

RISK ASSESSMENT METHODS OF INVESTMENT PROJECTS

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Introduction. There are numerous methodologies that can be employed to evaluate the risks associated with investment. The most pertinent techniques are sensitivity analysis, analysis of alternative scenarios, and Monte Carlo simulation. A sensitivity analysis enables a project to be evaluated in a comprehensive and expeditious manner, akin to a crash test. Accordingly, this method is the most prevalent. This method is employed to ascertain the factors that exert the greatest influence on the project, as well as to quantify the impact of factors that are challenging to anticipate. Notwithstanding the aforementioned disadvantage, the simplicity of calculation and the lack of correlation between individual factors represent significant advantages of this method. In order to apply this method, it is first necessary to identify the independent factors.

In order to evaluate alternative scenarios, it is necessary to construct three scenarios: a pessimistic, an optimistic and a realistic one. The analysis of this method enables the relationship between the parameters to be considered, as well as the potential options for the implementation of the project. The primary limitation of this approach is the necessity for extensive preparatory work, the lack of available information, and the scarcity of qualified specialists.

The Monte Carlo method represents the most accurate, yet more complex, approach to risk assessment. The Monte Carlo method allows for the analysis of socially significant projects, the consideration of the interdependence of certain project parameters, and the evaluation of projects with a high degree of accuracy. This is the most significant method for the analysis of costs and associated risks. One disadvantage of this method is the necessity for specialised software.

One of the most effective methods for generating creative ideas is brainstorming. It is a collaborative approach to the generation of novel ideas and solutions within a constrained timeframe. The method is employed in business meetings with the objective of resolving complex problems. The most significant benefit of this approach is that it fosters creative thinking and the generation of ideas during the brainstorming process. This method is predicated on the principles of intuition, receptivity, transcendence of conventional modes of thought, originality, and imagination.

The disadvantages of this approach include a deviation from the main idea and a lack of provision of a carefully developed idea. Furthermore, it is difficult to choose among a large number of ideas. The success of an investment activity is contingent upon the efficacy of the risk analysis conducted during the implementation of the investment and construction project. The utilisation of a multitude of analytical techniques in conjunction with one another enables the minimisation of existing risks and potential losses, thereby enhancing the efficiency of the implemented project.

Conducting a comprehensive analysis of project risks, understanding the strengths and weaknesses of valuation methods helps to make the right decision and choose the most appropriate method [5].

Improving the existing risk management systems ensures the reduction of the negative impact on the activities of the construction organisation, control and evaluation. The development of an investment risk management mechanism allows managing unplanned expenses and increases the organisation's competitiveness.

Analysis of recent research and publications. The classification of investment risks is a highly diverse field of study. One of the classification types, according to the main characteristics, is as follows:

1. The following types of risk are distinguished according to the areas of manifestation:

1) Economic – the risk associated with changes in economic factors. Since investment activity is carried out in the economic sphere, it is more exposed to economic risk;

2) political – various administrative restrictions on investment activity associated with changes in the political course pursued by the state;

3) social risk – the risk of strikes, unplanned social programmes implemented under the influence of employees of investees and other similar types of risk;

4) environmental risk – risk arising from the effects of various environmental disasters (floods, fires, earthquakes, etc.) that adversely affect the operations of investees;

5) other types – these include racketeering, theft of property, fraud by investment or business partners, etc.

2. The following types of risk can be distinguished according to the form of investment:

1) Real investment risk includes, for example, unsuccessful selection of a site for an object under construction, interruptions in the supply of construction materials and equipment, significant growth in prices for investment goods, selection of an unqualified or unscrupulous contractor and other risks; factors affecting the timely commissioning of an investment object or reduction of income (profit) during its operation;

2) financial investment risk is the risk of an ill-considered choice of financial instruments for investment, financial difficulties or bankruptcy of individual issuers, unexpected changes in investment conditions, direct deception of investors, etc.

3. There are two types of risks based on their sources [6]:

1) Systematic risk is the risk inherent to any business operation within the market system, affecting all participants in investment activities and forms of investment. It encompasses changes in the stages of the economic development cycle of the country or the market development cycles of the investment market, significant changes in tax legislation in the investment field, and other factors that the investor cannot influence when choosing investment objects;

2) unsystematic (or specific) – this type of risk is inherent in a particular investment object or the activities of a particular investor. This may be due to incompetent management of the investee organisation (company, firm), increased competition in a certain segment of the investment market, irrational structure of invested funds and other similar factors that may have significant negative consequences.

