International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

Quantity Assessment of the Risk of Investment Projects

Inna Riepina, Olha Hrybinenko, Nataliia Parieva, Oleksandra Parieva, Igor Savenko, Natalia Durbalova

Abstract: ***The key to increasing the value of the enterprise, its competitiveness and profit level, respectively, is a timely and adequate investment in the investment project. However, the risks that have been underestimated can adversely affect the sustainability and financial performance of the enterprise. That is why it is essential to quantify the risk of investment projects.***

The article covers the issues of quantitative risk assessment of an investment project. The concept and methodology of investment risk assessment are considered. The methods of a quantitative evaluation of risks are presented. The simulation experiment was performed.

Keywords : Decision Tree, Investment Project,Method of Analogies Risk, Sensitivity (Vulnerability) Analysis Simulation Modeling.

I. INTRODUCTION

At the present stage of economic development in most countries, there is a sharp increase in the number of innovative enterprises. Innovative are enterprises that produce innovative products using, as a rule, high technology [1]. High tech is a technology that systematically uses scientific and technical experience. Innovative products are sophisticated products that require specialized technological knowledge, are prone to aging technologies, and are produced by companies employing at least twice as much technical staff as conventional companies and investing at least twice as much in research and development amount of cash [2].

Therefore, an innovative project is a high-tech project aimed at achieving a specific goal (in particular, the development of innovative products). Risk management, risk management is the process of making and executing management decisions aimed at reducing the likelihood of an adverse result and minimizing the potential losses of the project caused by its implementation. Modern economic science poses a risk as a probable event that only neutral or negative effects can occur [3].

However, more detailed research requires quantification of the risk of investment projects.

The purpose of the article is to provide a methodology and a practical example of applying quantitative risk assessment of investment projects.

II. THE PROPOSED METHODOLOGY OF QUANTITY ASSESSMENT OF THE RISK OF INVESTMENT PROJECTS

A. Definition of the term "investment project"

In the conditions of turbulence in the economy and politics of Ukraine, there is a deterioration in the investment climate. Therefore, together with the development of promising investment projects, it is necessary to define a methodology for assessing the risks involved.

The interpretation of the concept of "investment project" by various scholars is given in Table. 1.

Table- I: Definition of the term "investment project"

Author	Definition
Dankov Ya. Ya., Vakarov V.M. [4]	Investment project - a set of united in one whole intentions and practical actions for making investment investments, ensuring certain specific financial, economic, industrial and social measures for profit.
Rusin R.S. [5]	Investment project - a set of measures and intentions, justifications and practical actions taken by the investor through the preparation of appropriate documentation, including an investment plan aimed at profit or social impact in the future.
Chernysh S. [6]	Investment project - a set of design estimates that substantiates the feasibility, scope and timing of investments; a plan of investing for the next generation of income or other significant effects (social, environmental), that is, a description of the investment idea and the specific steps of its implementation.
Shvets Y.A., Kapshuk A.S. [7]	The investment project is an interconnected system consisting ofa set of interdependent activities performed by the project team with limited resources, project execution time, the negative impact of investment market factors on the project implementation and aimed at achieving the goals in the short term.

Manuscript published on 30 September 2019
* Correspondence Author
Inna Riepina, Department of Business Economics and Entrepreneurship, SHEE «Kyiv National Economic University named after Vadym Getman», Kyiv, Ukraine
Olha Hrybinenko, Faculty of Finances and Economics, Dnipro University of Technology, Dnipro, Ukraine
Nataliia Parieva, Department of Accounting, Analysis and Audit, Odessa National Polytechnic University, Odessa, Ukraine
Oleksandra Parieva, Department of Accounting, Analysis and Audit, Odessa National Polytechnic University, Odessa, Ukraine
Igor Savenko, Management and Logistics Department, Odessa National Academy of Food Technologies, Odessa, Ukraine
Natalia Durbalova, Department of Management and Logistics, Odessa National Academy of Food Technologies, Odessa, Ukraine

Andreev M.A. [8]	Investment project - a package of documents that comprehensively characterize the process of investing investment resources with the definition of practical importance for the investor in economic, social or environmental aspects.
Zhukov V.V. [9]	Investment project - plan or program of capital investments in real assets of production for the purpose of income generation.

