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THE EVALUATION OF THE ECONOMIC EFFECTIVENESS OF THE INVESTMENT PROJECT WITH RISK CONSIDERATION

Summary: The scientific and methodological approach is elaborated to evaluate the economic effectiveness of investment projects with risk consideration, which, unlike the existing ones, gives the opportunity to take into account the causal relationships between the main factors of risk and take them into account comprehensively when evaluating the economic effectiveness of investment projects depending on their specific character. The results are tested on the example of purchasing equipment for the limited liability company "Ukr-Polymer".

Keywords: risk, investment project risk, risk assessment, risk factors, effectiveness of an investment project.

JEL Classification: E22, G32, H43, O22.

Introduction

In the context of limited investment resources, a comprehensive justification of the effectiveness of the investment decisions is of particular importance. Current economic conditions make significant adjustments to the scientific and methodological support for evaluating the economic efficiency of investment projects, which is caused, above all, by the high uncertainty that accompanies the investment decisions. In this regard, the issue of taking into account risks in evaluating the economic efficiency of investment projects is of particular relevance.

Risk is an integral part of any investment activity, even under the most favorable economic conditions, the possibility of income or even direct loss is retained. The purpose of the risk analysis is to provide potential partners with the necessary information to make decisions about participating in the project and measures to be taken against potential financial losses.

When evaluating the effectiveness of a particular investment decision, risks that may cause the actual result to deviate from the planned one or achieve the goals, and lead to additional financial or other costs, losses, etc., should be taken into consideration. According to Standish Group Chaos observations, in today's investment practice of all implemented real projects, only 32% of them are successful, 44% are controversial and 24% are doomed to failure [Tykhomyrova, 2014].

The larger the investment project, the greater the risk, and the greater the likelihood of negative (loss of income or profit, loss or additional cost of resources, project cost overruns, etc.), positive or neutral effects on one or more of the planned project goals.

1. Literature review

The issues of evaluating the effectiveness of investment projects with risk consideration are relevant and are being discussed by many scholars. Semenova and Protopopova [2016] in their works consider the main methodological approaches to determine the comparative evaluation of the economic efficiency of investment projects; substantiate the using of static and dynamic methods in modern conditions; outline the main methodological approaches to assess the investment projects risk under conditions of uncertainty. Scientists suggest the approach to calculate the payback period (efficiency ratio) of investments and determine the directions of analysis of factors that will affect the risk level of an investment project.

According to Sapohovska [2015], the methodology for assessing risks of an investment project should be developed, taking into account the main features of the investment activity of the organization and specific management goals for improving the efficiency of implementation of the entity's investment policy.

Zhukov [2017] substantiates methodological approaches to the evaluation of the effectiveness of investment projects in the conditions of economic transformation and suggests the quantitative and qualitative evaluation of the effectiveness of investment projects and to complement the indicators of investment attractiveness of investment projects by assessing their financial position, the analysis of methods and opportunities for insurance of the investment risk and

the willingness of the management of the company to provide investors with common international investment conditions. Such a scheme makes it possible to establish a logical link between the expected results and the attitude to risk, to obtain the projected characteristics of investment projects and on this basis to perform a comparative analysis of the attractiveness of projects.

The American Project Management Institute (PMI), which develops and publishes standards in project management, describes six risk management procedures, namely [PMBOK, 2009]:

- risk management planning – a selection of approaches and planning of project risk management activities;
- risk identification – the identification of risks that can affect a project and their characteristics;
- qualitative risk assessment – the qualitative analysis of risks and conditions of their occurrence in order to determine their impact on the project effectiveness;
- quantitative risk assessment – the quantitative analysis of the likelihood of the occurrence and impact of the effects of risks on a project;
- risk response planning – defining procedures and methods for minimizing the negative effects of risk events and taking advantage of potential benefits;
- risk monitoring and control – monitoring the occurrence of risk situations, identifying new risks, implementing a project risk management plan and evaluating the effectiveness of risk mitigation actions.

