THE RISK ANALYSIS FOR INVESTMENTS PROJECTS DECISION

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ABSTRACT: The risk signifies the possibility of existence of one situation in which the obtained results are far from the targeted objectives. Assuming the risk by the entrepreneurs becomes the source of profit within the economy; this is the reason why its analysis is a prior objective in substantiating decisions related on the investments efficiency. In the paper there are presented some categories of risks that can appear within the investment activity and is exemplified the risk analysis on the base of studying the projects sensitivity.

Key words: investments, risk, economic performance, sensitivity analysis

JEL codes: L21, L26, M21

Introduction

Investment projects are subjected to various forms of risk that can impact the performance expected by the beneficiary. The factors coming from the external environment, as well as the endogenous factors specific to the operational and functional structure of the investment objective can have in time a different manifestation than the one anticipated initially, and thus, the bigger are the noticed deviations, the higher is the risk of the project to fail to ensure reaching the expected results.

In a general sense, the risk represents "the probability that a specific adverse effect or event will occur in a given population", which shows that a future economic action can generate losses, especially because of having incomplete information when making decisions or because of the inconsistence of logical reasoning. The risk management will focus in this case on eliminating the negative aspects introduced by the risk probability, and the analysis will especially study the potential threats that can affect the projects profitability in the future. [1]

The modern approach of the risk concept sees risk as constancy in the socio-economic activities. Besides the losses it can cause, sometimes irreversible, it can also constitute an opportunity for the enterprisers, with the condition to adopt adequate strategies.

A complete definition of risks that incorporates the two aspects (threat and opportunity) considers risk as being an uncertain event or condition that in case of manifestation will have a positive or a negative impact over the project's objective. The project risk includes the threats over the objective, as well as the opportunity to improve these objectives [7].

The presence of risks in the economic environment is relatively constant, and their large diversity makes necessary to *identify the elements that could be subjected to risks* and which can identify the projects' viability and their analysis from this point of view, in order to diminish the negative consequences.

A. Seen as economic processes, the investment projects draw in numerous resources whose value consumption make *the investment cost*: expenses for obtaining and setting up the land, infrastructure expenses, design and technical assistance expenses (licences, agreements, authorizations, designing, project audit, technical assistance and construction site inspector, organizing the vendue procedures), expenses with the basic investment (constructions and works of

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intervention, expenses with independent acquisitions), other expenses (organization of the building site, commissions, taxes, legal fares, financing costs, various and unpredicted expenses), operating expenses (training the personnel for exploitation, technological evidences, trials, lapping, expertise when received).

The expenses with the implementation of the project are direct and immediate, they usually run their course during a period of 1 to 3 years and because of this they are relatively easy to quantify and their assessment has a high precision level.

Besides the cost of achieving the investment, the global cost of the investment project will be given by the operating cost generated by setting in motion the investment object, and this must be accurately estimated for the complete economic functioning period of the made investment. Taking into consideration the potential price variations or the variations of the quantities needed to achieve the project leads to the idea of influencing the cost parameters and to the occurrence of the risk to diminish the results. Thus, bigger difficulties to estimate accurately the economic parameters occur during the project exploitation, because this period has a farther time horizon.

B. During the process of assessing the *economic effects*, we must take into account the quantifiable direct effects that need an adequate estimation for a long period of operating the investment objective, as well the indirect effects, which usually don't have a value expression, their forecast being more difficult because of this.

In the field of implementing the investment projects, the effects can have a physical expression, as well as a value expression. The quantitative results of the projects are obtain by using the production capacity of the objective and are expressed in the achieved physical production or the volume of the physical sales on categories of products. The types of the effects expressed as a value are numerous and from their category are selected and ranked those results that become an economic criterion in the economic and financial assessment of the investment project: the exercise's production, the turnover, the added value, the net profit, the cash flow, the treasury flow, operating incomes, etc.

The quality and efficiency assessment of an investment project is actually based on an estimation of the future cash-flows resulted from the activity of an enterprise (from the public or the private sector), identifying the key factors and the potential risks, using a conceptual model or a framework that takes into account all these factors, as well as testing the project's capacity to place the company on a successful position on the market [8].

