QUID 2017, pp. 1352-1357, Special Issue N°1- ISSN: 1692-343X, Medellín-Colombia

MATHEMATIC ECONOMIC MODEL OF CAPITAL PROFITABILITY AND INNOVATIVE CHEMICAL PROJECT ASSETS WITH FUZZY DESCRIPTION OF ITS INDICATORS

(Recibido el 18-05-2017. Aprobado el 01-09-2017)

Igor Leonidovich Beilin
Kazan Federal University, Institute of Management, Economics and Finance, Kazan 420008, Russia Federation

Abstract.The range of applied possibilities of fuzzy logic theory in the analysis of the economic efficiency of an innovative chemical project is shown. A methodology for determining the return on assets and the return on assets of an innovative chemical project in conditions of uncertainty has been developed. In the 21st century, rapid changes took place throughout the world on the economic, social and business fronts. Their scales have formed an extremely complex and unpredictable decision-making structure that is difficult to model with traditional approaches. The main goal of this paper is to present the latest achievements in the development of innovative methods of uncertainty management that prevails in the global economic and administrative environment. Innovative projects that are highly technological, costly, energy- and labor-consuming, meeting all environmental standards are the basis for effective development of economy in each region. The Republic of Tatarstan is distinguished by a very high developed petrochemical cluster which small innovative projects are the most numerous and in demand today. Such models are the basis on which future breakthrough large-scale production is formed, but the forecasting of their development meets with high degrees of uncertainty connected both with traditional external and internal political and economic conditions, and are characteristic mainly for new projects with innovation, investment, market, commercial, raw materials, sector, and other risks.

Key words: mathematic economic model, return on assets, profitability of assets, uncertainty, fuzzy sets, project management, innovative chemical project.

Citar, estilo APA: Beilin, L. I. (2017). Mathematic economic model of capital profitability and innovative chemical project assets with fuzzy description of its indicators. *Revista QUID (Special Issue)*. 1352-1357.

1. INTRODUCTION

At present, the economy of the chemical industry has a number of specific features. First of all, this is due to the fact that the final product can be made from different raw materials and at the same time, a wide range of products can be obtained from a single raw material. Such an opportunity led to the rapid development of small innovative enterprises based on science intensive high-tech projects in the field of chemical sciences. It is possible to formulate the following research areas devoted to economic efficiency of the chemical complex in the Republic of Tatarstan:

- Study of hydrocarbon raw material distribution in neighboring regions of the Republic of Tatarstan,

- Allocation of products for their processing in the Republic of Tatarstan and in other regions,

- Formation of an end-to-end system for processing hydrocarbon raw materials and ensuring interregional cooperation on this basis.

Solution of these tasks can be of decisive importance for such issues of socio-economic development of the Republic of Tatarstan as:

- Innovative bases of competitiveness of the region,

- Factors and conditions for the formation of an innovative level of the regional economy,

- The scientific potential and the market of intellectual property in ensuring the innovative development of a regional production cluster,

- Influence of intra- and interregional cooperation on the innovation level and competitiveness of the petrochemical cluster,

- Impact of the financial sector on the innovative development of the region,

- Modeling of the influence of innovation potential on the competitiveness of the regional economy,

- Organizational basis of the regional state management system and the main areas of its improvement,

- Creation of a system of regional innovation sites and the intellectual property market as sources of innovations and their commercialization,

- Scientific and personnel support for the formation of a regional innovation model.