Scientists justify the use of economic and mathematical modeling to assess the impact of risks on the effectiveness of investment projects. In particular, the authors [Shpak et al., 2018; Kuzmin, Kulyniak, 2011] suggest assessing the impact of risks on the effectiveness of projects using the method based on the theory of fuzzy sets. Shvetsova, Rodionova and Epstein [2018] review the multicriteria decision-making (MCDM) methods in investment management and examine the advantages and disadvantages of these methods in the risk environment. In addition, they study the effectiveness of investment projects using the methods mentioned above. Monte Carlo simulation is recommended to evaluate the processes, financial or economic risk factors in investment projects appraisal by public sector institutions [Bock, Trück, 2011].

Farayibi [2015] offers to examine the impact of risk on investment decision in Nigeria using the descriptive analysis employing the use of primary data via the administration of questionnaires to respondents from various investment companies. Florescu [2012] states that risk is assessed through probability and incidence by using quantitative and qualitative methods.

However, nowadays, there is no sufficiently substantiated systematic approach to be guided when applying risk assessment methods to investment projects. Many investors often use risk adjustments that make it impossible to obtain a comprehensive assessment of investment projects risk, depending on its specific character, which, above all, affects the quality of the obtained economic indicators of investment projects and also leads to ignoring the possibility of management of such kind of risks. Everything mentioned above necessitates the need for further research and scientific substantiation of the methodologies of evaluating the economic efficiency of investment projects with risk consideration, which reflects the topicality of the given research.

2. Scientific and methodological approach to evaluating the economic effectiveness of the investment project with risk consideration

In general, the definition of risk and an investment project risk are closely related, only an investment project risk arises within the framework of a particular investment project and has narrowly targeted specificity. Therefore, taking into account the etymology and approaches to risk management based on basic scientific and regulatory frameworks allows us to focus on the general definition of the nature of risk and to apply this definition within a specific investment project, focusing on the specific character of investment activities.

In this article, we will adhere to the interpretation of the concepts of 'risk' and 'risk of an investment project', cited in the source [Kulyniak, Kopets, 2019], namely: 'risk' is a random event that with a certain level of probability can affect the course of work (process, project) and cause negative, positive or neutral results of the decision, and the 'investment project risk' is a random event that with a certain level of probability can affect the course of the investment project and cause negative, positive or neutral results of other investment decisions.

Characteristic of the nature of an investment project risk is the possibility of occurrence of neutral, negative as well as positive deviations from the set goals or expected results. It is therefore advisable to apply a complex risk-taking approach to evaluating the effectiveness of the investment project.

The evaluation of the effectiveness of an investment project refers to the pre-investment stage of preparation of any project. The outcome of the evaluation depends on whether the project will be implemented and the quality of the evaluation will determine whether the enterprise will receive the promised profit in future. Therefore, it is advisable to take into account risk, the recommenda-

tions for using in the investors' project activities such stages as risk management planning, risk identification, qualitative and quantitative risk assessment while evaluating its effectiveness.

Risk factors (accidental events that affect the purpose of an investment project) are in the external environments (macro and micro environments) and the internal environment of the enterprise. They are arranged on three levels. At the first level, there are risk factors that project managers have virtually no control over. They belong to different components of the macro environment. These are political, economic, natural, demographic, cultural, scientific and technological indicators of risk. At the second level, there are risk factors, the appearance of which is due to the activities of competitors, consumers, suppliers and other stakeholders related to the implementation of the investment project. Project managers in one or another way can influence them. At the third level there are risk factors that are directly related to the implementation of the investment project – production, personnel, etc. They are mostly under the control of managers [Kulyniak, Chernobai, 2011].

It is possible to evaluate risk factors of an investment project by the method of expert assessments. To do this, each expert should evaluate the probability (b) and the consequences (c) of each of risk factors (Table 1-2) according to a 10-point scale.

Table 1. Scale for assessing the consequences of an event

Level of consequences	Points	Characteristic
1. High (catastrophic risk)	7-9	The loss exceeds the value of the assets of the company performing the investment project
2. Medium (critical risk)	4-6	The loss is comparable to the working capital of the company performing the investment project
3. Low (acceptable risk)	1-3	The loss is comparable to the funds in the current account and inventories

Source: Starostina, Kravchenko [2004, p. 187].