Thus, an investment project is a system of measures, intentions, programs and documents regarding the investment of capital (investment resources) to obtain a positive effect (in terms of funds or environmental/social effect).

The risk associated with the investment project is the possibility of depreciation of the funds invested in the investment project at the expense of the owners or authorities, influenced by economic processes.

Due to investor caution, quantifying the risk of investment projects is an important consideration when analyzing and selecting a particular project (priority is given to the least risk with equal income).

The purpose of quantitative risk assessment of investment projects is - its measurement, which includes the calculation of the magnitude of risk; his assessment. Then, by comparing the benefit-risk balance, they choose a particular investment project. It also determines the range of fluctuations in indicators that are key and the sensitivity of net consolidated value to changes.

The indicators of the investment project evaluation are shown in Fig. 1.

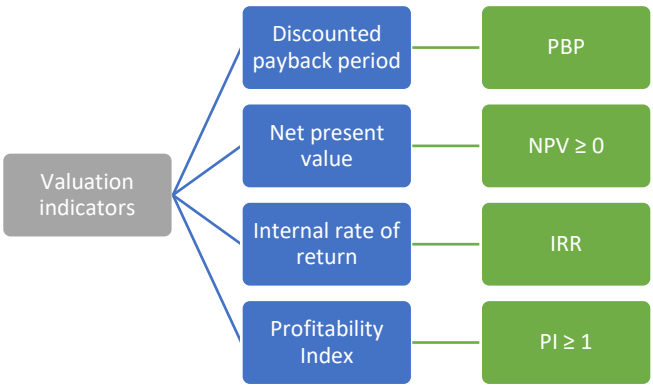

Fig. 1.Evaluation of investment projects.

B. Evaluation criteria for investment projects

Investment risk - the risk associated with possible impairment of an investment-financial portfolio consisting of both own securities and acquired ones.

The main criterion for the evaluation of investment projects, which is most commonly used in practice, is the net present value (discounted) value of NPV

:

$$NPV = \sum_{i=1}^{n} PV_i - IC \quad (1)$$

where IC is the amount of initial investment;PV - present value of receipts:

$$PV = \sum_{i=1}^{n} NFC_i - d_i \quad (2)$$

where NFC_i is the estimated amount of cash inflows in the i-th period; d_i is the discount rate of the projected cash inflows:

$$d_i = \frac{1}{(1+r)^i} \quad (3)$$

where r is the average interest rate.

Conclusion: NPV> 0 - Investment is advisable. NPV <0 - impractical. NPV = 0 - check the project by other criteria.

C. Research methods

The following methods are used for quantitative risk analysis

- method of analogies;
- sensitivity (vulnerability) analysis;
- decision tree analysis;
- simulation methods;
- loss risk analysis;
- methods of mathematical statistics.

1. The method of analogies. To analyze the risk that may be burdened by, say, a new project, it is advisable to identify data on the effects of adverse risk factors of some substantially similar to previously executed projects. In this area of activity, insurance companies are the most significant initiative. Databases and knowledge regarding risk factors are used in the use of analogues. These bases are based on materials from literary sources, search papers, monitoring, expert surveys and more. The obtained data are processed using the appropriate mathematical apparatus and computing equipment to identify dependencies and to account for potential risk. However, even in relatively simple and widely known cases of unsuccessful completion of projects, it is difficult to create the preconditions in which situations would replicate past experience that could be used for new projects. Therefore, the method of analogies can be sufficient only in simple cases, and it is mainly used as an auxiliary in some other methods.

