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SENSITIVITY ANALYSIS AND SCENARIO METHOD FOR EVALUATION OF EFFICIENCY OF INVESTMENT PROJECTS IN RISK CONDITIONS

Summary: *The aim of the research is that on the project we analyze the sensitivity and scenario method as one of the very important methods that allow us to assess the effectiveness of the investment projects in conditions of uncertainty and risk. In the conditions of the pandemic caused by the COVID-19 virus, as well as frequent uncertain events that cause economic crises and turbulence in the markets, sensitivity analysis and scenario method are certainly again in the forefront when assessing the cost-effectiveness of the projects as a response to increased risk and the need to predict future project outcomes. The result of the research is the necessity and obligation of usage of these analyses and methods for evaluation of all future investment projects, because we are witnesses of negative effects on economy that are caused by pandemic and other uncertain events. The conclusion of the research is that the classical methods for assessing of the effectiveness of investments are no longer allowed and reliable, that is, without sensitivity analysis and scenario methods and some other similar methods it will not be possible to to adequatly assess the investment project. The most important conclusion of the research is that predicting the future and predicting of uncertain events will be in the focus of the theory and practice of the business world. The question that arises is whether the world has reached the phase of globalization where the largest investors are so powerful that they are able to create scenarios according to their will and that they have already made answers and solutions to global problems while accomplishing their own interests.*

Key words: *sensitivity analysis, scenario method, assessment of effectiveness, investment projects, future.*

JEL classification: *C02, C60, C61, C65*

INTRODUCTION

Investment projects are exposed to various forms of risk and they may influence on the expected outcome. In general, risk implies the probability of accomplishment of unwanted outcome, which for an investment means the possibility of making a loss in the future due to insufficient or incorrect information when making a decision. Risk management involves analyzing of potential threats, that can affect the profitability of the project in the future. A complete definition of risk, which includes two aspects (threat and opportunity), considers risk as an uncertain event or condition, which will, in the case of manifestation, have possitive or negative effects on the outcome of the project. Determining and assessing of the justification of realization of an investment project is a very complex procedure, which have to include observation and consideration of all relevant factors, primarily, the process of determining of the effects that are obtained by the realization of a particular investment. The effects of an investment represent the result of a particular investment. In that way, the effects of the investment represent the measure of accomplishment of the set of investment goals and they serve as a criteria for assessing of the validity of investment projects and the selection of the most efficient investment. Measuring of the total effects brought by exploitation of the investment project and their quantitative expression, with the help of certain indicators, that is, criteria, enables us to assess whether the effects will exceed the total required investments. That procedure is called the assessment of the efficiency or profitability of the investment project, and it serves us to make investment decisions. Risk analysis consists of studying of the probability that a particular project will acchieve satisfactory performance (in terms of net present value – NPV or internal rate of return – IRR), as well as the variability of results, in comparison to the previous best estimate.