Table 2. Scale of probability of occurrence of events

Probability evaluation	Points	Characteristic
1. High (catastrophic risk)	7-9	Possible several times during the year
2. Medium (critical risk)	4-6	Possible once every three year
3. Low (acceptable risk)	1-3	It will most unlikely happen within three years

Source: Starostina, Kravchenko [2004, p. 187].

The consequences of the event are estimated based on the financial status of the investment project. The probability for the analyzed risk factors (events) is described as follows: high (if an event can occur once a year); medium (once during 3-5 years) and low (will not occur during 3-5 years).

Consistency of experts' responses is estimated using the coefficient of concordance [Legendre, 2005, 2010]:

$$W = \frac{\sigma_{act}^2}{\sigma_{\max}^2} = \frac{\sum_{i=1}^{m}\left\{a_i - \frac{1}{2}\cdot n\cdot(m+1)\right\}^2}{\frac{1}{12}\cdot n^2\cdot m\cdot(m^2-1)}, \quad (1)$$

where σ_{act}^2 – the actual variance (standard deviation) of the final estimates provided by the experts; $\sigma_{\max}^2$ – the variance of the final estimates, provided that the opinions of the experts are completely the same; a_i – the total score obtained by the i-th object; m – the number of objects being investigated; n – the number of experts.

The essentiality of the coefficient of concordance is verified by Pearson's criterion according to the formula $\chi^2 = W \cdot n(m-1)$ with $(m-1)$ the number of degrees of variation.

The risk map is divided into three stages: 1) priority of risk factors by calculating the final assessment of each factor; 2) selection of 20-25% of the highest rated factors; 3) drawing of selected factors on the map. On the risk map, the probability is displayed on the vertical axis and the force of influence or significance of losses (consequences) is on the horizontal axis. In this case, the probability of risk increases from the bottom up as you move along the vertical axis, and risk increases from the left to the right along the horizontal axis.

The process of evaluating and analyzing the effectiveness of investment projects is quite complex and multi-staged, requiring different approaches to evaluation procedures. The greater the accuracy of determining the efficiency and risk of an investment project is, the more risk factors are taken into account. The main risk factor is the time during which the investment project will be implemented. Each stage of implementation of an investment project has different risks, so it is necessary to take a critical approach to identifying risks and assessing the strength of their impact on the project or some of its components.

At present, there are many risk assessment techniques for investment projects which according to scientists Semenova and Protopopova [2016] are divided into three groups:

1. Methods of adjusting the project discount rate and reliable equivalents. Investments are assessed on the basis of the mathematical expectation of an efficiency criterion or market valuation. The lowering of the estimate relative to its mathematical expectation is also possible depending on the level of investment risk.
2. Methods that allow to get an individual assessment of the level of risk. These include: sensitivity analysis method and analytical risk models. They are able to estimate the level of risk in the form of a standard deviation, its derivative or in the form of special risk ratios.
3. Methods that allow to estimate the probability of the distribution form. This group includes the scripting method, the building of the 'decision tree', the simulation. In the process of using these methods, a number of variants of events are analyzed, as a result of which the analyst has a probability curve in the form of a graph or a table.

To evaluate the effectiveness of investment projects 2 groups of methods can be used:

1. Static – based on accounting estimates and do not take into account the entire life of the project and the inequality of cash flows at different time. These include:
   1) Payback Period (PP);
   2) Return On Investment (ROI);
   3) Coefficient of Comparative Efficiency (CCE).
2. Dynamic – based on the concept of discounting and operating time intervals. These include:
   1) Net Present Value (NPV);
   2) Profitability Index (PI);
   3) Internal Rate of Return – (IRR);
   4) Modified Internal Rate of Return (MIRR);
   5) Discounted Payback Period (DPP).