The distinction between systematic and unsystematic investment risk is a fundamental aspect of the theory of effective investment portfolio formation, which will be elaborated upon subsequently [2]. As investment risk is defined as the possibility of unexpected financial losses, the level of risk is determined by the discrepancy between the anticipated return on an investment and the calculated average return. Consequently, the evaluation of investment risk is inherently linked to the assessment of anticipated income and the potential for loss.

The risk security structure in project financing is comprised of three main components: a mortgage on project assets, an income flow (or cash flow) from the project, and risk sharing by contractual terms. The aforementioned elements are underpinned by a comprehensive risk and vulnerability analysis of the project. The following Tables (1 and 2) present the forms of safety against risks that can be employed prior to and following the completion of work, respectively.

Table-1

Forms of risk protection before completion

| Risk | Security forms | Who provides |
|-------------------------|---|-------------------------|
| Closure of the project | Guarantee against cash shortages | Shareholders |
| Delays in starting work | Penalty clause in the contract of advance profit insurance | Contractor's insurer |
| Cost increase | Fixed price, turnkey contract with penalties | Contractor |
| Technical injury | Professional liability guarantee | Suppliers insurers |
| Physical damage | Reconstruction of insurance/benefit insurance | Insurers |
| Attrition | Penalty clauses in contracts (in case of delay in performance) Guarantee against cash shortage | Contractor shareholders |

Source: compiled by the authors

Table-2

Security forms for post-execution risks

| Risk | Security forms | Who provides |
|---|--|----------------------------------|
| Sales risk | Long-term purchase and sale contracts with a minimum price/formula price | Sellers |
| Failure to meet the production plan | Insurance (property damage/interruption/marine) | Insurers suppliers |
| Poor management | Long-term supply contracts | Controller |
| Cost overruns | Management contract | Financial plan of suppliers |
| Increased financial costs | Determination of a fixed price by a formula in the contract | Financial partner |
| Currency risks | Contingency funding swaps or fixed interest rate swaps | Financial partner |
| Restrictions on confiscation or foreign exchange transactions | Forward foreign exchange contracts or swaps | Appropriate government authority |

Source: compiled by the authors

Objectives of the article. The principal objective of this article is to examine the methods of predicting and minimising potential risks that may affect the financing of investment projects, both in conditions of certainty and uncertainty.

The main material of the study. In the process of evaluating the potential financial losses associated with investment activity, both absolute and relative indicators are employed. The absolute amount of financial losses related to investment risk can be defined as the total loss incurred by the investor (or potentially possible) as a result of the occurrence of an unfavourable situation characteristic of this risk. The relative amount of financial losses related to investment risk is calculated as the ratio of the amount of loss to the main indicator. This could be, for example, the amount of expected income from the investment, the amount of invested capital, and so forth.

Investment risks are assessed for each investment project and financial instrument. They are measured using various methods and calculations [1]:

- Mean square deviation;
- coefficient of variation (coefficient of variation);
- β -coefficient;
- expert method.

The mean square deviation is the most common indicator for assessing the level of investment risks. The calculation of this indicator allows to take into account the variability of the expected return on different investments. Consider the mechanism of investment risk assessment based on the mean square deviation (Table 3).

Table 3

Probability distribution of expected profit for two investment projects

| Possible values of investment market conditions | Investment Project A | | | Investment Project B | | |
|---|--------------------------------|-------------------|---|--------------------------------|-------------------|---|
| | Estimated income, thousand AZN | Probability value | Amount of expected income, thousand AZN | Estimated income, thousand AZN | Probability value | Amount of expected income, thousand AZN |
| High | 1800 | 0,25 | 450 | 2400 | 0,20 | 480 |
| Medium | 1500 | 0,50 | 750 | 1350 | 0,60 | 810 |
| Low | 600 | 0,25 | 150 | 300 | 0,20 | 60 |
| Cumulative | – | 1,0 | 1350 | – | 1,0 | 1350 |

Source: compiled by the authors

A comparison of the data pertaining to individual investment projects reveals that the estimated income for Project A falls within the range of 600,000 to 1,800,000 AZN. The total expected income is 1,350,000 AZN. The total expected income for Project B is 1,350,000 AZN, with a variance of between 300,000 and 2,400,000 AZN. A straightforward comparison of the two projects reveals that the risk of implementing Project A is considerably lower than that of Project B, which exhibits a greater degree of income variability.