The directions of action that allow studying the risks faced by investment projects are:

- Identifying the risk sources, meaning to point out the areas that interact with the project during the achievement and operating of the investment objective and which can be affected in the future by an unpredictable evolution. These can be the economic, financial, technical, environmental, legal, social, etc., fields. Risks can also occur because of other cause, such as the wrong determination of the project's opportunity, errors in the economic phenomena prognosis, the lack of correlation between the financing sources and the objectives that need to be implemented;
- Establishing the risk types that can impact the project. The risks are ranked, the most important being considered the ones with a high occurrence frequency noticed at similar projects or estimated by experts;
- Assessing the risk level with the help of various techniques of risk assessment, such as: critical point, position indicator, variation coefficient, sensitivity analysis, etc.;
- The analysis of various potential situations in the future, evaluating the risk occurrence consequences and the extent to which it affects the economic-financial viability of the project. The impossibility to accurately prevision the information used in assessing the projects (the production and service volume, the qualitative level, prices, consumptions, etc.) causes the expected results to vary because of the risks;
- Mentioning the risk control strategies, meaning to indicate the necessary actions to minimize the risk occurrence probability, to diminish or eliminate them.

Generally, risk analysis means the efficiency and profitability analysis of the projects in conditions of incertitude and risk, conditions in which the variation of the influence factors (parameters) manifests with a certain probability.

Risk categories for investment projects

A first step in the risk analysis of the investment projects is to identify the various potential risk categories that can affect their viability.

A. A category of potential risks that impact the enterpriser's activity in its relationship with the market is manifested in the marketing sector. *The strategic risk* consists in diminishing the enterpriser's market share and leading him to financial losses. Measuring the impact of this risk class is done by determining the variation of the market share owed mainly to the change in the demand of products specific to the company.

In case the relationships with clients and suppliers won't materialize at the level foreseen in the contracts, a *commercial risk* could occur. It will be felt by losing some clients, which means the estimated production will not be completely turned into account, incomings won't cover costs and therefore the earnings will drop. At the same time, the commercial risk could lead to unfulfilled relationships with suppliers, which means the cost will be inflated with sums derived from preparing the supply, namely commercial meetings, preliminary studies, drawing up the supply for products, which also lowers the financial results of the project.

The legal risk comes from failing to subsume to the legislation in effect during the operating of the objective, because of potential changes of the legal stipulations regarding payment terms, taxation systems, norms, regulations. The consequences of the legal risk occurrence are obvious in the payment of penalties or in the occurrence of debts. The penalty losses are calculated depending on the number of days of delay, the daily cost and the average level of the resource recording the loss. For debts, the impact of the legal risk is given by measuring the direct and indirect prejudice occurred as a result of not cashing-in in time the sums owed by third parties.

The financial risk means the possibility to record additional financial expenses (the rise of the interest rate, unfavourable exchange rate), which will lead to diminishing incomes or even financial losses. It can be measured through the analysis of cash flows and loan cost.

The operational risk is related to changing conditions that affect the operating activity of the investment objective. Known also as economic risk or operating risk, the operational risk impacts the production costs statement and the profitability level of the project. The rise of the costs of raw materials, fuels, energy, work force or other resources over the initial estimations means an increase of the total efforts and an adequate drop in the earning in comparison to the expected level. The operational risk actually manifests in relation with the decrease of the investment objective's capacity to generate profit under the influence of the inadequate management of assets.

The maintenance and service risk is related to exceeding the costs established in accordance with inaccurate estimations of the repairs expenses, to unforeseen malfunctions of the endowments, to accidents, etc.

B. A structuring of the risks according to the elements taken into account for the calculus of the investment project's efficiency can also be done as follows: risks for the effort parameters called *cost risks* and risks for the effects parameters, called *income risks*. These categories of risks exercise an important influence over the enterpriser that starts an investment for modernization and expansion, thus having a high impact. The risks to fail to achieve the incomes or to exceed costs are amplified for strategic investments, which have as a materialization period a farther time horizon. The investment projects that target to reduce the operating expenses and the projects for the improvement of the work conditions have a lower risk level.

C. Depending on the level of manifestation, the risks that affect the investment project can be:

- *Individual risks* that measure the impact produced by the variation of the economic

parameter over the results, assuming the company has no other assets than those resulted through the project;

- *The company risk* affects the total earnings of the enterpriser, integrating the assets obtained from the investment in the total patrimony of the company. This is the risk of the enterprise as a whole as a result of implementing the investment projects;
- *The market risk* refers to the risk of the project from the point of view of the investor who owns a diversified stock portfolio.

Because the company risk and the market risk are difficult to measure, most often the individual risk specific to a project can approximate the other risk categories, because this risk is actually a direct influence on the risk for the enterpriser or for the investor.

Risk analysis methods for investment projects

In the area of investment projects in the pre-investment stage, the achievement level of the parameters specific for projects and the performance level can't be established with precision based on statistical information. The pre-established indicators levels will have a certain evolution in the future; they will be achieved with a certain probability, thus contributing to the size of the project risk.

