ON RISK EVALUATION IN INDUSTRIAL INVESTMENT PROJECTS

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Abstract

This paper presents the process of making decisions to finance an investment project, depending on the value of the project's risks. The main sources of risk for investment project are uncertainty, connected with unclear information about external and internal project environment. For quantitative risk assessment, we review the original risk-factor classifications and an original mathematical model based on a modified Monte-Carlo method. We also review the original algorithm based on results of quantitative risk assessment for making a clear decision whether is it worth participating to finance the project, or not. The practical effectiveness of original algorithm has been practically proved by the successful verification.

Introduction

Economical activity in market economics usually deals with the various difficulties connected with various risks, hence the economical business activity normally can't exist without risk. The investment process is one of such activities. The investor makes investment in projects which could be some portfolio investments in the stock market or direct investment in an industrial project. The direction of investments depends on motives of risk reduction and providing in future high-profitable incomes. The periods of investment activities usually are estimated in years. This means that investment decisions are based on suggestions about a hypothetical future. It is clear, that the verifications of such a forecast can't be very precise. The analysis of UNIDO methodology and other modern criteria and methods has already shown that using such criteria and methods we do not achieve a definite quantity risk-estimation of the project. A significantly difficult task is to analyse the economical effectiveness of industry's projects; since each project is unique, it often can be characterized by a high level of uncertainty and risk for investment. Thus, the uncertainties are defined by various circumstances such as the unclear information about mineral deposits, future deviation in prices for deposit's extraction, errors in calculations of expenditures, possible changes in external environment, unknown economics, tax policy and etc.

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The department of Economics and planning for mining production has been made detailed examinations of the problem of estimating risk for real investment projects in industry. We have defined that the risk of investment projects in mining industry is a value of non received the part of real profits (incomes) or the value of possible losses, depending on random combination of various risk-factors which having direct influence on project's financial result - net present value (NPV).

Also, an original economical-mathematical model for real risk estimation was created. The model's practical effectiveness has been proved by wide validation of the model for expertise of investment projects and for choice of projects in the processes of competitive financial support.

The risk-analysis model for industry's projects provides the real appraisal of the influence random combination various risk-factors on the project's net present value. The economical-mathematical model for quantitative risks assessment of investment project presented in Figure 1.

Risk estimation using the economical-mathematical model and the algorithm are carried out as follows:

1. Risks-identification for a specific industry project. The grounding of aims: putting common aims and frameworks within limits the risk-factors can be examined.

2. The grounding and highlighting of main risk-factors, which should be included in the model.

3. The morphological risks analysis (which are not included in the model), and estimation of the possible ways their influence reduction on the project.

4. The determination of risk-components. Risk-factors classification on the statistical-conditional and the dynamical-conditional.

5. Creating the group of statistical-conditional risks. Creating the imitation model: calculating mathematical expectation for each of correctional coefficient for business project – $k\ (\Phi_i)$ and the density of probability distribution for the appraisal of probability for realization risk-factors – $p^S\ (\Phi_i)$. The determination of dynamical-conditional risk-factors. Creating the group dynamical-conditional risks. Analyses of dynamical trends: calculations of row's rate increment for each correction coefficients, calculations the coefficient of regression between the empirical and base data for the appraisal of probability for realization risk-factors - $p^d\ (\Phi_i)$.

6. Compiling the massif of various risks-event – $\{C\}$.

7. Process of correcting parameters for the business project according to each risk-event: C_j. Creating the models of discounted cash flows NPV_R for each of the risk-event.

8. Final analysis of results NPV_R for each of the risk-event. Appraisal empirical probabilities of risk $P^{Н.Д.}{}_R$ for non-received profit and possible losses $P^{У}{}_R$ from the project.

9. If the empirical probability of possible losses is higher than empirical probability of non received profit, the project will be defined as a venture project: project has the significant risk potential; also is estimated the value of possible losses. If the empirical probability of possible losses is lower than empirical probability of non received profit, the project will be defined as having normal risk potential, also is estimated the value of possible non-received the part of profit.

Author will be grateful for any comments, questions and proposals.

Figure 1. The economical-mathematical model for quantitative risks 's assessment of investment project

Formula forming risk for investment activity:

$$R = \{C(\Phi_i), P_C, S\}.,$$

$C(\Phi_i)$ – risk-event can be caused by different factors – Φ_i:
P_C – general probability of the risk-event, that depends on ensemble probabilities of different factors – $p(\Phi_i)$;
S – financial results, that depends on realization some risk-event.

Formula forming risk-event:

$$C_j = \supseteq \bigcup \Phi_i, i = \overline{(1,n)}.$$

$$\Phi_i = \{k(\Phi_i), p(\Phi_i)\}.,$$

$k(\Phi_i)$ – coefficients for correcting the initial project's parameters, they take into account the degree of the project's initial parameters uncertainly and risk;
$p(\Phi_i)$ –probabilities of realization the risk-factors.

Coefficients for correcting the initial project's parameters – conditionally-static and conditionally-dynamic groups.

Conditionally-static coefficients and probabilities to correcting the initial project's parameters:

$$k^C(\Phi_i) = E(k) = \int_1^{\infty} k \cdot f(k)dk \approx \overline{k}. \qquad p^C(\Phi_i) = \int_1^{E(k)} f(k)dk.$$

Formula forming risk-event for conditionally-static group:

$$\Phi_i^C = \{k^C(\Phi_i), p^C(\Phi_i)\} = \left\{\overline{k}(\Phi_i), \int_1^{E(k)} f(k)dk\right\}.$$

Conditionally-dynamic coefficients and probabilities to correcting the initial project's parameters:

$$k^Д(\Phi_i) = \left(1 + T_{ПР}/100\right)^n. \qquad p^Д(\Phi_i) = \rho_{И,Э} = \frac{\mathrm{cov}(x_И, x_Э)}{\sigma_{X_И} \cdot \sigma_{X_Э}},$$

Formula forming risk-event for conditionally-dynamic group:

$$\Phi_i^Д = \{k^Д(\Phi_i), p^Д(\Phi_i)\} = \left\{\left(1 + T_{ПР}/100\right)^n, \frac{\mathrm{cov}(x_И, x_Э)}{\sigma_{X_И} \cdot \sigma_{X_Э}}\right\}.$$

Risk-estimation formula for investment project :

$$R_{ИП} = P_C\left[NPV - NPV_R(C)\right],$$

NPV – initial estimation project's net present value;
$NPV_R(C)$ – corrected estimation project's net present value to risk-event.

Elaborated formula forming risk-event :

$$C_j = \bigcup\left(\supseteq \Phi_i^Д\right), \left(\supseteq \Phi_i^C\right), i = \overline{(1,n)}$$

Elaborated risk-estimation formula for investment project :

$$\supseteq R_{ИП} = \left\{\prod\left[\supseteq p^Д(\Phi_i)\right], \left[\supseteq p^C(\Phi_i)\right]\right\} \times \left[NPV - NPV_R\left(\supseteq C_j\right)\right], \quad i = \overline{(1,n)}.$$

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