Substantiation of economic effectiveness of investment projects

Sustanciación de la efectividad económica de los proyectos de inversión

Khlynin Edward Valentinovich*
Tula State University - RUSSIA
hklynin@yandex.ru

Korovkina N. I**
Tula State University - RUSSIA
korovkina-n-i@yandex.ru

Zolkina A. A***
Tula State University - RUSSIA
zolochkina1408@mail.ru

ABSTRACT

In this article results of scientific research of a complex estimation of economic efficiency of investment projects are submitted. The basic theoretical positions and methodological principles which realization allows to generate a structural control system of investment process at the enterprise are established and to construct economic-mathematical model of his realization. Development of theoretical-methodological base of realization of a complex estimation of economic efficiency of investment projects is reached on the basis of realization of the put forward hypothesis about dependence of the investment decision not only on economic efficiency of investments, but also on an economic condition of the managing subject. In research substantive provisions of the theory of systems and also general scientific methods of the analysis and synthesis for the qualitative and quantitative description of a complex estimation of economic efficiency of investment projects are used. For realization of a complex estimation of economic efficiency of investment projects it is offered to establish dependence between economic efficiency of investments and an economic condition of the managing subject.

Keywords: investment project, economic efficiency, methodological principles, model, hypercube, cluster.

RESUMEN

En este artículo se presentan los resultados de la investigación científica de una estimación compleja de la eficiencia económica de los proyectos de inversión. Se establecen las posiciones teóricas básicas y los principios metodológicos que la realización permite generar un sistema de control estructural del proceso de inversión en la empresa y construir el modelo económico-matemático de su realización. El desarrollo de la base teórico-metodológica de la realización de una estimación compleja de la eficiencia económica de los proyectos de inversión se alcanza sobre la base de la hipótesis planteada sobre la dependencia de la decisión de inversión no solo en la eficiencia económica de las inversiones, sino también en una condición económica. del tema de gestión. En la investigación se utilizan disposiciones sustantivas de la teoría de sistemas y también métodos científicos generales de análisis y síntesis para la descripción cualitativa y cuantitativa de una estimación compleja de la eficiencia económica de los proyectos de inversión. Para la realización de una estimación compleja de la eficiencia económica de los proyectos de inversión, se ofrece establecer una dependencia entre la eficiencia económica de las inversiones y la condición económica del sujeto de gestión.

Palabras clave: proyecto de inversión, eficiencia económica, principios metodológicos, modelo, hipercubo, cluster.

Improving approaches and methods of managing investment projects is one of the most important economic problems, which is currently receiving much attention, both at the level of the scientific community and by practical economists who make decisions about the possibility of making investments. It needs to intensify investment activity, its impact on the economic growth of managing entities and the economic progress of society in general.

Considering the management of investment projects, it should be pointed out that the evaluation of the investments economic efficiency, based on generally accepted methods, does not allow obtaining a consistent result. Therefore, investment decisions cannot be considered economically reasonable and expedient. Indeed, in theory and practice of economic management of investment projects, methods for estimating the economic efficiency of investments are usually implemented based on the analysis of the values of such economic indicators as net present value (NPV), simple or discounted payback period (PP, DPP), internal rate of return (IRR), rate of return (ARR), profitability index (PI), etc. However, analyzing the results of using such methods, it is necessary to state the fact that the values of economic Customers do not always make the right investment decision. The simultaneous use of several economic indicators to assess the economic efficiency of investment projects can lead to ambiguous results (Khlynin & Khoroshilova, 2011). Moreover, the well-known economic criteria for accepting investment projects for implementation that exist for the economic indicators under consideration are theoretically not sufficiently substantiated, and from a practical point of view, not feasible. I would like to draw attention to the fact that this is not related to the probabilistic mechanism underlying the calculation of the economic indicators under consideration, which involves the use of verified methods of forecasting cash flows in the future, but primarily with the insufficient development of the theoretical and methodological principles of assessing economic efficiency of investment projects.