Dynamic methods allow taking into account the influence of time on the effectiveness of the investment decision. In addition, it is suggested considering causal relationships between the main risk factors when evaluating the cost-effectiveness of investment projects, depending on their specific character. Let's consider further the applied principles of the proposed scientific and methodological approach to evaluating the economic efficiency of the investment project with risk consideration of purchasing the equipment for LLC "Ukr-Polymer".

3. Applied principles for evaluating the economic effectiveness of the investment project considering risk (for example, the purchase of equipment for LLC "Ukr-Polymer")

As an investment project, we will consider the purchase of the new plastic injection molding machine for LLC "Ukr-Polymer" – model DE 3132-C1, worth 430 thousand UAH. The cost includes shipping, installing and adjusting the equipment. We will evaluate the effectiveness of the investment project in the light of risk consideration by using our scientific and methodological approach.

The occurrence of particular project risk is influenced by a set of factors, the early detection of which will help to avoid negative consequences and increase the efficiency of implementation and realization of the investment project. Risk factors of the investment project for purchasing the plastic injection molding machine DE 3132-C1 are given in Table 3.

Therefore, for the investment project of purchasing the automatic plastic injection molding machine DE 3132-C1, there are three sets of macro factors that cannot be controlled by the managers, micro environments – the managers do not control, but can also affect the internal environment in which 10 main factors are identified that have the most negative impact on the investment project for purchasing the automatic injection molding machine DE 3132-C1.

The results of determining the weight of risk factors for the investment project of purchasing the automatic injection molding machine DE 3132-C1 are presented in the form of a matrix (Table 4).

The next step is to rank risk factors of the investment project for purchasing the automatic injection molding machine DE 3132-C1, giving each risk factor a rank in the order.

The risk assessment of the investment project for purchasing the automatic injection molding machine DE 3132-C1 is conducted by using the method of expert assessments. For this purpose, each of the experts (the employees of LLC "Ukr-Polymer") evaluated the probability (b) and consequences (c) of each risk factor (Table 4) according to the 10-point scale from the list of factors (Table 3). The scale of assessment of consequences of occurrence of events and the scale of assessment of probability of occurrence of events are given in Tables 1-2.

Table 3. Risk factors of the investment project for purchasing the plastic injection molding machine DE 3132-C1

Levels	Conventional Signs	Groups of factors	List of factors	Impact on the investment project
1st		Macro environment factors	1. Economic	
	F1		1.1. Increasing the price of resources	Increase in product value
	F2		1.2. Exchange rate fluctuations	Decrease in profit
			2. Political	
	F3		2.1. Import prohibition on specialized equipment and materials	Reduced product quality due to the use of worse domestic materials
			3. Natural	
	F4		3.1. Natural disasters	Damage or failure of equipment
2nd		Factors of micro environment	4. Competitors	
	F5		4.1. The emergence of competitors with the similar production, but with less cost	Decrease in number of potential consumers
			5. Consumers	
	F6		5.1. Unacceptability of products by a certain category of consumers	Decrease in number of potential consumers
	F7		5.2. Insolvency of consumers	Decrease in number of potential consumers
			6. Suppliers	
	F8		6.1. Delayed delivery of plastic and other material resources	Reduction of regular customers, loss
3rd		Factors of the internal environment	7. Personnel	
	F9		7.1. Insufficient staff qualifications	Injuries of workers (threat to health), damage to the equipment
			8. Marketing	
	F10		8.1. Improperly conducted advertising campaign	Reducing the number of potential consumers of products

Source: Compiled by authors.

