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EVALUATION OF MANAGERIAL FLEXIBILITY: THE METHOD OF REAL OPTIONS

Summary: The flexibility of decision-making is one of the most important prerequisites for effective management, especially in investment projects. The author characterized the types of real options, depending on their contribution to the value of the business. Different types of real options are presented (option to abandon, to expand, to scale, to delay) in conjunction with examples of real applications in different industries (oil, construction, transportation, pharmaceuticals, etc.) A short description of the methods for evaluating real options, including binomial model is presented. the positive and negative aspects are assessed, and recommendations for extracting the maximum value from the application of the method of real options are provided in terms of building learning organizations, promoting empowerment and delegation, involvement in strategic decision-making, and organizational agility.

Keywords: flexibility, real options, binomial model.

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1. Introduction

The need to respond quickly to changes in the environment , to adapt to them with some benefit to itself is essential for the effectiveness of any business. Therefore more and more importance in scientific research, as well as practical managerial development (best practice), has been given to the concept of flexibility – a modern professional term of financial analysts describing the right of management to adjust future managerial actions to changing market conditions, competitive response or the results obtained during the previous stages of the project. This concept has a direct close connection with the theory of option pricing.

Let us recall that real options allow managers to make future decisions that change the value of capital budgeting decisions made today. Real options are similar to financial put and call options in that they give the holder of the option the right (but not the obligation) to make certain decisions. The difference is that real options are based on real rather than financial assets and are dependent on future events. Hence

the real options give managers the flexibility that increases the net present value of investment projects [Rogers 2002].

As was mentioned by us in a previous article [Leshchiy 2010], real options are often referred to as a value added by imbedding flexibility into an inflexible project. Hence, under uncertainty,

Expanded Value = Expected NPV + Value of Real Options.

Real options capture the value of managerial flexibility to adapt decisions in response to unexpected market developments. Companies create shareholder value by identifying, managing and exercising real options associated with their investment portfolio. The real options method applies financial options theory to quantify the value of management flexibility in a world of uncertainty.

The methodology of real options was proposed long ago – back in 1977, by S. Maersom, an American expert on finance theory. The basis for the emergence of this theory has also been the work of Fisher Black, Myron Scoles and Robert Merton, published in 1973. It still largely remains a theory because of the complexity of its application in practice (this question, however, is widely debated). But to lose one of the most interesting proposals for the alternative evaluation of investment projects would be unacceptable just because it may be difficult to present it to practitioners.

2. Types of options and methods of their valuation. The binomial model

Since uncertainty is an indispensable business attribute, the possibility to change or adjust managerial decisions in the course of project implementation, real option can be regarded as the increase of value of an inflexible project. The management literature identifies the following types of real options:

Option to abandon

This is the possibility to discontinue the least profitable projects. For example by leasing premises or machinery one can terminate the agreement with minimal losses while doing the same with purchased assets will be more difficult.

The first and most direct way of creating an option to abandon is to build operating flexibility contractually with those parties that are involved in the investment. Thus, contracts with suppliers may be written on an annual basis rather than long-term, and employees may be hired on a temporary basis rather than permanently. Entering into short-term agreements with suppliers and leasing the physical plant may be more expensive than committing for the life of the investment, but that additional cost has to be weighed against the benefit of maintaining the abandonment option.

Another approach is to build a highly flexible structure of the cost base as demonstrated by low cost airlines. Thus, when revenues decline (as they inevitably

do at some point in time when the economy weakens), these companies are able to cut their costs and stay profitable while other airlines face near- bankruptcy.

Option to expand

These are new opportunities that can emerge after the initial investment is made. For example an electronics company is looking at a new product development. In the current period this will bring nothing but cost, yet by investing in research and development, the company is creating an option to expand as there is a probability that the product will be a success and the project will be profitable.

In general, the option to expand is more valuable for more volatile businesses with higher returns on projects (such as biotechnology or computer software), than in stable businesses with lower returns (such as utilities or automobile production). Specifically, the option to expand suggests that large investments should be broken up into smaller phases, or that firms should accumulate cash or hold back on borrowing, thus preserving financial flexibility [Copeland, Keenan 1998].

