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Essence and the impact of risks and uncertainties in the investment-related decision-making process

La esencia y el impacto de los riesgos y las incertidumbres en el proceso de toma de decisiones relacionadas con la inversión

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ABSTRACT:
Investment risks are understood in the realization of investment projects. The object of risk in this case is the property of the person in the project in one form or another. Investment activity in all its forms and types is fraught with a risk that is increasing with the transition to market relations in the economy. The risk increases with the growth of supply for investing privatized objects, with the appearance of new elements and financial instruments for investment, etc.
Keywords: investment, economic effect, decision making, risk management.

RESUMEN:
Los riesgos de inversión se entienden en la realización de proyectos de inversión. El objeto de riesgo en este caso es la propiedad de la persona en el proyecto de una forma u otra. La actividad de inversión en todas sus formas y tipos está cargada con un riesgo que está aumentando con la transición a las relaciones de mercado en la economía. El riesgo aumenta con el crecimiento del suministro para la inversión de objetos privatizados, con la aparición de nuevos elementos e instrumentos financieros para la inversión, etc.
Palabras clave: Inversión, beneficio economic, toma de decision, gestión de riesgos

1. Introduction

The choice of the option of investing money is very important, since it is at this point the course of further actions of the investor is determined and the success in achieving the goals largely depends on it. The best option may not be necessarily one that simply provides the maximum profitability: other parameters, such as risk and taxation conditions, can play a significant role. For example, an investor who aspires to receive maximum annual dividends will buy an ordinary share of companies with the highest expected profit. If the company

that issued this share is bankrupt, then the shareholder will lose all the invested money. In order to successfully manage investments, it is extremely important to carefully select financial instruments so that they meet the set goals and are characterized by acceptable levels of profitability, risk and price.

An individual investor has a wide range of instruments in terms of the degree of risk, from valuable government securities with the lowest risk to those with very high risk. Each type of capital allocation has basic risk characteristics, but in each specific case the risk is determined by the specific features of the instrument. For example, although it is commonly believed that investing in shares is associated with a higher risk than investing in bonds, you can easily find bonds with a very high risk - greater than the risk of investing in shares of reputable companies. Low-risk investments are considered a safe means of generating a certain income, high-risk investments, on the contrary, are considered speculative (Backhaus, 1997).

The terms “investment” and “speculation” denote two different approaches to investing. Investments are understood as the process of buying securities and other assets, which can be confidently stated that their value will remain stable and they will be able to receive not only a positive amount of income, but even a predictable income: speculation consists in carrying out transactions with the same assets, but in situations where their future value and level of expected income are very reliable. Of course, with a higher degree of risk from speculation, a higher income is also expected.

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2. Literature review

The most significant publications in the scientific literature in the study area can be conditionally grouped according to the thematic focus as follows:

I. Ansoff, K. Bagrinovsky, A. Granberg, O. Inshakov, D. Lvov, I. Mazur: development of model-theoretical representations, conceptual bases of management and mission of investments in the transition of the Russian economy from the recovery to the trajectory of economic growth, approaches to solving the problems of increasing investment activity in economic systems of different levels;

O. Belokrylova, I. Grishina, A. Druzhinin, V. Zhdanov, V. Ignatov, A. Kondratiev, I. Lavrentieva, V. Leksin, A. Marshallova: analysis and theoretical comprehension of ideas about regionalism in improving the system investment management, determinants and specifics of reforming the regional investment policy at the present stage of the transformation of the Russian economy, including the diagnosis of regional investment and the assessment of the effectiveness of their use;

G.J. Alexander, J.V. Bailey, I. Blank, I. Lipsic, V. Kosov, I. Mazur, U. Sharp, Yu. Yakutia: theoretical modeling and methodological support of investment management issues at the meso- and microlevels of the economy, including multifaceted manifestations of modifications of the methodology for assessing the effectiveness of investment projects (including innovative orientation) in conditions of the formation of sustainable reproductive rhythm of territorially localized economic systems;

R. Baszel, V. Gamza, V. Zherder: substantiation of directions, ways, methods and tools for assessing investment risks;

K. Gonchar, J. Deryabina, A. Ponomarev, V. Yakimets: theoretical and practical substantiation of directions and forms of creation of adaptive models of formation of institutional infrastructure for management and regulation of investment activity in the regions of Russia.