Table 4. Matrix of weight of risk factors of the investment project for purchasing the automatic injection molding machine DE 3132-C1

Factors	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	Aggregate frequency of preferences by line, (l_j)	Aggregate frequency of preferences by column, (m_j)	Aggregate frequency of preferences, (l_j+m_j)	Factor of weight, w
F1	–	F1	F1	F1	F5	F1	F1	F8	F9	F1	6	–	6	0.13
F2	–	–	F2	F2	F5	F6	F7	F2	F9	F2	4	–	4	0.09
F3	–	–	–	F4	F5	F3	F7	F8	F3	F3	3	–	3	0.07
F4	–	–	–	–	F4	F6	F4	F4	F9	F10	3	1	4	0.09
F5	–	–	–	–	–	F5	F5	F8	F9	F5	3	3	6	0.13
F6	–	–	–	–	–	–	F6	F8	F6	F10	2	2	4	0.09
F7	–	–	–	–	–	–	–	F7	F7	F10	2	2	4	0.09
F8	–	–	–	–	–	–	–	–	F9	F8	1	4	5	0.11
F9	–	–	–	–	–	–	–	–	–	F10	–	5	5	0.11
F10	–	–	–	–	–	–	–	–	–	–	–	4	4	0.09
	Total:										26	19	45	1

Source: Compiled on the basis of expert estimates.

The results of the ranking of risk factors for the investment project for purchasing the automatic injection molding machine DE 3132-C1 are presented in Table 5.

Figure 1 shows a histogram of risk factors for the investment project for purchasing the automatic injection molding machine DE 3132-C1.

The results of the selection of factors with the highest indicators of the final evaluation are presented in Table 6. The selection of factors was done according to Pareto rule, in other words 20% of factors with the highest indicators of the final score was selected.

Table 5. Ranking of risk factors for the investment project for purchasing the automatic injection molding machine DE 3132-C1

Risk factors	The sum of the estimated probability of an event, *b*	The sum of the estimated consequences of an event, *c*	The sum total of estimates	The arithmetic mean of the sum of estimates	Factor of weight, *w*	Total score	Rank of factor
			$a = b + c$	$v = a / n$		$h = w * v$	
F1	63	48	111	11.1	0.13	1.48	1
F2	36	23	59	5.9	0.09	0.52	8
F3	21	26	47	4.7	0.07	0.31	10
F4	19	28	47	4.7	0.09	0.42	9
F5	64	43	107	10.7	0.13	1.43	2
F6	47	50	97	9.7	0.09	0.86	6
F7	44	52	96	9.6	0.09	0.85	7
F8	49	43	92	9.2	0.11	1.02	3
F9	42	46	88	8.8	0.11	0.98	4
F10	62	37	99	9.9	0.09	0.88	5

Source: Calculated by authors.

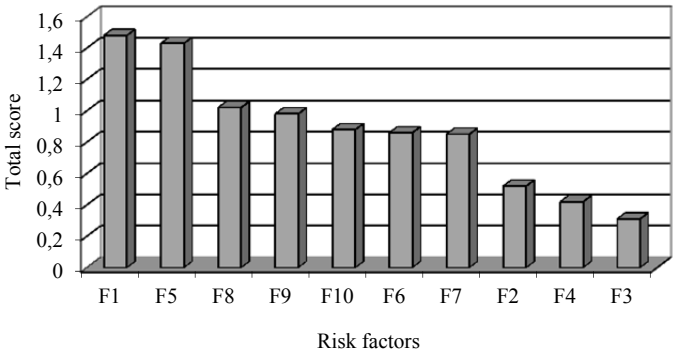

Fig. 1. Histogram of risk factors for the investment project for purchasing the automatic injection molding machine DE 3132-D1

Source: Compiled by authors.

Table 6. The main risk factors of the investment project for purchasing the automatic injection molding machine DE 3132-C1

Risk factors	Total score, h	Risks caused by factors (by saucers origin)	Risk code
F 1. Increasing the price of resources	1.48	Financial	101
F 5. The emergence of competitors with similar production, but with less cost	1.43	Marketing	201
F 8. Delayed delivery of plastic and other material resources	1.02	Resource risks	301
F 9. Insufficient staff qualifications	0.98	Personnel risks	401

Source: Compiled by authors.

Therefore, financial, marketing, resource and personnel risks have been identified as the highest risks for the investment project for purchasing the automatic injection molding machine DE 3132-C1, the total score for the factor causing them is 1.48; 1.43; 1.02 and 0.98 points.