A phased approach to investment is exactly what helped British Petroleum minimize its losses in Russia after the notorious nationalization of the joint venture in Tyumen. Generally the phased approach is recommended in the following cases:

- Projects where there are significant barriers to entry from competitors, which take advantage of delays in full-scale production. Thus, a firm with a patent on a product or other legal protection against competition pays a much smaller price for starting small and expanding as it learns more about the product.
- Projects where there is significant uncertainty about the size of the market and the eventual success of the project. Here, starting small and expanding allows the firm to reduce its losses if the product does not sell as well as anticipated, and to learn more about the market at each stage.
- Projects where there is a substantial investment needed in infrastructure (large fixed costs) and high operating leverage. Capital intensive projects as well as projects that require large initial marketing expenses (e.g. a new brand launch) will gain more from the options created by taking the project in multiple stages.

Option to scale

This is an up or downsizing of the scale of the operations during the project lifecycle which is specific for cyclical industries, for example the possibility to put on hold construction projects during the period of declining demand and growing interest rates.

Option to delay

Options with delay can value the ability to wait and learn, thus resolving uncertainty, before investing (a timing option). Eurotunnel has a statutory option on a second tunnel under the English Channel to be opened not earlier than 2020 (its lease on the first tunnel expires in 2052).

In a more down-to-earth example, sales of school stationary grow considerably before the beginning of the school year, hence the implementation of a project on the manufacture and sales of notepads exactly during this period will significantly increase its returns.

There are two methods of assessing the value of real options:

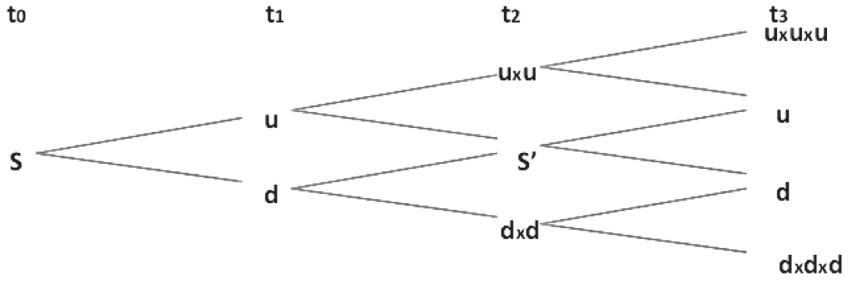
– the Black-Scholes model,
– the binomial model.

The first method is quite complex mathematically, the calculations contain a large number of parameters with estimated values, for example, the value of the discounted value of cash flows from the sale, statistical dispersion value, etc. Hence it is rarely used in practice (in addition, this model is partly seen in our previous article [Leshchiy 2010]) and we will focus more on the second method. The techniques of building a binomial model is more cumbersome than the Black-Scholes method, but it provides a more accurate outcome when there are many sources of uncertainty or a large number of different points in time when decisions are made.

The model is based on two assumptions:

– at each point in time there can only be two scenarios (worst and best),
– the investors' attitude towards risk is neutral.

This model can be represented as a decision tree, and at each point (node) managers strive to make the best decision. Cash flows arise as a result of future actions and are, in fact, present value. The more nodes of decision-making, the more difficult it is to make an assessment. Let us consider the following decision tree (Figure 1):



t – time,
s – the initial cost of the asset,
u – value growth (e.g. if s = 1.3 this means expectation of the value growing by 30%),
d – value reduction.

Fig. 1. A binomial tree

Source: [Брусланова; Ивашковская, Пирогов 2006].

In practice, the main difficulty of using this model is in the calculation of the relative increase or the decrease in the value of business in each period, and the probability of positive and negative scenarios. Let us look at the formula used for the respective calculations. It is possible to grow a business is computed as follows:

U = es.

The relative decrease in the value is computed by the formula:

D = 1 : u,

P = ((1 + r) – d): u – d.

The valuation of real options using the binomial model for a large number of decisions points will be close to the value obtained using the Black-Scholes model . Although the calculations are rather cumbersome, this allows us to take into account any additional factors and scenarios of the project. Consider applying the binomial model in a simplified form as an example [Брусланова].