The existence of fundamental approaches and applied research revealing certain aspects of the indicated topics is combined with the practical lack of model-theoretic notions about the systemic management of the risks of investment decisions and the need to integrate such instruments into the management system of investment processes at the meso-level.

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3. Materials and methods

The objects of the study are separate objects of risk management in investment activities,

including those that are under implementation of investment projects.

The subjects of the study are economic and organizational-economic methods of risk management of investment projects.

The dialectical method of cognition, the fundamental works of domestic and foreign scientists in the field of economic theory, investment and financial management, system analysis, the theory of management of investment projects, economic analysis, legislative acts, regulatory and methodological materials that regulate investment activity in Of the Russian Federation, periodical press materials, state statistics, reports to organizations form the methodological and theoretical basis of the research.

Also, methods of economic-mathematical modeling and logical analysis, expert assessments, and comparisons were used in the process of this research.

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4. Discussion

4.1. Decision Making under the Conditions of Complete and Partial Uncertainty at the Level of Individual Projects

The situations described by models in the form of strategic games may not be fully adequate in practice because the implementation of the model assumes multiple repetitions of actions (decisions) taken in similar conditions of reality. The number of economic decisions taken is unchanged provided conditions are unchanged. Often, the economic situation is unique, and the decision under conditions of uncertainty should be taken only once. This raises the need to develop methods for modeling decision-making under conditions of uncertainty and risk.

Traditionally, the next stage of this development is games with nature. Formally, the study of games with nature, as well as strategic games, should begin with the construction of a payment matrix, which is, in fact, the most time-consuming stage in preparing a decision. Errors in the payment matrix cannot be compensated by any computational methods and will result in an incorrect final result.

A distinctive feature of the game with nature is that only one of the participants acts in it consciously, in most cases they are called player 1. Player 2 (nature) does not act consciously against player 1, but acts as a partner having no specific goal and randomly choosing the next “steps” in the game.

Therefore, the term “nature” characterizes some objective reality, which should not be taken literally, although situations in which the “player” 2 can really be nature (for example, circumstances connected with weather conditions or with natural elemental forces) may well be encountered.

At first glance, the lack of deliberate opposition makes it easier for the player to choose the solution. However, although no one interferes with decision making person (DMP), it is more difficult for him to justify his choice, because in this case the guaranteed result is not known.

The methods of decision-making in games with nature depend on the nature of the uncertainty, more precisely, whether or not the probability of the states (strategies) of nature is known, i.e. whether there is a situation of risk or uncertainty.

Let’s consider the organization and analytical representation of the game with nature.

Let's consider the organization and analytical representation of the game with nature.

Let the player 1 have *m* possible strategies: A_1, A_2, ..., A_m, and the nature has *m* possible states (strategies): $П_1$, $П_2$, ..., $П_m$, then the game conditions with nature are set by player's payoff matrix *A:*

$$A = \begin{pmatrix} & \Pi_1 & \Pi_2 & \dots & \Pi_n \\ A_1 & a_{11} & a_{12} & \dots & a_{1n} \\ A_2 & a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots & \dots \\ A_m & a_{m1} & a_{m1} & \dots & a_{mn} \end{pmatrix}.$$

It is, of course, not nature that pays, but a certain third party (or a set of parties that influence decision-making by player 1 and are united in the concept of "nature").

Another way of specifying the game matrix with nature is possible: not as a winning matrix, but in the form of a so-called risk matrix R = || r_{ij} ||$_{m,n}$ or matrix of missed opportunities. The magnitude of the risk is the fee for the lack of information about the state of the environment. The matrix R can be constructed directly from the conditions of the problem or on the basis of the payoff matrix A.

The risk r_{ij} of the player when using his strategy A_i and the state of the environment $П_j$ will be the difference between the win that the player would receive if he knew that the state of the medium is $П_j$ and the payoff that the player will receive without having this information. Knowing the state of nature (strategy) $П_j$ player chooses the strategy, in which his winnings are maximum, that is $rij = \beta_j - a_{ij}$, где $в_j = max\ a_{ij}\ (1 \le i \le m)$, with given *j*.