The criterion of the net present value implies the sum of discounted net inflows (effects), which are realized in the period of the exploitation of an investment. Any investment project that has positive value of the net present value criterion is considered justified for realization. The internal rate of return represents the discount rate by which the net present value criterion is equal zero. It shows by what minimum discount rate is the realization of the investment project still justified. The recommended risk assessment procedure is based on the sensitivity analysis, as the first step, which represents calculation procedure of predicting of the impact of changes in input data on the output results of one model. The second step represents the study of probability distribution for selected variables, as well as calculations of expected values of the project performance indicators. The purpose of sensitivity analysis is the selection of „critical" variables and model parameters, that is, those whose variations, positive or negative, in comparison with the value used as the best estimate in the base case, which have the greatest impact on NPV or IRR, the ones that cause the most significant changes in these parameters. The criteria that should be implemented during the selection of critical variables vary from project to project, and they must be precisely estimated from case to case. After all the important variables have been selected, their elasticity can be estimated by calculation, which can be easier if a simple computer programme is used for calculation of the NPV or IRR index. During each calculation, it is necessary to assign a new value (higher or lower) to each variable, and then recalculate NPV or IRR, and during that process to pay attention to the differences (absolute and percentage) in comparison to the base case. A combined consideration of individual „optimistic" and „pesimistic" values of a group of variables can be useful in presentation of different scenarios within certain hypothesis. In order to define optimistic and pesimistic scenarios, it is necessary to choose extreme values for each critical variable within the range defined by the probability distribution. Then the project performance indicators are calculated for each hypothesis. In this case a precisely determined probability distribution is not required. The scenario analysis does not represent a substitute for sensitivity analysis or risk analysis, but it represents only a simplified procedure. When the critical variables have been determined, and all in order to conduct a risk analysis, it is necessary to assign a probability distribution to each of them, which is determined by a precise range of values around the best estimate, which is used in the base case, and all in order to calculate the assessment index. After establishing the probability distribution of the critical variables, it is possible to proceed with the calculation of probability distribution of IRR or NPV of that project. Only in the simplest cases it is possible to calculate these values by using of analytical methods for calculation of probabilities that are composed of a certain number of independent events. By increasing the complexity of the model of the cost analysis and benefit, even for just a few variables, the number of combinations will soon become too high for the direct procedure. For example, it should pay attention on that, if there are only 4 variables, by which for each of them only three values are taken into consideration (the best estimate and two deviations, one positive and one negative), in the end 81 possible combinations will appear for analysis.

Dynamic methods for investment assessment take into consideration the size and timing of expected cash flows during the economic life of the project, which enables more realistic assessment of investments. With the help of discounting technique, the investments and effects from all the previous years of the investment period and the exploitation period are included, and in that way dynamic criteria are calculated. Dynamic criteria are complex indicators that, in different ways, include investments and the inflow of effects from the investment, and in that way they enable more realistic analysis of different aspects of an investment project and assessment of justification of its implementation. (Mičić 2017, 60)

Classical dynamic methods for assessment of effectiveness of investments, such as net present value, internal rate of return and other methods often are not reliable enough to assess the effectiveness of investments. This is especially the case in conditions of uncertainty and risk when there are many variables and then it is necessary to use sensitivity analysis or sensitive analysis for reliable assessment of effectiveness of the investment project.

Sensitivity analysis is a technique by which we evaluate the sensitivity of an investment project to changes on some input variable. The number of variables on which the project depends is huge, but the changes in all variables do not have the same impact on the final results of project evaluations. In order to simplify the sensitivity analysis, in analysis should include only those variables that have bigger impact on the final results. Such variables are called critical project parameters. During that it is important to monitor and change one variable at a time and monitor its impact on project efficiency. That is how we get the data about elasticity of the project on the changes of certain variables and on data for the marginal efficiency of the project.

In conditions of great uncertainty and turbulence, and we are witnessing frequent sudden economic crises such as this one caused by the COVID-19 virus, one of the important methods for assessing of the effectiveness of investments has become the scenario method. However, this method even more gains in its importance and it is used in the business world just because of unpredictability and frequent changes in business conditions due to natural disasters, pandemics, terrorist attacks, war conflicts, migration and other unpredictable events.

The beginning of the application of the scenario method is connected with Plato and his discussions and descriptions of the Ideal Republic, and important personalities of that time such as Thomas Moore and George Orwell (Bradfield and Wright, Burt and Cairns and Heiden 2005, 795). The first documented records of today's scenarios appear in the 19th century in the works of two Prussian military strategists, von Clausewitz and von Moltke, who are also credited for development and setting of today's principles of strategic planning. Von Clausewitz put war events and scenario method at the center of his work as an ideal instrument for finding alternative ways to achieve victories through constant coordination and flexible application of the strategy, tactics and operations. In order to outwit the opponent, the military strategists of that time used the scenario method with the aim of recognizing their weaknesses and destroying the opponents as successfully and quickly as possible. World War II and further usage of scenarios through the Cold War and oil crisis gave further stimulus to the development of scenario methods (Bradfield and Wright and Burt and Cairns and Heiden 2004, 3)

The application of the scenario method in various forms of planning expanded after the World War II, and its development was related to military planning, planning in public administration, business planning, forecasting of technical development, environmental and sustainable development studies, spatial and regional planning and studies of the future in general. Making of scenario is marked as the basic methodology (Slaughter 2002, 349), that is, par excellence tool for the study of the future (Inayatullah 2008, 5).