2. LITERATURE REVIEW

Detailed design, research and calculation of risk have now become an integral part of successful operation of a modern chemical company. Nevertheless, most often companies must make decisions in conditions of uncertainty, which can lead to unexpected consequences and, as a result, undesirable results and losses [1]. Particularly severe consequences may be caused by incorrect decisions in long-term investments which are usually implied in the evaluation of investment projects. Therefore, early recognition, as well as an adequate and more accurate calculation of risk, is one of the most important problems of modern investment analysis. Unfortunately, the calculation of risks and their assessment include subjectivity and background factors that lead to errors in the risk assessment of a project. The theory of fuzzy sets is a new, actively developing approach to risk assessment. Recently, fuzzy modeling is one of the most active and promising applied research and trends in management and making decisions (Wierman & Mark, 2016). In the chemical industry, which is characterized by rapidly developing science and a high degree of commercialization, fuzzy modeling is especially important (Gerla, 2016). The risk of an investment project is the probability of deviation of future cash flows from the expected ones due to incomplete and asymmetric information. This is related both to external factors (legislation, market reaction to manufactured goods, competitive activity), and internal (personnel incompetence, errors in definition of project characteristics).
Below are the main methods of risk analysis of an investment project.

Qualitative analysis reveals certain types of project risks that affect the formation and flow of funds, as well as possible reasons for their deviation from the forecast. Its advantages include visible results and the fact that the risks identified can be used to obtain recommendations for minimizing them. The shortcomings include the lack of a quantitative risk assessment.

Quantitative analysis involves determining the quantitative consequences of risk realization in the project. Its advantages include ease of use and clarity of results. The disadvantages include the assumption of changing only one criterion when all the others are considered unchanged.

Scenario analysis is a definition of the project inefficiency risk as the sum of the probabilities of negative values of the project's net present value (NPV). Its advantages include ease of use and clarity of results. Its drawbacks include subjectivity in assuming the probability of each scenario and infinity of the number of possible options and scenarios of the innovative project's behavior.

The meaning of the computer modeling (Monte Carlo method) consists in multiple iterations to determine the spread of the values of net present value (NPV), the calculation of its mean values, and determination of the risk value on this basis. Advantages include a more accurate and concise assessment of project risks and high compatibility with other economic statistical methods, as well as with game theory and other operational research methods. The disadvantages include uncorrelated (cross-independent) variables, complexity and a large amount of computational work.

3. METHOD

In mathematics, fuzzy sets are sets which elements have degrees of membership. Fuzzy sets were introduced by Lotfi Zadeh and Dieter Claua in 1965 as an extension of the classical set concept. In the classical theory of sets, the membership of elements in a set is estimated by binary terms in accordance with the bivalent condition that an element either belongs to or does not belong to the set. On the contrary, the theory of fuzzy sets admits a gradual evaluation of the membership of elements in a set (Valiant & Leslie, 2013), (Giovanni, Bruno , Stefano & Vitiello, 2016), (Stefano & Bruno, 2013), (Giovanni & Chang-Shing, 2013), (Beilin & Arkhireev, 2006). This is described using the membership function defined in the real unit interval (Gautam & Sharma , 2014), (Beilin, 2016). Fuzzy sets generalize classical sets, since the indicator functions of classical sets are special cases of membership functions of fuzzy sets, if the latter take only values 0 or 1. In the theory of fuzzy sets, classical bivalent sets are usually called crisp sets. The theory of fuzzy sets can be used in a wide range of areas in which information is incomplete or inaccurate, for example, the economics of an innovative project.

4. RESULTS AND THEIR DISCUSSION

Analyzing the return on assets of the portfolio of innovative chemical projects "Copolymer +" (Beilin & Arkhireev, 2009), (Beilin & Arkhireev, 2005), (Beilin & Arkhireev, 2011), (Beilin & Arkhireev, 2011), on the basis of the initial data (Table 1) was conducted as a result of a fuzzy logic approach using L-R-type numbers.

Project characteristics	L (x)	A	R (x)
Assets, thousand rubles	480	510	570
Revenue, thousand rubles	80	100	155
Discount rate (r),%	15	17	22

Table 1 .Economic characteristics of the innovative chemical project "Copolymer +" to determine the return on assets.

We will make calculations that allow making a decision on the possibility of attracting loan investments. In our case, the return on assets increases in comparison with the return on assets as the volume of borrowed funds increases (Tab. 2).