2. Sensitivity (vulnerability) analysis. Sensitivity analysis is one of the simplest and most well-known methods of accounting for the uncertainty factors that characterize business appraisals. The sensitivity analysis is performed in two steps. The first step is the formation of a model (often with the help of software and hardware). Such a model determines the mathematical relations between the variables (parameters) that relate to the prediction (planning) of the future. The second step is sensitivity analysis. It allows you to identify the most important (possible risk factors) variables in the model associated with the assessment of the object (project). Its essence is to "measure the sensitivity" of the main indicators, the effectiveness of the project depending on a random change of factors (one or another variable value of the parameter). The main disadvantage of this method is that the change of one factor is considered in isolation, whereas in practice all economic factors are correlated to one degree or another, so the application of this method in practice as a stand-alone risk analysis tool is limited.

3. Analysis of the decision tree. The decision tree is a graphical representation of the sequences of decisions and the state of the environment, indicating the corresponding probabilities and benefits for any combinations, alternatives (actions) and states of the environment.

The decision-making process using the decision tree generally involves the following five steps:

1. Formulating a task.

2. Building a decision tree. How it works: The decision tree asks a series of questions that lead the reader to a specific action. The decision tree below uses a chemical spill on the shop floor as an example (Fig. 2).

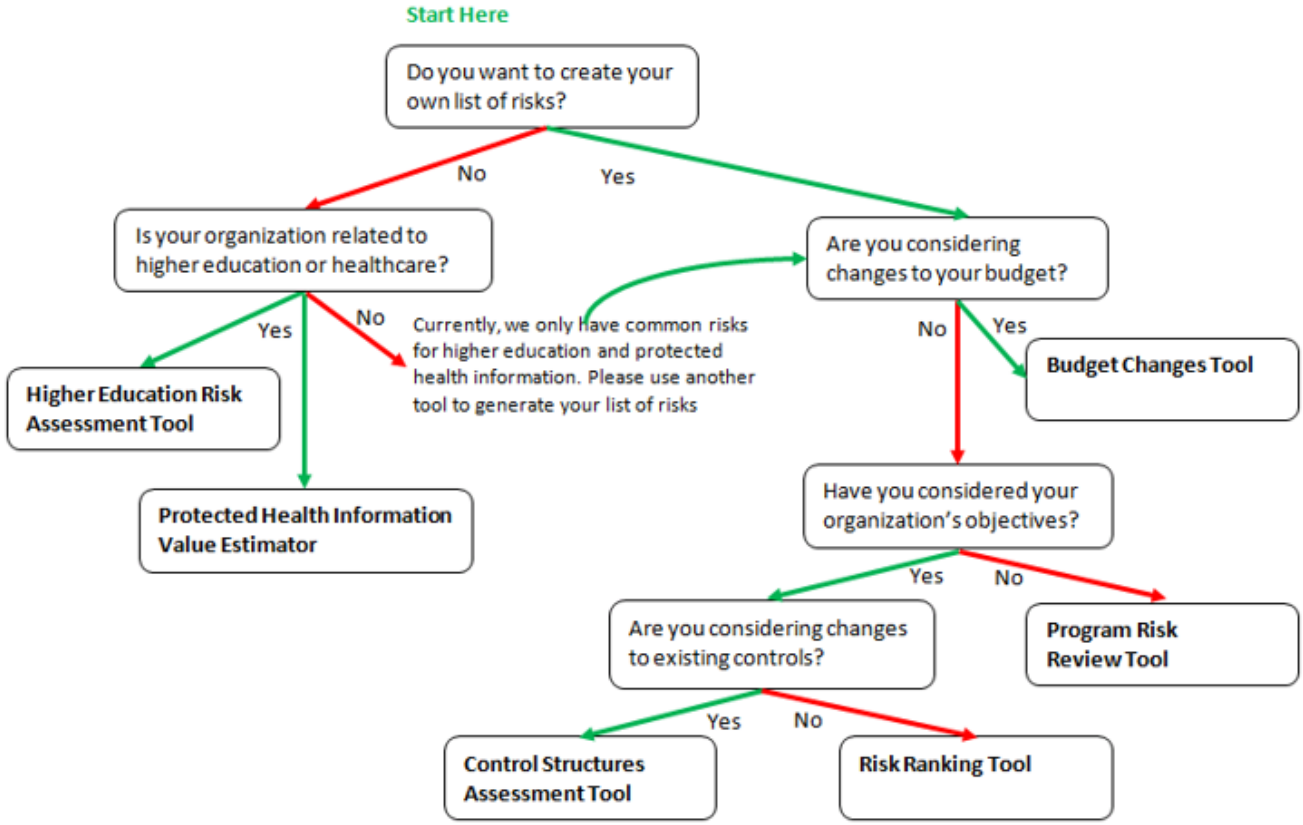

Fig. 2. Risk tool decision tree[10]

3. Estimation of probabilities of conditions of the environment that is a comparison of chances of occurrence of each specific event.

4. Establishing winnings (or losers as winnings with the sign "-") for each possible combination of alternatives (actions) and states of the environment.

5. Solving the problem.

The method is particularly useful in situations where decisions made at any given time depend heavily on decisions made earlier and, in turn, determine the scenarios of further developments [11]. The limitation of the practical use of this method is the initial premise that the project must have a reasonable number of development options.

4. Simulation modelling. Imitation modelling methods have become widely used in economics. The process of quantitative risk analysis using simulation modelling methods can be divided into seven steps:

1) forming a model for predicting the values of the respective performance indicators of the object (project);