Then we will build the map of the main risks for the investment project for purchasing the automatic injection molding machine DE 3132-C1 (Fig. 2).

Losses (consequences)	Probability		
	Low	Medium	High
Low			
Medium		301 401	101 201
High			

Fig. 2. Risk map of the investment project for purchasing the automatic injection molding machine DE 3132-C1

Source: Compiled by authors.

As we can see from Fig. 2, high probability and medium level of consequences are typical for financial and marketing risks, medium level of consequences and medium probability are typical for resource and personnel risks.

To determine the efficiency of the investment project for purchasing the automatic injection molding machine DE 3132-C1, formulas to evaluate the economic efficiency of investment projects are used. For calculations a discount rate of 20% is accepted. Considering the unstable economic and political situation in Ukraine, three options for its development are identified: the probability of the improvement of economic development is expected in 20%, the probability of a standard (stable) scenario of development – 60%, and the probability of deterioration of economic development – 20%.

The results of the calculation of the projected amount of cash inflows, the expected amount of net income, expenses and net cash flow are shown in Table 7.

Table 7. Estimated net cash flows from the investment project for purchasing of DE 3132-C1 machines, thousand UAH

N	Indicators	Years					
		2019	2020	2021	2022	2023	2024
1	Initial investment	430					
2	Cash inflows from selling products in the relevant economic conditions:						
	• optimistic (20% probability)		192.30	215.38	241.22	270.17	302.59
	• real (60% probability)		183.20	205.18	229.81	257.38	288.27
	• pessimistic (20% probability)		174.60	195.55	219.02	245.30	274.74
3	Expected cash flows from selling products		183.30	205.30	229.93	257.52	288.43
4	Current costs of production in the relevant economic conditions:						
	• optimistic (20% probability)		15.40	17.25	19.32	21.64	24.23
	• real (60% probability)		17.30	19.38	21.70	24.31	27.22
	• pessimistic (20% probability)		18.90	21.17	23.71	26.55	29.74
5	Expected operating costs of production		17.24	19.31	21.63	24.22	27.13
6	Depreciation		71.67	71.67	71.67	71.67	71.67
7	Expected income before tax		94.39	114.32	136.64	161.64	189.63
8	Expected net profit		77.40	93.74	112.04	132.54	155.50
9	Expected net cash flow (N.8+N.6)		149.07	165.41	183.71	204.21	227.16
10	Discounted net cash flow (N.9/(l+i)t)		124.22	114.87	106.31	98.48	91.29
11	Cumulative discounted cash flow	–430	–305.78	–190.91	–84.59	13.89	105.18

Source: Calculated by authors.

To calculate the cost-effectiveness of the investment project for purchasing the automatic injection molding machine DE 3132-C1 with risk consideration, the net present value (NPV) is calculated by the formula:

$$NPV = \sum_{t=1}^{T} \frac{I_t - C_t}{(1+d)^t} - Inv, \tag{2}$$

where I_t – income received from the implementation of the investment project in year t; C_t – costs related to the implementation of the investment project in year t; t – the number of the estimated year; T – term of the investment project realization; d – discount rate; Inv – initial investment.

For the investment project of purchasing the automatic plastic injection molding machine DE 3132-C1 NPV = 13.89 thousand UAH > 0, therefore, the investment project is effective.

As the current net value is positive, the investment project for purchasing the automatic injection molding machine DE 3132-C1 is profitable and it is advisable to be implemented.

Another indicator that makes it possible to evaluate the investment project for purchasing the automatic plastic injection molding machine DE 3132-C1 with risk consideration is the internal rate of return, which shows the upper limit of the allowable value of the discount rate, the excess of which makes the estimated project unprofitable.