For example, the well-known economic criterion of accepting investment projects for implementation is the positive value of the net present value. Formally, the criterion is undeniable. However, there are reasonable questions:

- Does every business entity adhere to this criterion when drawing up a decision on the implementation of an investment project?

- Are there any enterprises for which it would be acceptable to implement an investment project with a negative net present value?

- Are there enterprises that reject an investment project with a positive value of the net present value, and in this case, what value of the economic indicator will be critical?

Answering negatively the first question and positively the next two, we prejudice the existing criterion for net present value.

Another example is the assessment of the economic efficiency of investment projects on the basis of a simple or discounted payback period. There is no exact criterion for the economic indicator, but only recommended values. Therefore, the use of a method for assessing the economic efficiency of investment projects based on calculating the value of a simple or discounted payback period provides for certain subjectivity in the development of a management decision and requires practical experience.

Certain disadvantages are inherent in other methods for evaluating the economic efficiency of investment projects. As a result, decisions can be made on the implementation of those investment projects that are not economically feasible to implement, and deviate those that could ensure economic growth and development of economic entities.

Understanding the disadvantages inherent in various methods of evaluating the economic efficiency of investment projects, many scientists and practical economists who carry out research in this field of knowledge obtained results related to the justification of the economic feasibility of implementing a particular method, and also suggested using the integral criterion evaluation of the effectiveness of investments, providing for the integration of various economic indicators in one on certain principles (Brealey & Myers, 1997; Stoyanov, 2006; Byrman, 2003).

In our opinion, to achieve an objective assessment of the economic efficiency of investment projects is not enough to be guided only by cosmetic manipulations. It is necessary to change the methodological approach underlying the development of investment decisions. Any investments from the point of view of their economic efficiency should be considered not on their own, isolated and isolated from the business entity that implements them, but taking into account its real economic condition and development prospects, in context with the implemented strategy. The proposed methodological approach ensures the implementation of a comprehensive assessment of the economic efficiency of investment projects. To implement such a methodological approach, it is hypothesized that the assessment of the economic efficiency of investment projects is influenced not only by the characteristics generated by them, such as the period of implementation, the size of investments, the amount and distribution of cash flow over years, the discount rate, etc., but and the economic indicators inherent in the entity that intends to implement them.

The methodological approach of an integrated assessment of the economic efficiency of investment projects provides for the implementation of the following methodological principles: complexity; consistency; analyticity; economic efficiency; innovativeness.

Considering the basic methodological principles of a comprehensive assessment of the economic efficiency of investment projects, first of all, attention should be paid to such as complexity. The complexity of the assessment is justified by the fact that in order to determine the economic efficiency of investment projects, it is proposed to consider not only their effectiveness in the usual interpretation of this concept, as a relative excess of return on investment over the costs necessary for their implementation, but also the economic condition of the economic entity. The need for a comprehensive assessment of the economic efficiency of investment projects is indicated by many economists. For example, Drabenko V.A. notes that "the project should not be considered isolated from the enterprise implementing it. ...A project that is

effective for one enterprise may turn out to be ineffective for another due to objective and subjective reasons" (Drabenko, 2009).