2) selection of key arguments (risk factors) of the object (project) to be analyzed;

3) determining the set of possible (probable) values of key arguments (risk factors);

4) determining the distribution of random values of key arguments (risk factors);

5) identify relationships of correlation (correlation) between key arguments (risk factors);

6) generation of random scenarios based on a system of accepted hypotheses regarding the possible values of key factors;

7) obtaining relative frequencies for the final indicator (efficiency, project NPV, income standards, etc.).

5. Loss risk analysis. Risk analysis can also be conducted in terms of the potential (probable) losses that are specific to any object (project). The concept of risk areas (zones) is introduced to perform this analysis. There are such risk zones:

1. The risk-free zone is an area where no accidental damage is expected. It corresponds to zero losses or excess of profit over the expected value. This area is the area of entrepreneurial gain.

2. The permissible risk zone is an area within which the economic viability of the business is retained, that is, accidental losses may occur, but they are less than the expected profit from the business.

3. Critical risk zone is an area where there is a possibility of losses that exceed the amount (volume) of expected profits up to the value of the full calculated (estimated) revenue from business activities.

The magnitude of the possible (probable) losses in this area exceed the expected profit and may lead to the loss of all the funds invested by the entrepreneur in the business.

4. Catastrophic risk zone is an area of potential losses that exceed the critical level by size and volume and can reach the size (volume) of the entrepreneur's property status. Catastrophic risk can lead to the collapse, bankruptcy of a company (firm),
its closure and the sale of its property. The category of catastrophic risk should also include the risk associated with an imminent threat to life or an environmental disaster.

6. Methods of mathematical statistics. The main indicators of risk assessment in mathematical statistics are:

1. Pi is the probability of occurrence of a random variable, which can be determined by subjective and objective methods. The objective calculation method is to estimate the frequency with which the event occurred in the past:

$$p = \frac{n'}{n} \tag{4}$$

where n is the total number of cases; n'events of interest.

2. M - mathematical expectation X (average) of the study value (the consequences of any action, such as profit):

$$M = \bar{X} = \sum_{i=1}^{n} p_i - x_i \tag{5}$$

where x_i is the value of a random variable.

The average is a generalized quantitative characteristic and does not allow one to decide in favour of one of the several options considered.