Borrowed funds (E), thousand rubles.	Return on assets (ROA),%		
	L (x)	A	R (x)
0	14.035	19.608	32.292
50	13. 27	19. 89	34. 30
70	12. 92	20. 02	35. 24
120	11. 91	20. 41	38. 06

Table 2.L-R-type fuzzy numbers of return on assets (ROA) for the innovative chemical project "Copolymer +".

Moreover, when the right branch of the L-R-type fuzzy number is shifted to the right, its left branch is shifted to the left to a much lesser degree, what can be considered as being at the error level. In the first case, when all assets are own funds, the left branch advances significantly to the left, which also emphasizes the economic feasibility of raising borrowed funds (Table. 3).

Borrowed funds (E), thousand rubles	Return on assets (POA),%	μ (x)	Crisp number for ROA, %	Integrated area L (x)	Integrated area R (x)
0	13.097	0.000	18.651088	-	-
	19.608	1.000			
	32.29	0.00			
50	13.269	0.000	21.838541	5.08611538	1.01
	19.891	1,000			
	34.30	0.00			
70	12.920	0.000	22.052.339	4.9115	1.48
	20.023	1.000			
	35.244	0.000			
120	11.911	0.000	22.696794	4.40705555	2.88
	20.410	1.000			
	38.056	0.000			

Table 3 .The degree of membership for L-R-type fuzzy numbers as to return on assets for the innovative chemical project "Copolymer +".

As the borrowed funds increase, the decrease in the area of triangles (Table 3) formed by left branches of the membership function, and at the same time the increase in the areas of the triangle formed by the right branches of the membership function confirms the conclusions drawn above about the appropriateness of attracting the most possible borrowed funds upon a given discount rate (Fig. 1).

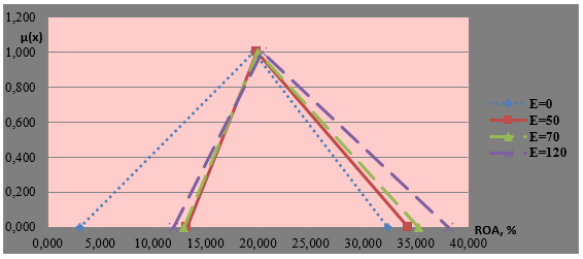

Fig. 1. The function of membership for the return on assets of the innovative chemical project "Copolymer +" under conditions of uncertainty.

The change in the return on assets behaves in the opposite way (Fig. 2, Table. 4). The most probable, the extreme left and the extreme right values of the return on assets are reduced proportionately with increase in the number of borrowed funds. Unlike the return on assets, this result cannot be affected by the economic efficiency of the innovation project, since its calculation does not take into account the differences between the profit given by borrowed funds and their value.

Borrowed funds (E), thousand rubles.	Return on assets (ROA),%		
	L (x)	A	R (x)
0	14.035	19.608	32.292
50	12.11	17. 94	30. 73
70	11. 33	17. 27	30. 10
120	9. 40	15. 61	28. 54

Table 4 .L-R-type fuzzy numbers for return on assets (ROA) for the innovative chemical project "Copolymer +".

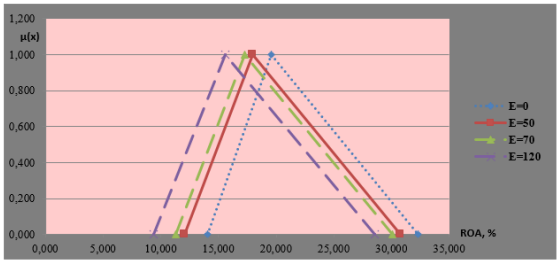

Fig. 2. Membership function for the return on assets of the innovative chemical project "Copolymer +" in conditions of uncertainty.