Although the average amount of expected revenue in both projects is the same.

Project A:

$$\bar{x}_A = \frac{\sum x}{n} = \frac{1350}{3} = 450 \text{ thousand AZN};$$

Project B:

$$\bar{x}_B = \frac{\sum x}{n} = \frac{1350}{3} = 450 \text{ thousand AZN}.$$

The range of variation and mean square deviation will be different:

Width of variation:

Project A: $R_A = x_{\max} - x_{\min} = 1800 - 600 = 1200 \text{ thousand AZN};$

Project B: $R_B = 2400 - 300 = 2100 \text{ thousand AZN}.$

In accordance with the data presented in Table 4, the anticipated return on each investment project is to be calculated. Given that the data are provided on an individual basis, it is possible to employ straightforward formulas for calculating variance. In order to calculate the variance, it is first necessary to calculate the mean. The variance for each investment project (Table 4) is to be calculated. The anticipated income is expressed in thousands of manats.

Table 4

| Investment Project A | | | Investment Project B | | |
|---|-----------------|---------------------|---|-----------------|---------------------|
| Amount of expected income, thousand AZN | $x - \bar{x}_A$ | $(x - \bar{x}_A)^2$ | Amount of expected income, thousand AZN | $x - \bar{x}_B$ | $(x - \bar{x}_B)^2$ |
| 450 | 0 | 0 | 480 | 30 | 900 |
| 750 | -300 | 90000 | 810 | 360 | 129600 |
| 150 | -150 | 22500 | 60 | -290 | 84100 |
| Сөм:1350 | - | 112500 | Сөм:1350 | - | Сөм:214600 |

Source: compiled by the authors

Since the data is presented individually, it is necessary to use simple formulas for variation indicators. The initial step is to calculate the expected income for each investment project [1]:

Average expected return (Project A) $\bar{x}_A = \frac{\sum x}{n} = \frac{1350}{3} = 450;$

for Project B, the expected average income is $\bar{x}_B = \frac{\sum x}{n} = \frac{1350}{3} = 450;$

for Project A, the variance is equal to $\sigma_A^2 = \frac{\sum (x - \bar{x}_A)^2}{n} = \frac{112500}{3} = 37500;$

for Project B, the variance is equal to $\sigma_B^2 = \frac{\sum (x - \bar{x}_B)^2}{n} = \frac{214600}{3} = 71533.$

Root mean square deviation:

For Project A, the root mean square deviation is equal to $\sigma_A = \sqrt{\frac{\sum (x - \bar{x}_A)^2}{n}} = \sqrt{37500} = 193,6;$

for Project B, the root mean square deviation is equal to $\sigma_B = \sqrt{\frac{\sum (x - \bar{x}_B)^2}{n}} = \sqrt{71533} = 267,5.$

The coefficient of variation is a statistical measure that enables the assessment of risk in situations where the anticipated average returns vary significantly. The coefficient of variation (V) is calculated using the following formula:

$$V = \frac{\sigma}{\bar{x}} \cdot 100\% .$$

According to the example above, the coefficient of variation for Project A is

$$V_A = \frac{\sigma}{x} \cdot 100\% = \frac{193,6}{450} \cdot 100\% \approx 43.6\% ;$$

The coefficient of variation for Project B is equal to, $V_B = \frac{\sigma}{x} \cdot 100\% = \frac{267,5}{450} \cdot 100\% \approx 59.4\% .$

An investment project (IP) is defined as a system of organisational, legal, settlement and financial documents that are necessary for the implementation of any actions related to its placement or use for the purpose of increasing capital in various areas of the economy, or for the description of such actions.

Current values of β -coefficient (Table 5) are as follows [1]:

Table 5

Current values of β -coefficient

| β -coefficient value | Security risk level |
|----------------------------|---------------------|
| $\beta = 1$ | Medium |
| $\beta > 1$ | High |
| $\beta < 1$ | Low |

Source: compiled by the authors

An investment project is completed upon achievement of a specified rate of return or other indicator reflecting the investment objectives.