It is planned to manufacture a new product. The project duration is two years. The initial investment – 120,000. In a year it is planned to launch the product and it is still required to invest 150,000. Cash flows are expected in two years after the start of the project, but it is still unclear whether the product will be in demand. The probability of a positive scenario with a revenue of 500,000 is 60%, and the probability of a negative scenario with an income of 50,000 is 40%. The discount rate is 18%. Calculate the NPV standard way:

$$NPV = –120 + (–150): 1{,}18 + (0{,}6 \times 500 + 0.4 \times 50): 1.18\ 2 = –17{,}3.$$

Since the NPV is less than zero, the project should be abandoned. But if one year after the start of the project we know whether there is a demand for these products, managers will be able to decide whether to continue the project. The possibility of choice in this case is the firm's option to abandon.

Calculate the NPV using the option:

$$NPV = –120 + (0{,}6 \times (–150) + 0.4 \times 0): 1.18 + (0.6 \times 500 + 0.4 \times 0): 1{,}18\ 2 = 19.2 .$$

As you can see, the value of NPV is positive, and this project can be implemented.

In a broader sense, a pure decision-tree analysis tends to consider in great detail the cash flow models and many uncertainties, but relatively less in the way of dynamic decision-making, i.e. "detail complexity". Instead, real options focus on "dynamic complexity" [Smith 1999]: the evolution of a few complex factors over time that determine the value of investment and cash flows. These are factors about which decisions can be taken at any time over a period. There are a large number of these factors with decisions made at discrete time periods. Actually, "dynamic complexity" is supplementary to "detail complexity" as real options are supplementary to NPV evaluations.

3. Advantages, disadvantages and recommendations for the use of the real options method: concluding remarks

The concept of real options to some extent contradicts the traditional approaches to investment evaluation. Traditionally, an increase in uncertainty leads to an increase in the discount rate and, consequently, a reduction of project return (e.g. net

present value). Whereas using the real options method opens up new possibilities for a comprehensive and objective evaluation of projects even at the stage of their development, with even seemingly unprofitable projects turning out to be quite acceptable and even profitable.

Real options can actually be viewed as a bridge between corporate finance and corporate strategy. Historically, the former has been focused on how best to assess the value of risky assets in the interests of maximizing a firm's value, and the latter on the sources of competitive advantages and market potential. The real option framework allows us to bring the rigors of financial analysis to corporate strategic analysis and link it up with value creation and maximization. The real options approach unleashes the value of maintaining flexibility in both operating and financial decisions [Luehrman 1998; Trigeorgis 1996].

Let us look at the activities for which the consideration and measurement of managerial flexibility is crucial, and which, in our opinion, would have received the benefits of using the method of real options:

1. High tech and innovative industries – electronics, pharmaceuticals, cosmetics. These industries operate under conditions of uncertainty, because the demand estimate for innovative products is always probabilistic in nature.

The option to delay provides interesting perspectives on two common investment problems. The first is in the valuation of patents, especially those that are not viable today but could be viable in the future; by extension, this will also allow us to look at whether R&D expenses are delivering value. The second is in the analysis of natural resource assets – vacant land, undeveloped oil reserves etc.

2. Industries highly sensitive to political and regulatory impacts as well as the impacts of world commodity prices such as petro chemistry, gas transportation etc.

Mining and commodity companies have been at the forefront in using real options in decision-making. One reason is that natural resource options come closest to meeting the prerequisites for the use of option pricing models. Firms can learn a great deal by observing commodity prices and can quickly adjust their behavior in terms of development and exploration. In addition, if we consider exclusivity to be a pre-requisite for real options to have value, that exclusivity for natural resource options derives from their natural scarcity.

What are the implications of treating natural resource reserves as options? As the authors explain [www.stern.nyu.edu/~adamodar/pdfiles/valrisk/ch8.pdf]:

- The first is that the value of a natural resource company can be represented as the sum of two values: the conventional risk adjusted value of expected cash flows from developed reserves and the option value of undeveloped reserves. While both will increase in value as the price of the natural resource increases, the latter will respond positively to increases in price volatility. Thus, the value of oil companies should increase if oil prices become more volatile, even if oil prices themselves do not increase.