Internal Rate of Return (IRR) is calculated according to the following formula:

$$IRR = d_1 + \frac{NPV_{d_1}}{NPV_{d_1} - NPV_{d_2}}(d_2 - d_1), \tag{3}$$

where d_1 – the discount rate at which $NPV_{d_1} > 0$; d_2 – the discount rate at which $NPV_{d_2} < 0$. At $d_1 = 20\%$, $NPV = 13.89$ thousand UAH ≥ 0; at $d_2 = 25\%$, $NPV = -27.18$ thousand UAH ≤ 0.

$$IRR = 20 + \frac{13.89 \cdot (25 - 20)}{13.89 - (-27.18)} = 21.69\ \%.$$

Therefore, for an investment project of buying the automatic plastic injection molding machine DE 3132-C1, 21.69% is the upper limit of the allowable value of the discount rate when exceeding it makes the decision about the investment project is unprofitable.

Figure 3 shows the relationship between the discount rate (d) and the current net value of the investment project (NPV).

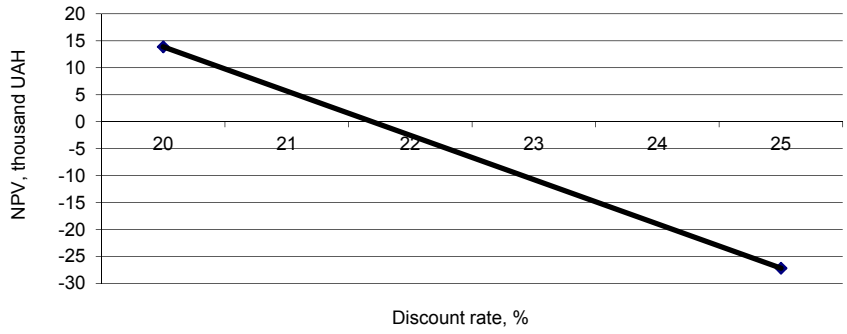

Fig. 3. Graphic representation of the dependence of the current net value on the discount rate

Source: Compiled by authors.

Let's calculate the profitability index of the investment project for purchasing the automatic plastic injection molding machine DE 3132-C1 by the formula:

$$IP = \frac{\sum_{t=1}^{T} \frac{I_t}{(1+d)^t}}{\sum_{t=1}^{T} \frac{C_t}{(1+d)^t}} = \frac{443.89}{430.00} = 1.24. \quad (4)$$

As we can see, the investment project for purchasing the automatic plastic injection molding machine DE 3132-C1 is effective with a positive value of the profitability index.

Let's calculate the discounted payback period for the investment project of purchasing the automatic plastic injection molding machine DE 3132-C1 by the formula:

$$PP = \frac{\sum_{t=1}^{T} C_t \cdot (1+d)^{-t} - \sum_{t=1}^{T} I_t \cdot (1+d)^{-t}}{I_{(m+1)} \cdot (1+d)^{-(m+1)}} + m \le T, \quad (5)$$

where m – the number of the estimated year.

Therefore, the discounted payback period of the investment project with consideration of risk will be:

$$PP = 3 + \frac{420 - (124.22 + 114.87 + 106.31 + 98.48)}{91.29} = 3.85.$$

The payback period of the investment project is 3.85 years or 3 years 10 months, which is less than the estimated term of 5 years, so the investment project should be accepted by this criterion.

Graphically, the cash flow dynamics of the investment project for purchasing the automatic plastic injection molding machine DE 3132-C1 is shown in the form of the financial profile of the project (see Fig. 4).

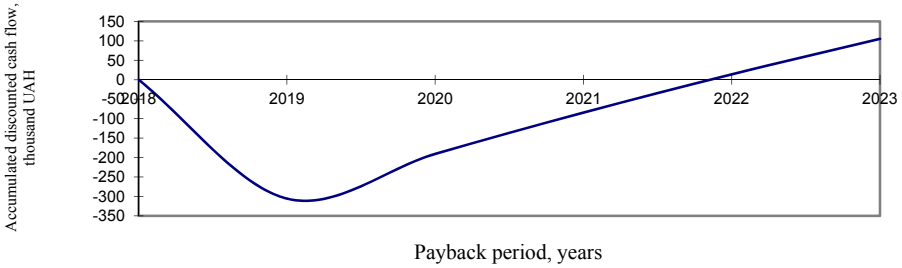

Fig. 4. Graphic representation of the financial profile of the investment project for purchasing the automatic plastic injection molding machine DE 3132-C1

Source: Compiled by authors.