Thus, as the value of the β -coefficient increases, the level of systematic investment risk also increases.

In instances where the investor lacks the requisite information or statistical data to calculate the aforementioned indicators, or in the absence of a comparable investment project, the expert method of risk assessment is employed. This method is founded upon the assessment of duly qualified specialists (investment, insurance, financial managers) and the subsequent mathematical processing of the findings derived from this assessment. In order to obtain a more detailed description of the level of investment risk for the project, it is necessary to focus the inquiry on certain types of risk that are characteristic of a particular investment project.

Conclusions. The results of the risk assessment for individual investment projects allow to quantify their level. The following assessment criteria are used for this purpose:

1. Risk-free investments. In foreign practice, such investments usually include short-term government bonds. In the conditions of the Russian investment market, similar fund instruments can be considered risk-free by a large convention. When such fund instruments are issued, they can probably be called the least risky investment objects, i.e., they are considered the minimum starting point for investment risk.

2. Investments with an acceptable level of risk. The criterion of acceptable risk level is the probability of losing the entire amount of expected net profit on the investment project under consideration.

3. Investments with a critical level of risk. In this case, the risk level criterion is the probability of losing not only profit, but also the entire amount of the estimated total income from the investment project under consideration.

4. Investments with a level of catastrophic risk. The criterion for this level of risk is the probability that the investor will lose all its assets as a result of bankruptcy.

A further aspect of investment management is that of risk assessment. It is not possible for the investor to select a risk-free investment project (and in the real world there are few, if any, such projects), which gives rise to the question of how the level of risk should be compensated. The answer to this question is provided by calculating the so-called "risk premium", which is the additional return required by the investor above the level that would be achieved by risk-free investments. This additional income should increase in proportion to the level of risk of the investment project. It should be noted that the "risk premium" should increase in proportion to the growth of systematic risk, which is determined by the market or β -coefficient, and not the overall level of risk in the project, as it is unsystematic. risk is mainly related to the influence of subjective factors. The basis of this relationship is the "market reliability line".

The net present value remained positive, indicating that the project will continue to be profitable for investors. However, in comparison to the initial option, which did not consider the impact of inflation, the return on the initial investment was significantly lower when the discounted value of income from the sale of new products was taken into account.

An investment institution is defined as a legal entity engaged in activities pertaining to mediation, consultancy, or joint endeavours within the context of the stock market. The founders of an investment institution may be either legal or natural persons, including residents. The forms of investment institutions include, but are not limited to, investment companies and funds, exchanges, investment brokers and dealers, and investment advisers.

Investment companies and funds represent a specific category of financial and credit organisations. They raise funds from private investors by issuing their own securities and placing them in the securities of other issuers. It is possible for investment companies and funds to issue securities, including investment certificates, which are then placed on the stock market. The issuance limits are constrained by the extent of coverage provided by the portfolio of securities.

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Risk assessment methods of investment projects.

All forms and types of investment activity are inherently associated with an element of risk, the degree of which is contingent upon the evolution of market relations within the economy. In the contemporary era, the escalation of risk is contingent upon the instability and accelerated transformation of the economic milieu at the national level and within the investment sector. This encompasses the availability of privatised assets for investment, the advent of novel financial instruments, the emergence of new investment vehicles and a multitude of additional factors. Investment risk pertains to the potential for unforeseen financial losses (reduced profitability, income, capital erosion, etc.) in the context of uncertainty inherent to investment activities. The primary functions of investment management encompass a range of activities, including: the formulation of current forecasts and the planning of future activities; the identification of potential risk sources; the selection of appropriate management decisions aimed at eliminating or mitigating the impact of negative factors; the calculation of economic feasibility and the justification of proposed projects; the assurance of normal operations in the context of changing conditions; the determination of an acceptable level of risk; the development and implementation of measures designed to minimise the identified risks associated with a given project; the forecasting and modelling of relationships between factors; and the undertaking of complex analysis. The necessity to manage investment risks is contingent upon their existence. At present, a number of techniques are employed for the purpose of evaluating the degree of risk. A risk management method may be defined as a system of techniques or methods for performing individual operations within the risk management process. Nevertheless, the principal challenge lies in selecting the most suitable risk assessment approach, as each method possesses a distinct scope, along with inherent advantages and disadvantages. The main types of risk insurance in project finance are as follows: Direct, which includes an unconditional guarantee of full payment from a guarantor with a sound financial position and cash security;- restrictions, including quantitative, time and other limitations. Simultaneously, project financing is beset with a number of challenges, including a dearth of local expertise in the development of large-scale projects, a paucity of qualified managers to oversee the data of individual entrepreneurs, insufficient resources for the large-scale financing of capital-intensive projects, the low qualifications of project financing participants, and the absence of a developed and legally approved mechanism for sharing risks between participants, among other factors that exacerbate project risks. The resolution of contemporary problems necessitates a multifaceted methodology that considers the interests of multiple stakeholders. The most crucial elements are the reinforcement of the state's role in guaranteeing project risk insurance, the provision of tax incentives for investment