Scenario method developed later in the 70's, after the oil crisis, when the shortcomings of the previous traditional planning were noticed, which meant that the future was certain. After that, the managers were faced with turbulent environment, uncertain future, highly changeable internal and external business conditions and the need for a new kind of planning appeared.

Scenario method has been used in recent period and it is particularly important for strategic planning. In the literature, in this area, the word scenario appeared in the late 1960's in the

famous work of H.K.Kahn and A.Wiener: where they define scenario as a hypothetical sequence of events constructed in order to focus attention on causal processes and decision points. As such, the scenario differs from other prediction approaches on two grounds: First, it usually provides more qualitative and contextual description of the evolution of the present in the future, and insists less on numerical precision. Second, scenario analysis usually tries to identify a set of possible futures, where each can be possible, but none of them is certain.
In Europe, the scenario method has developed through public administration planning. In the mid 1950's French philosopher Gaston Berger developed a scenario approach to long term planning called (la prospective), based on thinking about the decision making process through consideration of the future (Durance 2010, 1469), and a little more spectacular approach, few years later, developed Bertrand de Jouvenel (Godet 2000, 3). The first application of the scenario was noted during the research of geographical futures, and it was made for DATAR, French administration for spatial planning and regional development (Godet and Roubelat 1996, 164).
The scenario method has been present in society since ancient times. People have always been fascinated by the future and they wanted to explore the future in different ways and possibly to predict it. During relatively stable time (50's and 60's of the last century) people used the prediction method in order to control the future events. However, as the environment itself became more dynamic and complex, so as the methods of forecasting became more prone to mistakes and that encouraged people to develop a method of thoughtful breach into the future known as the scenario method. (Wack 1985, 139)

1. SENSITIVITY ANALYSIS FOR EVALUATION OF THE EFFECTIVENESS OF THE INVESTMENT PROJECT IN CONDITIONS OF UNCERTAINTY

Sensitivity analysis of the investment project (sensitivity analysis) assesses the impact of the change of the key factors of the investment project on project effectiveness indicators.
The degree of sensitivity of the project in relation to possible changes of the conditions of realization, and thus the degree of risk can be assessed on the basis of indicators of the marginal level of the production volume, production costs and some other project parameters. Parameter limit value of the project in i-year of its realization represents the value of that parameter by which the net profit in that year is 0. Each limit value indicator characterizes the degree of sensitivity depending only on the specific project parameter (production volume etc.).
One of the indicators is the coverage point (breaking point of profitability), which characterizes the sales volume by which the operating profit is equal to the production costs. The coverage point should determine how many units of the product has to be sold in order to compensate total production costs (variable and fixed costs).
The coverage point analysis enables us to identify the bottlenecks of the project in terms of achieving of the planned revenues, which provides the necessary effectiveness of the investment project. The coverage point indicates the volume of sales that has to be achieved in order to avoid loss. Based on the coverage point it is possible to determine minimum required production volume.
Profit before interest and taxes can be expressed on the basis of the following equation:

Revenue – variable costs – fixed costs = profit before interest and taxes

$$(JPC x K)-(JVT x K)-FT=PBIT \qquad (1.1.)$$

Where the:
JPC- price per unit of product (unit of net profit)
JVT- variable cost unit