3. D - variance - weighted average of the squared deviations of the true results from the expected average:

$$D(X) = \sigma^2 = \sum_{i=1}^{n} p_i (x_i - \bar{X})^2 \tag{6}$$

4. σ - standard deviation::

$$\sigma = \sqrt{D(X)} \tag{7}$$

$D(X)$ and σ are indicators of absolute fluctuation and are measured in the same physical units as the varying sign.

5. CV - coefficient of variation:

$$CV = \frac{\sigma}{M} \tag{8}$$

As an example, consider the problem of choosing a production investment project.

D. The simulation experiment of quantitative assessment of the risk of investment projects

Let the investor consider 2 projects: A and B. The amount of initial investment 2000 thousand UAH. Project A: cash flows: UAH 600 thousand; 900 thousand UAH; UAH 1300 thousand Interest rates: 1 = 3%; 2 = 4%; and3 = 5%. Project B: cash flows: UAH 700 thousand; UAH 990 thousand; UAH 1100 thousand Inflation rate: 9%.

In this case, the risks are: interest rate inflation and interest rates.

$$\begin{aligned} NPV\ (A) = {} & (600\ /\ (1 + 0.03) * (1 + 0.09)) \\ & + (900\ /\ (1 + 0.03) * (1 + 0.04) \\ & * (1 + 0.09)\ )\ \wedge\ 2) + (1300\ /\ (1 \\ & + 0.03) * (1 + 0.04) * (1 + 0.05) \\ & * (1 + 0.09)\ \wedge\ 3) - 2000 \\ & = 534{,}426 + 707{,}162 + 892{,}491 \\ & - 2000 = 2134{,}079 - 2000 \\ & = 134{,}079\ thousandUAH. \end{aligned}$$

$$\begin{aligned} NPV\ (B) = {} & (700\ /\ (1 + 0.03) * (1 + 0.09)) \\ & + (990\ /\ (1 + 0.03) * (1 + 0.04) \\ & * (1 + 0.09)\ )\ \wedge\ 2) + (1100\ /\ (1 \\ & + 0.03) * (1 + 0.04) * (1 + 0.05) \\ & * (1 + 0.09)\ \wedge\ 3) - 2000 \\ & = 623{,}497 + 777{,}878 + 755{,}185 \\ & - 2000 = 2156.56 - 2000 \\ & = 156.56 thousandUAH. \end{aligned}$$

NPV or investment performance indicator is better than the second project.

$$PI\ (A) = 2134.079\ /\ 2000 = 1.067$$
$$PI\ (B) = 2156.56\ /\ 2000 = 1.078$$

Investment attractiveness is greater than one in both projects, but it is better in B.

$$PBPnormal\ (A) = 2000\ /\ (600 + 900 + 1300) : 3 = 2.14$$
$$PBPNormal\ (B) = 2000\ /\ (700 + 990 + 1100) : 3 = 2.15$$

The payback period is slightly shorter in the first project.

PBP discounted 2 projects are shown in Fig. 2

$$PBPdiscounted\ (A) : 2 + 758{,}412\ /\ 892{,}491 = 2.85$$
$$PBPdiscounted\ (B) : 2 + 598.625\ /\ 755.185 = 2.79$$

However, the discounted payback period is less than in the second project.

A		534,426	707,162	892,491
	–2000	–1465,574	–758,412	134,079
B		623,497	777,878	755,185
	–2000	–1376,503	–598,625	156,56

Fig. 3. Data for PBP Discount Calculation.