Thus, only a comprehensive assessment of trends in indicators of investment efficiency and the economic condition of an economic entity allows us to justify the feasibility of implementing investment projects. The implementation of an integrated approach to assess the economic efficiency of investments involves the formation, processing and periodic updating of the information and statistical base of investment projects, as well as the selection and standardization of indicators of the economic condition of an economic entity, building a hypercube based on them and positioning an enterprise in it. The implementation of these actions allows you to build an economic-mathematical model for a comprehensive assessment of the economic efficiency of investment projects (Graphic. 1).
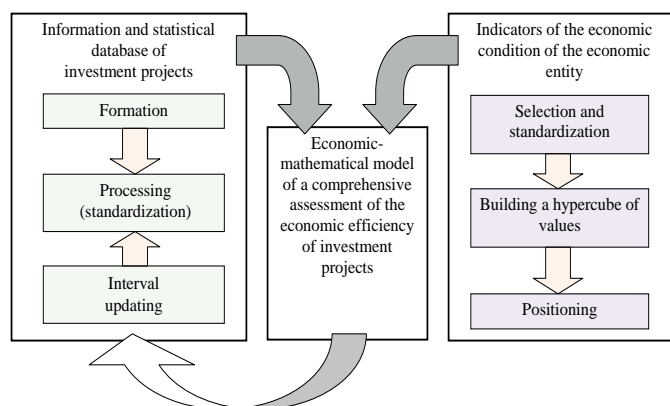

Graphic. 1 The structural system of interaction of the main elements, a comprehensive assessment of the economic efficiency of investment projects

The first element of a comprehensive assessment of the economic efficiency of investment projects is the information and statistical base. Formation of the information and statistical base is carried out by accumulating economic information about investment projects implemented previously in an enterprise or industry, such as, for example, net present value, simple and discounted payback period, internal rate of return, rate of return, profitability ratio, etc. economic information about investment projects, differing in size and direction of influence on the economic efficiency of investments, it is necessary to normalize. This will allow bringing heterogeneous economic information on the effectiveness of investments to a comparable form. Periodic updating of the information statistical database provides a dynamic account of changes occurring in the enterprise and in the external environment.

Indicators of the economic condition of an economic entity act as the second element of a comprehensive assessment of the economic efficiency of investment projects. The formation of this element involves the selection of indicators of the economic state of the enterprise and their standardization. The number and composition of indicators of the economic state of an enterprise should be determined, on the one hand, by the full coverage of the features of the business entity, and, on the other hand, by the practical importance of the comprehensive assessment model for the economic efficiency of investment projects. Our recommendation is to use two or three indicators of the economic condition of an enterprise, such as profitability, labor productivity, capital productivity, financial stability, solvency, etc. It should be noted that it is advisable to select the most significant of them as indicators of the economic condition of an economic entity. To assess the degree of implementation of the corporate strategy of the enterprise. To describe all possible economic positions of an enterprise in the space of selected indicators of the economic state of an economic entity, a hypercube of the values of the considered indicators is constructed (Pic. 2). The positioning of an enterprise in a hypercube of values of indicators of the economic status of an economic entity provides for determining its real and prospective position in the space of selected indicators.

The interaction of the two considered elements of a comprehensive assessment of the economic efficiency of investments allows us to establish which characteristics of investment projects need to be paid attention to when making management decisions about their implementation and what values they should take in the real economic situation of an enterprise in order to achieve a prospective position. Given this, the assessment of the economic efficiency of investment projects should be considered comprehensive.

To make management decisions about the economic feasibility of implementing investment projects based on the correspondence between the values of investment performance indicators and the economic condition of an economic entity, the necessary information should be provided in the form of a structural system consisting of three interrelated elements (Pic. 1). Such a presentation of information about the management of the investment process makes it possible to implement the principle of consistency, which is one of the main methodological principles of a comprehensive assessment of the economic efficiency of investment projects.
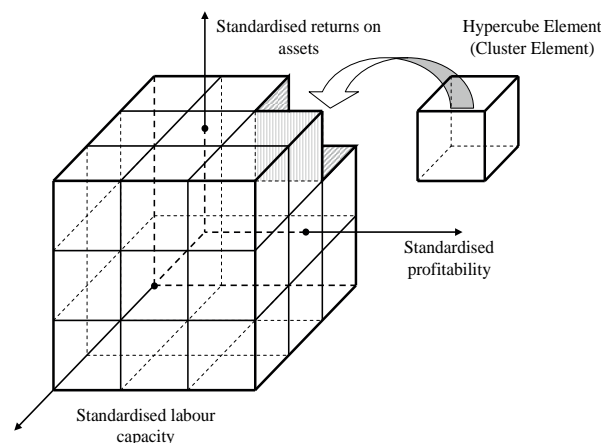
Graphic 2. Hypercube (cluster) of standardized values for the three indicators of the economic condition of the business entity