The risk analysis for projects is tied to the *probabilistic risk conception*. The chances to reach the project's parameters can be established by experts based on their own intuition and experiences (one of the sources could be brainstorming) as trust levels granted by them for the production of the anticipated phenomena, meaning the probability to reach a certain level of the project's parameters is assessed.

Another association method of the occurrence probability for the variables of the project is to establish a precise range of values around the value of the parameter used in the basic version. The distribution of the probability for each option can be assimilated with the one obtained on experimental basis, in conditions as close as possible to the conditions of the project or in case of similar projects. Other methods to determine the probability distribution for the parameter of a project can also be used, such as: Monte Carlo Simulation, Decision Trees and Force Field Analysis, which were applied to Suncor Bitumen Selection Strategy and other applications [12].

The models used for the risk analysis are many and they target to quantify the risk level in order to avoid intuitive decisions and to increase decision quality: the method of the Net Present Value *NPV*, the statistic indicators method, the payback period method, Return on Investments *ROI*, the sensitivity analysis, the method of the Internal Rate of Return *IRR*, the decision tree method, simulation, etc. [4], [6].

We will give an example of one of these methods, namely the *sensitivity analysis*, because it's a largely used method for the economic-financial analysis of investment projects. It give the possibility to identify the critical variables of a project, it allows establishing the financial sustainability level of the project given by the potential changes of the influence factors and it serves, at the same time, to measure the project risk in order to justify decisions.

The sensitivity analysis used to measure the risk takes into consideration the identification of the factors that have the biggest influence over the net present value and the quantification of these influences.

The start is the calculus of the net present value, which for projects is done in a short period of time (less than a year) and has the following formula [9], [10]:

$$NPV = \sum_{h=1}^{n} \frac{NI_h}{(1+a)^h} - I \qquad (1)$$

where: NI_h represents the net incomes generated annually by the project;

I - the cost of the total investment;

a - discount rate (the capital cost).

In order to calculate the *NPV* of an investment projects in conditions of risk, we introduce the risk element in the formula; it adjusts the discount rate (the risk adjusted discount rate method - *RADR*). The discount rate consists of the risk-free rate *i* plus a risk premium *rp.* The higher is the risk, the higher the discount rate is [5].

$$a = i + rp \qquad (2)$$

Based on this relation, formula (1) is transformed in a model that highlights risks and quantifies the generated effects, found in *NPV*.

$$NPV = \sum_{h=1}^{n} \frac{NI_h}{(1+i+rp)^h} - I \qquad (3)$$

The formula is changed as follows because the cash flows of the project express the net income flows resulted annually from the project, which are established depending on the operating expenses and the incomings made by selling the production and the services [2]:

$$NPV = \sum_{h=1}^{n} \frac{q_h(p_h - Ef_h + Em_h)}{(1+i+rp)^h} - I \qquad (4)$$

where: q_h is the quantity of products commercialized in year *h*;
p_h - product prices;
Ef_h - unit expenses with the labour force;
Em_h - unit expenses with raw materials and materials.

In case average values are estimated for the incomes and expenses elements, which influence the cash flows *q, p, Ef* and *Em,* these can be seen as a common factor and the formula becomes:

$$NPV = q \cdot (p - Ef - Em) \sum_{h=1}^{n} \frac{1}{(1+i+rp)^h} - I \qquad (5)$$

The expression $\sum_{h=1}^{n} \frac{1}{(1+i+rp)^h}$ represents the cumulated discount factor adjusted to risk or cumulated *RADR*, which has the value: $\frac{(1+i+rp)^n - 1}{(i+rp)\cdot(1+i+rp)^n}$. It is also called annuity factor for a period of *n* years and a discount rate *a* (abbreviated next as A_a^n).

The simplified formula (5) is:

$$NPV = q \cdot (p - Ef - Em) \cdot A_a^n - I \qquad (6)$$

In order to measure the level of an influence factor that could impact the size of the foreseen net present value, is considered that the risk occurs when *NPV=0*. The critical value of the influence factor is determined from that equation.

- the critical level of the investment: $I_{cr} = q \cdot (p - Ef - Em) \cdot A_a^n$ (7)

- the critical level of sales: $q_{cr} = \frac{I}{(p - Ef - Em) \cdot A_a^n}$ (8)

- the critical level of the unit prices: $p_{cr} = Ef + Em + \frac{I}{q \cdot A_a^n}$ (9)

- the critical level of the labour force cost per product: $Ef_{cr} = p - Em - \frac{I}{q \cdot A_a^n}$ (10)

- the critical level of the material expenses per product: $Em_{cr} = p - Ef - \frac{I}{q \cdot A_a^n}$ (11)

Assessing the sensitivity of the influence factors is based on the relative deviations of the critical values calculated towards the foreseen initial values.

$$\Delta\%F = \frac{F_{cr} - F}{F} \cdot 100 \qquad (12)$$

where: F_{cr} represents the critical value of the influence factor for which the net present value is zero;

F - the value of the influence factor established through the initial prognosis.