In fact, the strongest economic structures, such as banks, enterprises and entire states function in a regime of constant borrowing, disposing the borrowed funds so that the profits they receive exceed the cost of debt.

5. SUMMARY

The performed calculations showed that for the innovative chemical project "Copolymer +", with an increase in the cost of debt, the most probable and the maximum possible return on assets (shareholder returns) grow. At the same time, the minimum possible return on assets remains virtually unchanged. Therefore, for the implementation of the innovative chemical project "Copolymer +" in conditions of uncertainty, the most promising is the fourth option of financing, in which the borrowed funds are maximum at a given discount rate.

6. CONCLUSION

Thus, after calculating the most cost-effective alternative to the development of the project, its plan may be presented. Project and Portfolio Management system (Microsoft Project Professional) helps to optimize the projects, resources and portfolio management, and integrated planning tools help to trace projects and keep them under control. The innovative projects management system makes it possible to start works quickly and simplifies the implementation of projects. Built-in templates, planning tools and access from different devices increase the efficiency of project managers and project teams.

ACKNOWLEDGMENTS

The work is carried out according to the Russian Government Program of Competitive Growth of Kazan Federal University.

REFERENCES

Acampora, Giovanni; Loia, Vincenzo; Lee, Chang-Shing; Wang, Mei-Hui (2013). "On the Power of Fuzzy Markup Language".

Ahlawat, Nishant, Ashu Gautam, and Nidhi Sharma (International Research Publications House 2014) "Use of Logic Gates to Make Edge Avoider Robot." International Journal of Information & Computation Technology (Volume 4, Issue 6; page 630).

Beilin, I.L. Analysis of efficiency of the innovative project in the field of chemistry fuzzy logic // Journal of Economics and Economic Education Research. 2016, Volume 17, Special Issue 3, Number 4, pp. 177 – 185.

Beilin, I.L., Arkhireev, V.P. Copolymerization of cyclic carbonates with isocyanates under anionic initiation conditions and structure of the new copolymers // Russian Journal of Applied Chemistry. January 2006, Volume 79, Issue 1, pp 133–136.

Beilin, I.L., Arkhireev, V.P. New copolymer products from cyclic carbonates and isocyanate-containing compounds // Protection of Metals and Physical Chemistry of Surfaces. July 2009, Volume 45, Issue 4, pp 450–454.

Beilin, I.L., Arkhireev, V.P. New copolymers of propylenecarbonate with controlled complex of properties // Plastics: Synthesis. Characteristics. Processing. Use. Issue 7, 2005, Pages 12-15.

Beilin, I.L., Arkhireev, V.P. Synthesis and structure of copoly(amide esters) based on cyclic carbonates and monofunctional isocyanates // Protection of Metals and Physical Chemistry of Surfaces. July 2011, Volume 47, Issue 4, pp 478–483.

Beilin, I.L., Arkhireev, V.P. The supermolecular structure of new copolymer products based on cyclic carbonates // International Polymer Science and Technology. Volume 38, Issue 1, 2011, Pages 37-40.

Di Stefano, Bruno N. (2013). "On the Need of a Standard Language for Designing Fuzzy Systems". 296: 3–15. ISSN 1434-9922.

Gerla G. (2016). "Comments on some theories of fuzzy computation". International Journal of general Systems. 45 (4): 372–392.

Giovanni Acampora, Bruno N. Di Stefano, Autilia Vitiello: IEEE 1855TM: The First IEEE Standard Sponsored by IEEE Computational Intelligence Society [Society Briefs]. IEEE Comp.Int. Mag. 11(4): 4-6 (2016)

Valiant, Leslie, (2013) Probably Approximately Correct: Nature's Algorithms for Learning and Prospering in a Complex World New York: Basic Books.

Wierman, Mark J. "An Introduction to the Mathematics of Uncertainty: including Set Theory, Logic, Probability, Fuzzy Sets, Rough Sets, and Evidence Theory". Creighton University. Retrieved 16 July 2016.