \right\} \cdot p_{i}. \tag{4}
\]

When analyzing real options, it is often impossible to apply the calculation formulas derived for financial options, since options that have real assets as their underlying assets differ significantly from them. In particular, the difference between them is related to the interest rate used for them. In the first case, the yield of the least-at-risk asset default asset is used—short-term 3-month government bonds. For real options, the risk-free interest rate is usually determined individually for each project, for example, the refinancing rate of state central banks for the least risky projects, but more often the average return on investment in the relevant industry.

7. Conclusion

It is very important, especially for Russia, to use real options for ARI, in particular, for projects in conditions of investors having a psychological distrust of large and long-term private investment. It should be borne in mind that the cost of creating of a real option may be unjustified, for example, the ability to increase output (investment in additional production capacity) may not be provided by an increase in demand for them [2].

The use of a more objective formula for calculating the expected effect of the implementation of an investment project using real options allows you to increase the effectiveness of ARI insurance using real options under conditions of risk and uncertainty and use the additional features contained in investment projects for more effective development.

References

[1] Kim, K., Park, H., and Kim, H. (2017) Real options analysis for renewable energy investment decisions in developing countries. Renewable and Sustainable Energy Reviews, 75. P. 918-926.

[2] Kudryashov, A. A. (2007) Improving the mechanisms for attracting investments using options for innovative development in the Russian economy/Ed. L.P. Goncharenko. Book 3. M: Ros.ekon.akad., 44 p.

[3] Baranov, A.O., and Music, E.I. (2015) The concept of real options as an innovative method for evaluating investment projects in industry. Bulletin of Novosibirsk State University. Series: Socio-economic sciences, 15 (1). P. 32-51.

[4] Sedash, T. (2014) The method of real options in the assessment of investment projects in the field of energy supply. Financial life, 3. P. 62-65.

[5] Malyuga, K.A. (2015) Features of the application of the real options method in investment projects. Scientific Review, 2. P. 229-235.
[6] Menassa, C., Pea Mora, F., and Pearson, N. (2010) Study of real options with exogenous competitive entry to analyze dispute resolution ladder investments in architecture, engineering and construction projects. Journal of Construction Engineering and Management—ASCE, 136(3). P. 377-390.

[7] Fan, Y. & Zhu, L. (2010). A Real options Based model and its application to china's overseas oil investment decisions. Energy Economics, 32(3). P. 627-637.

[8] Kokin, A.S., and Oskolkov, I.M. (2015) The theory of real options as a paradigm for making investment decisions. Audit and financial analysis, 4. P. 237-240.

[9] Krychowski, C., and Quélin, B. (2010) Real options and strategic investment decisions: can they be of use to scholars? The Academy of Management Perspectives, 24 (2). P. 65-78.

[10] Матяш, И.В. (2015) Инвестиционная стратегия предприятия в условиях неустойчивой экономики: метод реальных опционов//Известия Алтайского государственного университета, Vol. 1, 2 (86). P. 111-116.

[11] Chernenkaya, L.V., Desyatirikova, E.N., Fedosova, S.P., Ievleva, A.A., and Vertakova, A.Y. (2018) Optimization of risk management of innovation projects in civil engineering. Proceedings of the 2018 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering, ElConRus 2018. P. 1251-1253.

[12] Leonova, T.I., Mager, V.E., Mikeladze, B.D., Chernenkaya, L.V., and Chernenkii, A.V. (2017) Support of decision-making in organizations' Quality Management. Proceedings of 2017 20th IEEE International Conference on Soft Computing and Measurements, SCM 2017, 7970741. P. 843-845.

[13] Fernandes, B., Cunha, J., and Ferreira, P. (2011) The use of real options approach in energy sector investments. Renewable and Sustainable Energy Reviews, 15(9). P. 4491-4497.

[14] Volkova, V.N., Kozlov, V.N., Mager, V.E., and Chernenkaya, L.V. (2017). Classification of methods and models in system analysis. Proceedings of 2017 20th IEEE International Conference on Soft Computing and Measurements, SCM 2017. P. 183-186.

[15] Filin, S.A. & Chaikowska, L.A. (2018) A Model of Option Pricing When Calculating Size of Net Assets. Journal of Corporate Finance Research, vol. 13, 1. P. 91-106.

[16] Bemš, J. & Starý, O. (2013) Investment modeling using real options approach. Economy and Entrepreneurship, 3(32). P. 195-199.