The structure of the system provides for a systematic presentation of individual elements of a comprehensive assessment of the economic efficiency of an economic entity. So, for example, indicators reflecting information about the economic status of an economic entity, as an element of the system, should be presented in the form of a cluster, which is a type of system (Pic. 2). Such a cluster has a certain dimension, depending on the number of indicators of the economic condition of an economic entity involved in the implementation of a comprehensive assessment of the economic efficiency of investment projects. An enterprise that establishes a set of indicators of economic status that are taken into account in the implementation of a comprehensive assessment of the economic efficiency of investment projects forms its own specific cluster. In cluster analysis, the structural system describing the corresponding cluster of indicators of the economic condition of an economic entity, which is formed to carry out a comprehensive assessment of the economic efficiency of investment projects, is called the n-dimensional hypercube (Mandel, 1988).

As with any system, a cluster of indicators of the economic condition of a host entity has a certain structure, including the corresponding number of cluster elements (hypercube elements). The number of cluster elements depends on the dimension of the formed cluster of indicators of the economic condition of the economic entity and the number of selected intervals of values. It should be noted that cluster elements are interconnected. These relationships are determined by the existing trajectories of strategic development, ensuring the achievement of various economic conditions of the economic entity, described by the formed cluster.
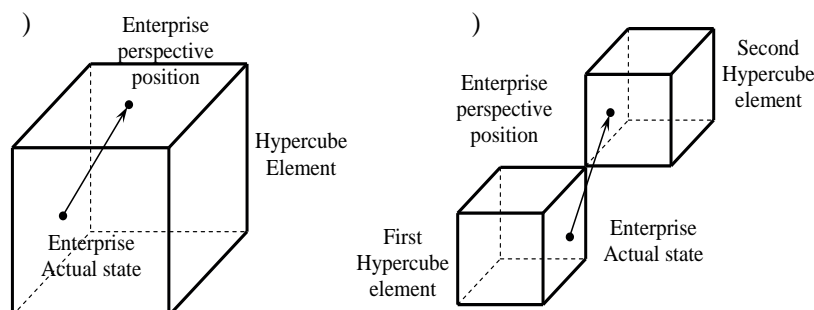
Thus, a cluster of indicators of the economic condition of an economic entity, represented as a system of cluster elements, describes the set of possible economic conditions of an enterprise in terms of the values of those indicators of financial and economic activities that form the basis for the formation of the cluster. At any given time, a certain cluster element corresponds to the economic condition of an economic entity. The implementation of management decisions for the implementation of certain investments leads to a change in the economic condition of the enterprise relative to the considered indicators of financial and economic activity and the corresponding change of the cluster element. The essence of a comprehensive assessment of the economic efficiency of investment lies in the implementation of those investment projects that allow you to form the required trajectory of strategic development, describing the dynamics of changes in the economic conditions of an enterprise. Investment projects that do not ensure the formation of the required trajectory of strategic development should be rejected. Therefore, a cluster of indicators of the economic condition of an economic entity should be considered as a dynamic system, the pace of development of which depends on previously adopted investment decisions.

It is necessary to pay attention to the fact that the implementation of the periodic updating of the information and statistical base of investment projects caused by changes occurring in the external environment ensures, first, the system is viewed as a structure open to external influences, and, second, availability of feedback in the system.(Atarzadeh & Seyedi,2018).

Any cluster formed by the considered indicators of the economic condition of the economic entity is inherent in the property of analyticity. This fact is confirmed by the analyticity of the indicators themselves of the economic condition of the economic entity. Justifying the observance of the principle of analyticity in the theoretical and methodological description of a comprehensive assessment of the economic efficiency of investment projects, it should be noted that the position of the enterprise in the relevant cluster is determined by the numerical values of the economic indicators of the economic entity.