The factors which have a low variation (positive or negative) are the more risky elements for the investment project.

The sensitivity of the investment projects. Case study

In order to exemplify the sensitivity analysis in assessing the risk that can occur in the evolution of the project's critical parameters, we take into consideration a project that creates an annual production capacity of 1052 tons with a total investment of 1850 thousand lei. The average selling price of the products obtained by setting in motion the investment objective will be 5000lei/ton, and the average production cost is estimated at 4520lei/ton divided in 1240lei/ton for labour force expenses per product and 3280lei/ton represent unit costs with crude materials, materials and fuels. The project will produce economic effects for 9 years and the capital cost (*RADR*) is 8%.

The net present value of the project is:

$$NPV = q \cdot (p - Ef - Em) \cdot A_a^n - I =$$
$$= 1052 \cdot (5000 - 4520) \cdot 6{,}247 - 1850000 = 1304485\,lei$$

The critical values of the influence factors for which NPV=0 are:

- Total investment:

$$I_{cr} = q \cdot (p - Ef - Em) \cdot A_a^n = 1052 \cdot (5000 - 4520) \cdot 6{,}247 = 3154485\,lei$$

- sales volume:

$$q_{cr} = \frac{I}{(p - Ef - Em) \cdot A_a^n} = \frac{1850000}{(5000 - 4520) \cdot 6{,}247} = 617\, tone$$

- the unit commercialization price of the products:

$$p_{cr} = Ef + Em + \frac{I}{q \cdot A_a^n} = 4520 + \frac{1850000}{1052 \cdot 6{,}247} = 4802\, lei$$

- labour force cost:

$$Ef_{cr} = p - Em - \frac{I}{q \cdot A_a^n} = 5000 - 3280 - \frac{1850000}{1052 \cdot 6{,}247} = 1439\, lei$$

- crude materials cost:

$$Em_{cr} = p - Ef - \frac{I}{q \cdot A_a^n} = 5000 - 1240 - \frac{1850000}{1052 \cdot 6{,}247} = 3479\, lei$$

The synthesis of the risk resulted from the potential variation of the factors over not achieving the net present value is shown in table 1.

Table no 1

Economic-financial indicators

Indicators (lei)	Initial level forecast in the project	Critical level	Relative deviation
Total investment	1850000	3154485	70,5 %
Annual sales volume	1052	617	-41,3 %
Unit price	5000	4802	-4 %
Unit cost for labour force	1240	1439	16 %
Unit cost for raw materials	3280	3479	6,1 %

The obtained data show as a main risk factor for the project the price for selling the production. There is a possibility for the project to not generate positive updated cash flows when the commercialization prices drop with more than 4%. The project is also sensitive to the influence of the prices of raw materials and materials consumed in the exploitation; if their change affects the increase of the unit cost of the products with more than 6%, it will result in financial losses in comparison to the initial forecast. The project proves to be more stable to the variation of the labour force cost and especially to the variation of the sales volume.

For the sensitivity analysis it resulted that the most important risk factor for the analysed project is the selling price, which will direct efforts towards the improvement of the practiced prices policy.

Conclusions

Because practice proved that the risk is an inevitable phenomenon in the life of investment projects, the risk analysis has as a main objective the study of potential economic alternatives, of the achievement probability and the resulted effects. The fact the investor knows the possible unfavourable consequences guides his attitude towards the project, meaning that in order to reach the set objective, once the project is implemented he will have to also assume a certain risk level.

Risk analysis becomes a qualitative analysis method that supplies the project managers with the necessary instruments in making better decisions, combining scientific elements with art [11].

In the analysis process of the projects from the perspective of the risks they involve, identifying the risk category is a necessary step to start from in order to better know and manage the produced impact. Aspects like the following will be targeted: the description of the specific elements of the identified risk, factors that produce it, the element or the activity that will be influenced by the risk, assessing the size of the risk – element closely tied to the occurrence probability of the event in question and to the generated impact. In the end, prevention or rectifying strategies for the negative consequences will be formulated. For some fields (public health, agriculture and food safety, etc) studying the potential risks and quantifying them are important not only for the selection of the best option, but also for the public's perception [1].

Using proper risk analysis methods increases the enterpriser's chances to accurately justify a decision regarding the opportunity of certain investment projects, in order to achieve its specific interests.

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