For example, for a payoff matrix $в_1 = 4$, $в_2 = 8$, $в_3 = 6$, $в_4 = 9$.

$$A = \begin{pmatrix} & \Pi_1 & \Pi_2 & \Pi_3 & \Pi_4 \\ A_1 & 1 & 4 & 5 & 9 \\ A_2 & 3 & 8 & 4 & 3 \\ A_3 & 4 & 6 & 6 & 2 \end{pmatrix}.$$

According to the introduced r_{ij} and $в_j$ definitions we obtain the risk matrix

$$R = \begin{pmatrix} & \Pi_1 & \Pi_2 & \Pi_3 & \Pi_4 \\ A_1 & 3 & 4 & 1 & 0 \\ A_2 & 1 & 0 & 2 & 6 \\ A_3 & 0 & 2 & 0 & 7 \end{pmatrix}.$$

Regardless of the type of game matrix, it is required to choose a player strategy (pure or mixed, if the latter makes sense), which would be the most profitable compared to others. It should be noted that in the game with nature, the concept of a mixed player strategy is not always legitimate, since its actions can be alternative, i.e. the choice of one strategy rejects all other strategies (for example, the choice of alternative projects).

4.2. Decision-Making on Investment Projects

Classification of common investment decisions. All enterprises are more or less connected with investment activities. Decisions on investment projects are complicated by various factors: the type of investment, the cost of the investment project, the multiplicity of available projects, the limited financial resources, for investment, the risk associated with the adoption of a decision. In general, all solutions can be classified as follows (Lebedeva et al., 2016).

Classification of common investment decisions is as follows:

1. Mandatory investments, the network is those that are necessary for the firm to continue its activities:

- Decisions on harm reduction to the environment;
- Improvement of working conditions to state standards.

2. Decisions aimed at reducing costs:

- decisions on improving the applied technologies;
- to improve the quality of products, works, services;
- improving the organization of work and management.

3. Decisions aimed at expanding and updating the firm:

- Investments for new construction (construction of facilities that will have the status of a legal entity);
- investment for expansion of the company (construction of facilities in new areas);
- Investments for the reconstruction of the company (erection of construction and installation works on existing areas with partial replacement of equipment);
- Investment in technical re-equipment (replacement and modernization of equipment).

4. Decisions on the acquisition of financial assets:

- Decisions aimed at the formation of strategic alliances (syndicates, consortia, etc.);
- Decisions on the absorption of firms;
- Decisions on the use of complex financial instruments in transactions with fixed capital.

5. Decisions to develop new markets and services;

6. Decisions on the acquisition of intangible assets.

The degree of responsibility for the adoption of an investment project in a given direction is different. So, if we are talking about replacing existing production capacities (Bogoviz Alexei, Vukovic Galina & Stroiteleva Tamara, 2013), the decision can be taken quite painlessly, since the management of the enterprise clearly understands to what extent and with what characteristics new fixed assets are needed. The task is complicated when it comes to investments related to the expansion of the core business, since in this case it is necessary to take into account a number of new factors: the possibility of changing the position of the firm in the commodity market, the availability of additional volumes of material, labor and financial resources, the ability to develop new markets, etc.

Obviously, the question of the size of the proposed investment is important. Thus, the level of responsibility associated with the adoption of projects at a cost of $ 100 thousand and $ 1 million is different. Therefore, the depth of analytical elaboration of the economic side of the project, which precedes the decision making, must also be different. In addition, in many firms, the practice of differentiating the right to make decisions of an investment nature becomes commonplace, i.e. limits the maximum amount of investment, within which a particular leader can make independent decisions.

Often decisions must be made in conditions when there are a number of alternative or mutually independent projects. In this case it is necessary to make a choice of one or several projects, based on some criteria. Obviously, there can be more than one criterion, and the probability that a certain project will be preferable to others by all criteria, as a rule, is negligible.

Two analyzed projects are called independent, if the decision to accept one of them does not affect the decision to accept the other.

Two analyzed projects are called alternative if they cannot be realized simultaneously, i.e. the acceptance of one of them automatically means that the second project should be rejected (Bulatov, 2014).

In a market economy, there are many opportunities for investment. However, any enterprise has limited financial resources available for investment. Therefore, the task is to optimize the investment portfolio.