The presence of analytical relationships for indicators of the economic condition of the economic entity allows establishing the real and promising position of the enterprise in the formed cluster, i.e. to carry out its positioning (Pic. 3).

Positioning an enterprise on the basis of determining its real and prospective position in the hypercube space of standardized values of indicators of the economic state of an economic entity allows one to define the trajectory of its strategic development. When considering the first option (Pic. 3 a), the trajectory of the strategic development of the enterprise is entirely located in one element of the hypercube of standardized values. Therefore, in order to make a decision on the economic efficiency of investments, it is necessary to use an economic-mathematical model corresponding to this element of the hypercube. In the second variant (Pic. 3 b)), the trajectory of the strategic development of an enterprise begins in one element of the hypercube, and ends in another. Consequently, the assessment of the economic efficiency of investments should be carried out on the basis of the use of an economic-mathematical model built for that element of the hypercube that corresponds to the perspective position of the economic entity.

Graphic 3. Variants of enterprise positioning in a hypercube of standardized values of indicators of the economic condition of an economic entity

As a result, the analyticity of a comprehensive assessment of the economic efficiency of investment projects is determined not only by the numerical values of indicators of the economic condition of the business entity, but also by the existing relationships between the cluster of economic status indicators of the business entity and investment performance indicators. It should be noted that between these groups of indicators there is a stochastic dependence, which allows the construction of an economic-mathematical model of a comprehensive assessment of the economic efficiency of investment projects, which has the form:

$$I = \sum_{j=1}^{m} k_j^c \cdot p_j > 0,$$

where m - the number of indicators of economic efficiency of the investment project; k_j^c - the standardized value of the j-indicator of the economic efficiency of the investment project; p_j - the weight coefficient of the j-indicator of the economic efficiency of the investment project.

Comprehensive assessment of the economic efficiency of investment projects provides for the implementation of the principle of economic efficiency in the theoretical and methodological substantiation of investment management.

The proof of achieving an effective result of a comprehensive assessment of investments is the structure of the economic-mathematical model. The structure of the economic-mathematical model is formed by various indicators of the economic efficiency of investments, which are combined into one weight coefficients. Proceeding from the statement that all indicators included in the structure of the economic-mathematical model make it possible to reflect various aspects of the economic efficiency of investment investments, it should be concluded that the result obtained on the basis of its use will also be effective.

It should be noted that the principle of economic efficiency can be implemented in the economic-mathematical model because its structure depends on the actual values of indicators of the economic condition of the economic entity. With insignificant changes in the economic state of an economic entity that do not extend the position of the enterprise beyond the borders of the cluster element under consideration, the structure formed by the economic-mathematical model does not change and makes it possible to evaluate the economic efficiency of investment projects. On the contrary, in order to adequately assess the economic efficiency of investments as a result of significant changes in the economic condition of an economic entity, taking the enterprise beyond the boundaries defined by the cluster element in question, the structure of the economic-mathematical model should be reconsidered. In such conditions, the new composition of indicators of the economic-mathematical model allows to evaluate the economic efficiency of investment projects.

Thus, an adequate assessment of the economic efficiency of investment projects is carried out through a corresponding modification of the structure of the economic-mathematical model in the event of a significant change in the economic condition of the economic entity.

Among the methodological principles inherent in a comprehensive assessment of the economic efficiency of investment projects, it is necessary to point out the principle of innovative development. The innovativeness of a comprehensive assessment of the economic efficiency of investment projects is formed as a result of the periodic updating of the economic and mathematical model, which occurs on the basis of clarifying the values of weighting factors or

changing the model structure.