- The second is that conventional DCF valuation will undercall the value of natural resource companies because it will miss the option premium inherent in their undeveloped reserves.
- The third is that the development of natural resource reserves will slow down as the volatility in prices increases; the time premium on the options will increase, making the exercise of the options (development of the reserves) less likely.

3. Industries related to exports and imports (especially for countries with "soft" currencies). In addition to traditional uncertainty that is inherent to all these sectors, they are also exposed to the FX risk.

With a large FX change in the course of the project, NPV values can easily change into the opposite. Therefore the presence of an option to abandon in this situation, and considering it in quantitative terms when evaluating the investment project can be extremely important.

Note that despite the validity of the mathematical evaluation, the method of real options is quite intuitive and often contains an element of creativity. Therefore not every organization can use it, and above all, it depends on the skills, capabilities and style of the managers. Thus, more and more scholars are inclined to think that such an advanced management technology requires the creation of a special type of organization – a learning organization. Let us articulate the basic and, in our view, the most important requirements for this organization:

- Continuous training and high level of skills. The participation of employees and middle-level managers in strategic decision-making (encourage the submission of improvement proposals, a comprehensive assessment of industrial achievements and best practices).
- Understanding by the managing director of the business' specifics, including the technological aspects as well as the prospects of the industry, market conditions, etc.
- Understanding by the managers and the rest of the staff the importance of the latest management and information technology. In particular, the importance of understanding the design and analysis of brands.
- Agility in decision-making and a balanced attitude towards risk as an integral part of the modern business environment.

References

Copeland T.E., Keenan P.T., 1998, *Making real options real*, The McKinsey Quarterly, no. 3, McKinsey & Company, New York.

Leshchiy L., 2010, *Real options in evaluation of investment decisions*, Quantitative Methods in Accounting and Finance", Research Papers of Wrocław University of Economics, no. 145, pp.75-80.

Klingebiel R., Adner R., *Real options logic revisited: The performance effects of alternative resource allocation regimes*, amj.aom.org/content/early/2014/03/17/amj.2012.0703.full.pdf+html.

Kumiega A., Van Vliet B., 2013, *A practical real options approach to valuing High-Frequency Trading System R&D Projects*, The Journal of Trading, vol. 8, no. 3, pp. 40-48. DOI: 10.3905/jot.2013.8.3.040.

Luehrman T., 1998, *Strategy as a portfolio of real options*, Harvard Business Review, Sept-Oct, reprint: 98506.
Rogers J., 2002, *Strategy, Value and Risk – The Real Options Approach: Reconciling Innovation, Strategy and Value Management*, Palgrave Houndmills, Basingstoke, Hampshire, New York.
Smith J., 1999, *Much ado about options?*, Fuqua School of Business, Duke University, July.
www.stern.nyu.edu/~adamodar/pdfiles/valrisk/ch8.pdf.
Trigeorgis L., 1996, *Real Options: Management Flexibility and Strategy in Resource Allocation*, MIT Press, Cambridge, Mass.
Бухвалов А.В., 2004, *Реальные опционы в менеджменте, Российский журнал менеджмента*, № 2.
Брусланова Н., *Оценка инвестиционных проектов методом реальных опционов*, www.rbsys.ru/print.php?page=342&option=media.
Ивашковская И., Пирогов Н., 2006, *Гибкость: взгляд финансиста*, Управление компанией, № 6.
Пенцак Є., *Гнучкість має вартість*, www.companion.ua/.../CrisisM-2-KMBS-Pentsak.
ROA, Метод реальных опционов, www.k2kapital.com.

EWALUACJA ELASTYCZNOŚCI MENEDŻERSKIEJ: METODA OPCJI REALNYCH

Streszczenie: Elastyczność podejmowania decyzji jest jednym z najważniejszych warunków efektywnego zarządzania, szczególnie w projektach inwestycyjnych. Autorka przedstawia różne rodzaje opcji realnych w połączeniu z przykładami rzeczywistych ich zastosowań w różnych gałęziach przemysłu (energetyczny, budownictwo, transport, farmaceutyczny itp.) oraz prezentuje krótki opis metody ewaluacji opcji realnych, w tym model dwumianowy.

Słowa kluczowe: elastyczność, opcje realne, model dwumianowy.