mechanisms, and the advancement of interbank collaboration in the domain of joint crediting of individual entrepreneurs. The article examined the classification of risks in investment projects, the methods of risk assessment and the minimisation of risks in investment projects.

Keywords: investment, project, risk, financing, forecast, method, dispersion, variation, mean square deviation, evaluation.

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Шірінов Башар Хабіб огли, кандидат економічних наук, доцент, Азербайджанський архітектурно-будівельний університет. **Гасанов Кенан Рахіб огли**, магістр, Азербайджанський архітектурно-будівельний університет. **Методи оцінки ризиків інвестиційних проєктів.**

Інвестиційна діяльність у всіх її формах і видах пов'язана з ризиком, ступінь якого зростає з розвитком ринкових відносин в економіці. У сучасних умовах підвищення рівня ризику пов'язане з невизначеністю та швидкою зміною економічної ситуації в країні в цілому та на інвестиційному ринку зокрема, пропозицією об'єктів приватизації для інвестування, появою нових елементів і фінансові елементи, інструменти інвестування та ряд інших факторів. Інвестиційний ризик означає можливість несподіваних фінансових втрат (зменшення прибутку, доходу, втрати капіталу тощо) в умовах невизначеності в умовах інвестиційної діяльності. До основних функцій управління інвестиціями належать: поточне прогнозування та планування діяльності, виявлення джерел ризику, вибір необхідних управлінських рішень для усунення впливу або зменшення негативних факторів, розрахунок економічної доцільності та обґрунтування проєкту, забезпечення нормального функціонування в будь-якій ситуації. мінливих умов, прийнятного рівня розрахунку ризику, розробки та впровадження заходів щодо мінімізації виявлених ризиків проєкту, прогнозування та моделювання взаємозв'язків між факторами, а також комплексного аналізу. Наявність інвестиційних ризиків зумовлює необхідність управління ними. На сьогоднішній день використовуються різні методи оцінки рівня ризику. Метод управління ризиками – це система прийомів або способів виконання окремих операцій у процесі управління ризиками. Однак головною проблемою є вибір найбільш прийнятного методу оцінки ризику, оскільки кожен метод має свою сферу застосування, а також переваги та недоліки. Основними видами забезпечення ризиків при проєктному фінансуванні є: прямий, який включає безумовну гарантію повної оплати гарантом з надійним фінансовим станом і грошовим забезпеченням; обмежені, включаючи обмеження за кількістю, часом тощо. Водночас проєктне фінансування має ряд проблем, серед яких: недостатній місцевий досвід розробки великих проєктів; відсутність кваліфікованих менеджерів для управління даними фізичних осіб-підприємців; відсутність достатніх ресурсів для масштабного фінансування капіталомістких проєктів; низька кваліфікація учасників проєктного фінансування; відсутність розробленого та законодавчо затвердженого механізму розподілу ризиків між учасниками та інші чинники, що посилюють ризики проєкту. Вирішення проблем в сучасних умовах потребує комплексного підходу, що враховує інтереси різних сторін. Його найважливіші складові: посилення ролі державних гарантій у страхуванні проєктних ризиків, податкові пільги для механізмів інвестування, розвиток міжбанківського співробітництва у сфері спільного кредитування фізичних осіб-підприємців. У статті досліджено такі питання, як класифікація ризиків в інвестиційних проєктах, методи оцінки та мінімізації ризиків в інвестиційних проєктах.

Ключові слова: інвестиція, проєкт, ризик, фінансування, прогноз, метод, дисперсія, варіація, середньоквадратичне відхилення, оцінка.