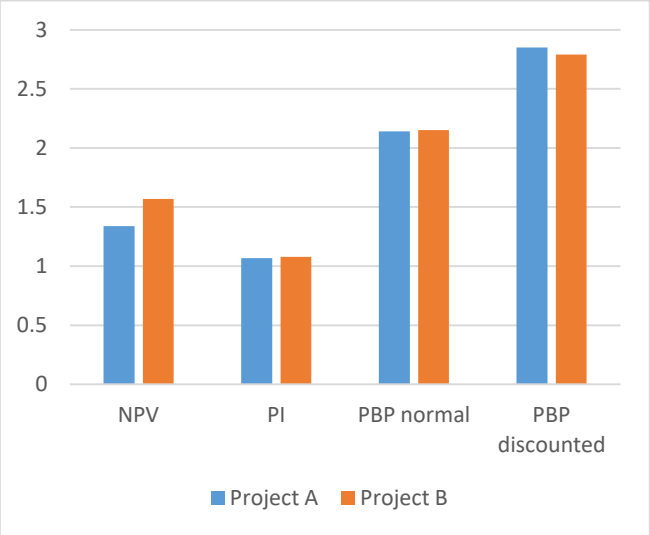

Fig. 4.Evaluation criteria for investment projects.

III. RESULT AND DISCUSSION

Thus, it is advisable for an investor to choose Project B because of the best NPV, PI, PBP rates discounted.

One of the most important tasks when deciding on the best choice for alternative investment projects is to consider the risks involved in quantifying investment projects.

The prospect of further research may be to analyze and evaluate the potential risks of venture capital projects.

Thus, the following methods are used to quantify the risk of a high-tech project: the analogy method; sensitivity (vulnerability) analysis; decision tree analysis; methods of simulation modelling; loss risk analysis. The most versatile of them is the simulation method because it has advantages over other methods (analogy method, sensitivity (vulnerability) analysis, decision tree analysis) and includes some of them, such as mathematical statistics. As an example of the practical use of quantitative methods for risk assessment, the task of selecting an investment project for the production of high-tech products was considered.

REFERENCES

1. B. Danylyshyn, S. Bondarenko, M. Malanchuk, K. Kucherenko, V. Pylypiv, O. Usachenko. Method of Real Options in Managing Investment Projects, *International Journal of Innovative Technology and Exploring Engineering*, Volume-8 Issue-10, August 2019, pp. 2696-2699DOI: 10.35940/ijitee.J9449.0881019
2. Prokopenko O., Holmberg R., Omelyanenko V. Information and communication technologies support for the participation of universities in innovation networks (comparative study), Innovative Marketing, Vol. 14, Issue № 3, 2018, pp. 17-29.
3. S. Filyppova, I. Bashynska, B. Kholod, L. Prodanova, L. Ivanchenkova, V. Ivanchenkov, Risk management through systematization: Risk Management Culture, *International Journal of Recent Technology and Engineering*, Volume-8 Issue-3, Sep. 2019
4. Dankiv Y., Vakarov V. Risks in audit of investment projects, Proceedings of the III International Scientific and Practical Conference "Improvement of accounting, control, audit, analysis and taxation in modern conditions of integration processes in the world economy", 2018, pp. 296–299.
5. Rusin R. Investment projects: essence and classification,*Economic Bulletin of the University*, Issue 31 (1),2016,pp. 177–183.
6. Chernysh S. A systematic approach to the analysis of investment projects, *Collection of scientific papers of the State Economic and Technological University of Transport*, Issue 35, 2016,pp. 357–366.
7. Shvets Yu., Kapshuk A.Features of realization of investment projects at industrial enterprises under conditions of variability of environmental factors, *Investments: practice and experience*, № 1, 2017,pp. 63–67.
8. Andreev M. Financing the production of intellectual products as a progressive form of public investment, Economy and State, № 10, 2018, pp. 68-71
9. Zhukov V. Methodical approaches to the evaluation of attractiveness of investment projects, *Scientific Bulletin of Uzhgorod National University*. Issue 13, 2017, pp. 100–105.
10. Bashynska I., Filyppova S. Risk Management. Practical lessons & Case Study: textbook, Kharkiv: "Disa Plus", 2018, 220 p.
11. Prokopenko O., Eremenko Y., Omelyanenko V. Role of international factor in innovation ecosystem formation, *Economic annals – XXI*, № 3-4 (2), 2014, pp. 4–7.