K- quantity of units sold
FT- fixed costs
PBIT- profit before interest and taxes

The coverage point is the amount of the production where the total income is equal to the total costs, that is, where there are no operating profit (equal to zero), which can be expressed through the equation:

$$(JPC x K)-(JVT x K)-FT=0 \quad (1.2.)$$

By solving the stated equation by Q (quantity of units sold), we get:

$$K = \frac{FT}{JPC - JVT} \quad (1.3.)$$

As the actual production volume is higher than the coverage point, the more stable is the project. A project is usually considered stable if the coverage point does not exceed 75% of the nominal production volume. When estimating the point of coverage it is necessary to keep in mind that fixed costs do not depend from the volume of product sales, that the profit increases or decreases faster than the volume of the product sales. The effects that fixed costs have on changes in profit before interest and taxes describe business leverage. Business leverage studies effects that changes have in the sales volume on profit before interest and taxes, which are the result of impact of the fixed costs.

The impact of business leverage is expressed through the following formula:

$$S = \frac{FT + PBIT}{PBIT} = \frac{K(JPC - JVT)}{PBIT} \quad (1.4.)$$

and represents the ratio of percentage changes in profit before interest and taxes and percentage changes in the sales volume.

Example: A company produces product X. Fixed costs of the production of this product are 1000 € per year. The maximum possible production volume of the production of the product X is 200 units during the year. For simlicity, it is assumed that there is no time gap between product production and realization. The price per unit of the product is 50 €. Variable cost per unit of the product is 30 €.

The coverage point on the basis of equation (1.3.) is:

$$K = \frac{1.000}{50\text{-}30} = 50$$

The volume of sales that the company should provide, in order not to operate with loss is 50 units, that is, the operating income from business should amount 2500 €.

If the expected production volume is 150 units, the coverage point is 33,33% of the possible production volume, so the project can be considered stable. The operating profit in this case is 50x150-30x150-1.000= 2.000 €.

If it is expected that in the second year the number of the sold units will increase for 2%, that is Q=153, this increase will affect the sales revenues and variable costs, which will also increase for 2%.

The impact of business leverage will be:

$$S = \frac{(JPC \cdot K) - (JVT \cdot K)}{PBIT} = \frac{7.500 - 4.500}{2.000} = 1{,}5$$

The increase in product sales of 2% will cause an increase in profit before interest and taxes of 1,5*2%=3%, which means that the profit before interest and taxes at the end of the second year will be 2000x1,03=2060 eura (50x153-30x153-1.000)
The disadvantages of this analysis is that it is based on the estimation of profit, and not on the estimation of net cash flows, and beside that it analyzes the sensitivity of the project only to changes in the volume of product sales.

Due to these shortcomings the sensitivity analysis is mainly based on the estimation of the impact of changes in variable projects on net cash flow. The most rational order of this analysis is:

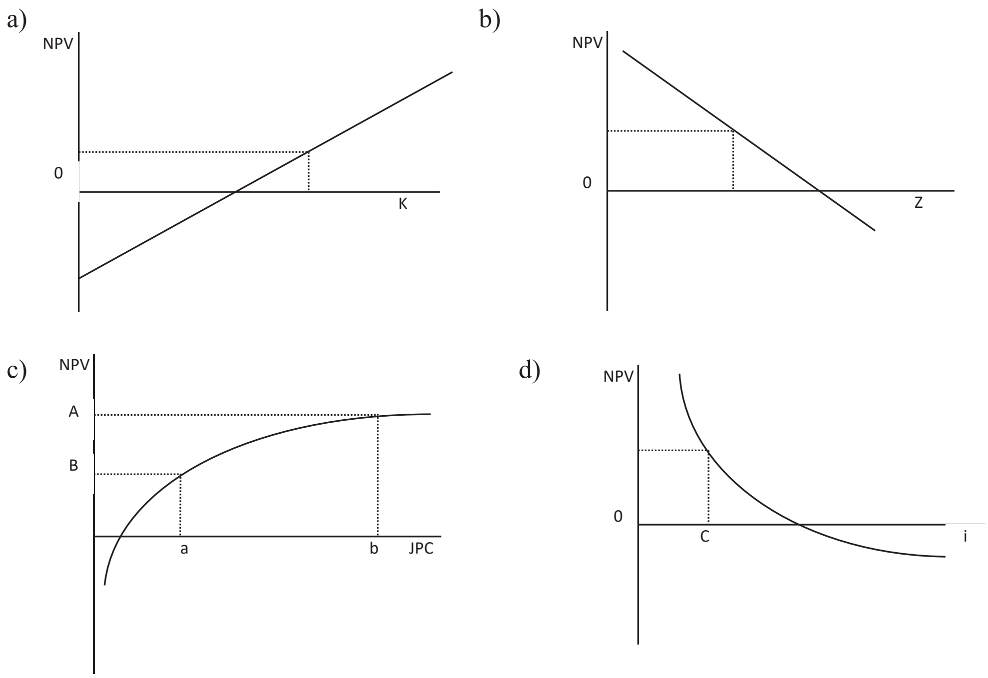
1. The selection of key project factors, which significantly affect on the efficiency indicator and which do not have unambiguous value, that is, which are uncertain (typical are: the price of capital and investment in working capital; market factors – price of goods and sales volume; cost price components; construction time and introduction of fixed assets).
   The number of these parameters should not be large because, otherwise, this analysis should be difficult to use without serious computer programmes. Therefore, the effectiveness indicator is observed as a function of a limited number of key variables. Other variables in the model are considered as constants.
2. Determining of expected intervals of values of key variables (eg. ±15% of the base value).
3. Calculation of the value of the effectiveness indicators for the intervals of values of key variables, after which the percentage change of the efficiency indicator is estimated in relation to the base case and the sensitivity indicator is calculated. On the basis of these calculations the variables are ranked according to the degree of importance and the expert assessment of the predicted values of the variables.

The results can be presented in tabular form or in the form of sensitivity graphs for all uncertain factors, which allows to single out the most critical factors, on which the special attention is focused during the implementation of the investment project in order to reduce the risk of the investment project. If, for example, the price of the production is a critical factor, during the realization it is necessary to improve the marketing programme or to increase the quality of goods. If the project is sensitive to changes in the volume of the production, it is necessary to pay more attention to training of the management of the company and introduce the measures to increase the production. If the critical factors are material costs, it should try to reduce the price of raw materials, by improving the relationships with the suppliers of raw materials by concluding the long term contracts and so on.
In order to facilitate the calculation spread sheet computer programmes are used which enable faster calculation and transparency. The usage of these programmes provided faster analysis of the impact of changes of important factors on the effectiveness indicators.

The graphs below, characterize the dependence of net present value (NPV) from:

a) Changes in annual production volume (K)
b) Annual volume of operating costs (Z);

c) Prices per unit of production (JPC);
d) Capital price levels (i) if all model variables are fixed.



Graph 1. Sensitivity of the project to changes in uncertain factors (Четыркин 2001, 286)

Example: A company plans to produce a new product. For its production it is necessary to procure the new equipment, which requires the initial capital expenditure of A_0=150.000 €. The economic turn of the investment (n) is six years, after which it is estimated that there is no residual value.

Relevant data for decision making are:
- The estimated annual sales volume is Q=5000 units.
- The planned cost of the product is JPC=30 €.
- Labour costs are L=12 € per product.
- Material costs are M=9 € per product.
- Other costs do not have significant impact on decision making.
- The price of capital is i=11%.
- Income tax T=20%.

The annual amount of amortization is Am=150000/6=25000 €.

Based on the previous data NPV will be calculated and the sensitivity of NPV will be analyzed according to the above listed factors.