The graph shows that the payback period of the investment project for purchasing the automatic plastic injection molding machine DE 3132-C1 is 3 years and 10 months. Initial investments thus amount to 430 thousand UAH, and the current net value from the realization of this project during four years makes 13.89 thousand UAH.

Accordingly, on the basis of the received calculations, the further risk assessment of this project is carried out. Using the data in Table 7, we determine the current net value for the optimistic, pessimistic and most realistic risk-based investment project. Data on risk assessment of the investment project for purchasing the automatic plastic injection molding machine DE 3132-C1 are given in Table 8.

Table 8. Consolidated results on risk assessment of the investment project of purchasing the automatic plastic injection molding machine DE 3132-C1

Indicators	Formula of calculation	Values
Estimation NPV, thousand UAH:		
1. Optimistic condition of the economy		40.68
2. Real condition of the economy		6.92
3. Pessimistic condition of the economy		−11.72
Variation in NPV (thousand UAH)	$R_{NPV} = NPV_0 - NPV_{II}$	52.40
Expected NPV value, with probability-weighting (thousand UAH)	$NPV = \sum_{j=1}^{3} NPV_j \cdot p_j$	13.89
Standard deviation (thousand UAH)	$\sigma_{NPV} = \sqrt{\sum_{j=1}^{3} \left(NPV_j - NPV\right)^2 \cdot p_j}$	17.43
Variation rate, %	$v_{NPV} = \sigma_{NPV} / NPV$	25.49

Source: Calculated and compiled by authors.

Therefore, the obtained results indicate some significant risk of the investment project for purchasing the automatic plastic injection molding machine DE 3132-C1, which assumes that it should be taken into account in making the final management decision.

Conclusions

The problem most often faced by developers of investment projects is taking organizational, technical, technological decisions and their evaluation. Virtually every stage is characterized by taking new, unknown decisions and the most difficult of these stages is the financing of the project by the investor.

The important component of the investment project is the analysis of the investment process, the search for and attraction of investments, the study of the potential investor and his willingness to invest at potential risks. There are three main factors that have a direct impact on decision making: external – economic and political situations; internal – technical, technological and organizational risks; personal – the nature and behavior of the investor of the investment project.

Finding the best combination of return on investment risk involves the need to consider many different factors, which make this task very difficult. In the context of high uncertainty and multiple risks that accompany the implementation of investment activities, a complex approach to project risk analysis is required, based not only on the combination of qualitative and quantitative risk analysis methods, a system of static and dynamic indicators of evaluation of project effectiveness, but also the construction of different scenarios of prospective development of the enterprise and the use of methods of assessing the impact on the projected indicators.

That is why, risk assessment of investment projects is a necessary step in understanding the planning of investment in business operations, which helps to identify and eliminate the negative effects in the implementation and realization of the investment project in time.

The results of the study presented in the article can be used by potential investors, partners, managers of enterprises or organizations to evaluate the economic effectiveness of an investment project in order to substantiate the effectiveness and taking an investment decision in conditions of risk and instability.

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OCENA EFEKTYWNOŚCI GOSPODARCZEJ PROJEKTU INWESTYCYJNEGO Z UWZGLĘDNIENIEM RYZYKA

Streszczenie: W artykule opracowano naukowe i metodologiczne podejście do oceny efektywności ekonomicznej projektów inwestycyjnych obarczonych ryzykiem, które, w przeciwieństwie do istniejących, daje możliwość uwzględnienia związków przyczynowych między głównymi czynnikami ryzyka oraz umożliwia ich kompleksową integrację przy ocenie efektywności ekonomicznej projektów inwestycyjnych w zależności od ich specyfiki. Wyniki są testowane na przykładzie zakupu sprzętu dla LLC „Ukr-Polymer".

Słowa kluczowe: ryzyko, ryzyko projektu inwestycyjnego, ocena ryzyka, czynniki ryzyka, skuteczność projektu inwestycyjnego.