The risk factor is very significant. Investment activity is always carried out in conditions of uncertainty, the degree of which can vary significantly. So, at the time of acquiring new fixed assets, one can never accurately predict the economic effect of this operation. Therefore,

decisions are often taken on an intuitive basis (Blaginin et al., 2017).

Investment decisions, like any other type of management activity, are based on the use of various formalized and non-formalized methods and criteria. The degree of their combination is determined by different circumstances, including the one of how much the manager is familiar with the available apparatus, applicable in a particular case. In domestic and foreign practice, a number of formalized methods are known, with the help of which calculations can serve as the basis for making decisions in the field of investment policy. There is no universal method suitable for all cases of life. Probably, management is still more of an art than a science. Nevertheless, having some estimates obtained by formalized methods, even to some extent conditional, it is easier to make final decisions.

Criteria for making investment decisions. The criteria for making investment decisions are:

1. criteria for assessing the reality of the project:

- normative criteria (legal); norms of national, international law, requirements of standards, conventions, patentability, etc.;
- resource criteria, by type:
- scientific and technical criteria;
- technological criteria;
- production criteria;
- volume and sources of financial resources.

2. Quantitative criteria allowing assessing the feasibility of the project.

- Conformity of the project's objective for a long-term perspective with the objectives of the business environment development;
- Risks and financial implications (whether they lead to additions to investment costs or a decrease in the expected volume of production, prices or sales);
- Degree of project sustainability;
- Probability of designing a scenario and the state of the business environment.
- Quantitative criteria, allowing choosing from those projects, the implementation of which is expedient. project cost;
- net present value;
- profit;
- profitability;
- internal rate of return;
- payback period;
- sensitivity of profit to the horizon (term) of planning, to changes in the business environment, to an error in the evaluation of data.

In general, the adoption of an investment decision requires the joint work of many people with different qualifications and different views on investments (Granturov, 2002). Nevertheless, the last word remains for the financial manager, who adheres to certain rules.

Rules for the Adoption of Investment Decisions. Rules for making investment decisions:

1. investing money in production or securities makes sense only if you can get a net profit higher than from keeping money in the bank;

2. Investing means makes sense only if, the return on investment exceeds the growth rate of inflation;

3. It makes sense to invest only in the most cost-effective projects considering discounting.

Thus, the decision to invest in the project is accepted if it meets the following criteria:

- low cost of the project;
- minimizing the risk of inflationary losses;
- short payback period;
- stability or concentration of receipts;
- high profitability per se and after discounting;
- lack of more beneficial alternatives.

In practice, projects are selected not so much the most profitable and least risky, how much

better fit into the strategy of the firm.

In addition to the most accurate, but also the most time-consuming method for making investment decisions with the help of the net present value indicator, other methods are used, determined by the following criteria: the payback period; profit on capital; internal rate of return.

As an option, you can use the emerging modern software that allows you to make a decision in a short time, but with certain bindings to the algorithm of the program or its specifics.

The use of alternative methods of choosing an investment strategy can be justified by the situation when a decision needs to be made quickly and there is no time to apply more precise, but at the same time more laborious methods of choosing certain solutions.

4.3. Computer Tools for the Process of Making Investment Decisions

Investing is a complex process associated with the need to identify the impact on the project of a number of factors that cannot be expressed only in quantitative terms. The qualitative nature of a number of factors, often of significant importance for the project, makes it inadequate to use purely mathematical methods and strengthens the role of the person in making a decision. The tool for this solution is computer technology (Vittas, 1991).

At present, the market of software products provides ample opportunities for the analyst and the manager of investment projects. First of all, the special software product COMFAR (Computer Model for Feasibility Analysis and Reporting) must be mentioned, which was based on the principles of the United Nations Industrial Development Organization (UNIDO) methodology; its first version was created back in 1982. This package was translated into Russian, but its practical use is difficult due to a number of reasons: high cost, the fact that it is not adapted to Russian taxation conditions and accounting organization.

Some business plans developers, guided by their internal capabilities and needs, conduct the necessary calculations using spreadsheet formats (for example, Lotus 123, QPRO, Excel). The computer model (block diagram) of such calculations is programmed by the project analyst and should be briefly justified in the business plan.