Periodic actualization of the economic and mathematical model used for a comprehensive assessment of the economic efficiency of investment projects ensures its adaptation to a constant change in the external environment. From the point of view of the systems approach, this allows considering the economic-mathematical model as a system open to external influences. In addition, the periodic updating of the economic-mathematical model describing a comprehensive assessment of the economic efficiency of investments is carried out as a result of the specification of the parameters corresponding to the investment projects being implemented. Such actualization of the economic-mathematical model should be considered as a self-developing system or a system with feedback.

Thus, the use of the possibilities of taking into account external influences and components of self-development in the economic-mathematical model ensures the implementation of the innovation principle in the implementation of a comprehensive assessment of the economic efficiency of investment projects.

The implementation of the above theoretical and methodological foundations provides for the construction of one or several economic and mathematical models for a comprehensive assessment of the economic efficiency of investment projects, each of which corresponds to the actual values of indicators of the economic condition of an economic entity or the values that the company seeks to achieve. The investment project is accepted for implementation if the condition of the economic-mathematical model is met; otherwise the investment project is rejected. All completed investment projects, depending on the implemented economic and mathematical model, ensure the achievement of a lower or higher intensity improvement of indicators of the economic condition of an economic entity.

As a result of theoretical and methodological studies related to the implementation of a comprehensive assessment of the economic efficiency of investment projects, the following conclusions should be made:

1. Separately used indicators for assessing the economic efficiency of investments do not allow obtaining an unambiguous result for making the right investment decision. In this regard, those investment projects that should not be implemented can be carried out, and those that could improve the economic condition of the economic entity are rejected. To solve the problem of adequate investment appraisal, it is necessary to pay attention to the development of the theoretical and methodological basis for the implementation of a comprehensive assessment of the economic efficiency of investment projects;

2. On the basis of the hypothesis put forward about the dependence of the economic efficiency of investments on the economic condition of an economic entity, the development of a theoretical and methodological framework for the implementation of a comprehensive assessment of the economic efficiency of investment projects was carried out, which envisages the formulation of methodological principles, the formation of a structural system of interaction of its basic elements state of the enterprise, as well as the development of economic and mathematical model;

3. It has been established that in order to develop the theoretical and methodological foundations for the implementation of a comprehensive assessment of the economic efficiency of investment projects, a number of basic methodological principles should be followed to construct an economic-mathematical model. The main methodological principles of a comprehensive assessment of the economic efficiency of investment projects include such as complexity, consistency, analyticity, economic efficiency and innovativeness;

4. The theoretical and methodological approach to the comprehensive assessment of the economic efficiency of investment projects involves the formation of a system whose structure includes three main elements: the information and statistical base; indicators of the economic condition of the economic entity; economic and mathematical model. The structural system for a comprehensive assessment of the economic efficiency of investment projects is open, which allows it to adapt to changes in the external environment, and has a feedback that ensures its self-development;

5. The structure of the main elements of a comprehensive assessment of the economic efficiency of investment projects and their content was determined. It was proposed to form, process (standardize) and periodically update the information and statistical base of investment projects, and for indicators of the economic state of an economic entity to carry out selection and standardization, constructing a hypercube of values and positioning the enterprise;

6. For a reasonable choice of an element of a hypercube of standardized values of indicators of the economic condition of an economic entity, for which an economic-mathematical model of a comprehensive assessment of the economic efficiency of investment projects is being built, it has been proposed to form a cluster of indicators of the enterprise's economic status, ensuring the determination of its real and prospective position and building a strategic development trajectory;

7. Consideration of methodological principles made it possible to identify an analytical form of an economic-mathematical model for a comprehensive assessment of the economic efficiency of investment projects, including the most significant indicators for assessing the economic efficiency of investments for the corresponding element of the hypercube, and parameters that take into account the features of the data presented in the information and statistical database of investment projects. The use of the economic and mathematical model of a comprehensive assessment of the economic efficiency of investment projects provides a choice of such investment projects, the implementation of which allows improving the economic condition of the enterprise and realizing the intended trajectory of strategic development.

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