Based on the baseline data, the annual net cash flow will be:

$$Pi=\{K\cdot[JPC-(L+M)]\cdot(1-T)+Am\cdot T\}=\{5000[30-(12+9)]0.8-25000\cdot 0,2\}=41000.$$

It is about equal net cash flows during the 6 years of the duration of the project, so that the NPV will be calculated by using of IV financial tables:

NPV=-A₀+ {K·[JPC-(L+M)]·(1-T)+Am·T}· IV_i^n (1.5.)

$$NPV = -150000 + \{5000[30 - (12+9)]0{,}8 - 25000 \cdot 0{,}2\} IV_{11}^{6} = -150000 + 41000 \cdot 4{,}2305 = 23450{,}5$$

The net present value is positive and a project on the basis of this caalculation can be accepted.

In order to examine the sensitivity of the net present value on the changes of individual variables, the values of the variables that give NPV=0 are calculated.

♦ Initial investment:

$$-P_0 + \{5000[30-(12+9)]0{,}8-25000 \cdot 0{,}2\} \cdot 4{,}2305 = 0$$

P_0=173450,5

♦ Annual sales volume:

$$-150000 + \{K[30-(12+9)]0.8-25000 \cdot 0{,}2\} \cdot 4{,}2305 = 0$$

$$K = \frac{P_0}{\{[JPC-(L+M)] \cdot (1-T) - Am \cdot T\} \cdot IV_k^n} = \frac{150000}{\{[30-(12+9)] \cdot 0{,}8 - 25000 \cdot 0{,}2\} \cdot 4{,}2305}$$

K=4230 units

♦ Sales price per unit of product:

$$JPC = \frac{\frac{P_0}{IV_i^n} - Am \cdot T}{K \cdot (1-T)} + (L+M) = \frac{\frac{150000}{4{,}2305} - 25000 \cdot 0{,}2}{5000 \cdot 0{,}8} + (12+9) = 28{,}61$$

♦ Labour costs per unit of product:

$$L = (JPC - M) - \frac{\frac{P_0}{IV_i^n} - Am \cdot T}{K \cdot (1-T)} = (30-9) - \frac{\frac{150000}{4{,}2305} - 25000 \cdot 0{,}2}{5000 \cdot 0{,}8} = 13{,}39$$

♦ Material costs per unit of product:

$$M = (JPC - L) - \frac{\frac{P_0}{IV_i^n} - Am \cdot T}{K \cdot (1-T)} = (30-12) - \frac{\frac{150000}{4{,}2305} - 25000 \cdot 0{,}2}{5000 \cdot 0{,}8} = 10{,}39$$

♦ The price of capital:

$$IV_i^6 = \frac{A_0}{\{K \cdot [JPC - (L+M)](1-T) - Am \cdot T\}} = \frac{150000}{\{5000 \cdot [30-(12+9)] \cdot 0{,}8 - 25000 \cdot 0{,}2\}}$$

IV_i^6=3,6585

The price of capital is between 16 and 17%.
We will get the requested price by interpolation:

Table 1. Interpolation (Authors, 2020)

i (%)	Value IV tables	i (%)	Value IV tables
16	3,6847	K	3,6585
17	3,5892	17	3,5892
1	-0,0956	17-k	-0,0693

1: (17-i)=0,0956:0,0693

i=16,2745

♦ Project duration

At a given price of capital 11% IV_{11}^{n} =3,6585

In IV tables we find IV_{11}^{4} =3,1024, a za IV_{11}^{5} =3,6959.

Project duration at a given price of capital of 11% will give NPV= 0 and it is between 4 and 5 years.

By interpolation we get that it is 4,9369 ,that is, 4 years 11 months and 7 days.

Project duration can only be established when the project is completed and it is then possible to assess whether the expected duration of the project was optimistically estimated (McLaney 2003, 149).