The most common project planning system in the world today is Microsoft Project. In many Western companies, Microsoft Project has become a familiar addition to Microsoft Office even for ordinary employees who use it to schedule simple work routines.

Among the merits of the package quite convenient and flexible tools for creating reports must be mentioned. The ability to simultaneously have up to six plans for each project makes it possible to increase the effectiveness of the “what if?” analysis. At the same time, Microsoft Project provides a minimal set of tools for planning and managing resources.

The need for competitive conditions to have a “commodity” appearance of the business plan of the project and the possibility of computerization of routine settlement operations in the early 90's led to the advent of software on the market a number of diverse domestic products. All available computer packages in the field of investment calculations can be conditionally combined into two large classes - open and closed systems, depending on the ability of the user to make changes to the calculation algorithms (Zhdanov, 2001; Bogoviz, Vukovich & Stroiteleva, 2013).

Under the “openness” of the system, we will understand the possibility for the designer to design his own calculation models, modify and edit the formulas, which the spreadsheets allow. “Closeness” of the system is the impossibility of the user changing the formulas and algorithms by which the calculations take place (Romanov, 2017).

This can be both a virtue and a disadvantage, depending on the goals that are facing the investor and the initiator of the project. Sufficiently qualified users can simulate quite complex and diverse scenarios of project implementation, using the flexible capabilities of the “open” system, which at the same time conceals the threat of errors. The fact is that the professional developer uses the standard approach to calculating the indicators and criteria

of the project, which is independent of the openness of the packages. While an insufficiently advanced user can try to adjust the formulas instead of changing the input information in order to obtain an effective calculation variant.

Note that on the other hand, when using “closed” packages, the possibility of errors arises from the absence of an algorithm that allows you to monitor the calculation, and also because you can not modify the calculation formulas taking into account the features of the project.

Table 1 lists the main Russian producers of the most known software packages.

Table 1
Major Russian software products.

Producer	**City**	**Product**
IKF “Alt”	Saint-Petersburg	Alt
“Pro-Invest-IT” Company	Moscow	Project Expert
“INEC” Firm	Moscow	Analitic

Source: Prepared by the authors.

Complexity and systemic character. With all the variety of software developments, the packages used to calculate business plans for investment projects have a number of common features:

- basis of all calculations
- cash flow of the project;
- output forecast tables are formed:
- statement of income,
- statement of cash flows,
- balance sheet,
- a system of financial ratios,
- system of criterial indicators of project efficiency;
- there is the possibility of graphical illustration of a series of calculations performed;
- quantitative risk analysis is most often present in the form of a simple sensitivity analysis.

Similar software products are used by large banks, investment funds, industrial enterprises, consulting firms, educational institutions and other organizations related to making investment decisions, developing, evaluating, analyzing investment projects and researching their risks. However, it is natural and understandable that each user chooses exactly the tool that best suits his needs and tasks.

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5. Conclusions

So, summing up, we can say that investing is not as simple as it may seem. Investment, above all, is a thoughtful and responsible step that determines the further state of the investing entity. This step by its nature has to be carried out in conditions of uncertainty at different levels, which, accordingly, requires additional study of the investment project using a variety of criteria that make it possible to clarify the situation and make a decision that will best match the investment strategy.

It is very important to take into account the environment in which the project is implemented, that is, it is necessary to conduct both qualitative and quantitative analysis (risks of country, regional, sectoral, project investment).

To improve the quality of the decision, it is necessary, if possible, to apply several criteria for the effectiveness of the project, especially in a situation where the originally chosen criterion

does not give complete certainty for the final choice of a decision

In the situation of lack of information about the state of the environment, the theory does not provide unambiguous and mathematically rigorous recommendations on the choice of decision criteria. This is largely due not to the weakness of the theory, but to the uncertainty of the situation itself. The only reasonable way out in such cases is to try to obtain additional information, in the absence of which the decisions made are theoretically insufficiently substantiated and to a large extent subjective.

Although the application of mathematical methods does not give an absolutely reliable result and it is to some extent subjective (due to the arbitrary choice of the criterion for making the decision), it nevertheless creates some ordering of the data available: a set of states of nature, alternative solutions, winnings and losses under various combinations of the "environment-solution" state. This streamlining of the concept of the problem itself helps to improve the quality of decisions made.

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