The previous results are shown in the table:

Table 2. Display of results (Authors 2020)

Factor	**Original data**	**Values that give NPV=0**	**Deviation (%)**
Initial investment	150000	173450,50	15,63%
Annual sales volume	5000	4230	-15,40%
Selling price per unit of the product	30	28,61	-4,63%
Labour costs per unit of the product	12	13,39	11,58%
Material costs per unit of the product	9	10,39	15,44%
Cost of capital	11%	(IRR) 16,2745%	47,95%
Duration of the project	6	4,9369	-17,72%

Based on the percentage deviation of the initial values from the values that individually give zero NPV it is possible to determine the sensitivity of NPV on changes in these values. If the stated factors of the project would move to the stated limits the project could be accepted.

The project is the most sensitive to changes in the selling price and labour costs. The reduction of the selling price per unit of the product for only 4,63% with other unchanged conditions, makes the project unprofitable. That fact could cause that the company gives up from the investment.

There is no need to analyze the sensitivity of the increase in the initial capital expenditure because it is an expenditure that is happening in the present and its value is familiar.

In this way it is possible to determine the critical factors of the project and the impact of individual factors on the final result of the project.

The main disadvantage of sensitivity analysis is that the change of one factor is observed isolated, because in practice all economic factors are in one way or another correlated.

The method can be modified by taking into account the correlation between the key indicators.

Sensitivity analysis of effectiveness indicators to changes of more variables requires that after the calculation of effectiveness indicators for each expected value of an individual factor, to evaluate the efficiency indicators for a combination of key project factors. In this way it is possible to determine how big is the sensitivity of the project effectiveness indicator on the changes in a single factor and the changes in a combination of factors.
Sensitivity analysis (Mičić and Trtić 2015; Duvnjak 2014; Duvnjak and Babić 2014) is useful for identification of variables for whose changes are expected to have the greatest influencet on the net present value or on the internal rate of return of the project. It facilitates the identification of possible decisions if the basic assumptions of the model have to be changed. It can be used in conditionally accepted investment projects in order to determine whether they should be continued, modified or rejected.
There are also certain drawbacks in this analysis. First, it is hard to determine precisely the relationship between a particular variable and the indicators of effectiveness. Second, the final decision is subjective, because this analysis does not provide a decision rule that can be used for accepting or rejecting of the investment projects. The application of this method in practice, as an independent instrument of risk analysis, is by the opinion of many authors very limited.

2. SCENARIO METHOD FOR EVALUATION OF THE EFFECTIVENESS OF THE INVESTMENT PROJECT IN RISK CONDITIONS

Scenario method (scenario building) is based on predicting of variants of possible values of factors that influence on the realization of the investment project and the calculation of the effectiveness of investments for each scenario. By attributing certain probabilities to scenarios enables the formation of probability distributions, estimation of expected values and standard deviation and schedule asymmetry.
The allocation probability approach assumes that the premium of risk related to project is included in estimated allocation of probability.

The steps of this analysis are:

Step 1: The key factors of the investment project are selected and the probabilities of occurence of these factors are determined.
Step 2: For each combination of factors, an effectiveness indicator is calculated by using a risk free rate.
Step 3: Based on the calculated effectiveness indicators and their probabilities, statistical risk indicators are calculated, a probability distribution curve is formed and a final decision is made.

An approximate estimate of the effectiveness of the net present value or internal rate of return is provided by the elaboration of „pessimistic“, „the most probable“ and „optimistic“ scenarios. The pessimistic variant of the prediction implies an assessment of the conditions for the realization of the investment project at the worst expectations (eg. small volume of product realization). The optimistic variant implies an assessment of the conditions at the best expectations, for example at the largest volume of product realization, which makes it possible to assess the needs for working capital. Along with the basic information about the project the sequence of other data are considered, which in the opinion of the project manager may appear in the process of realization.
In the following examples we will show the calculation principle, so that project risk will be observed as variability in the sales volume and variability in labour costs. The model is further complicated when a bigger number of factors are included which affect on net cash deadlines.
Example: It is estimated that the possible sales volume is:

A) 4000 units with probability 0,2
B) 5000 units with probability 0,5
C) 5500 units with probability 0,3.

For each expected sales volume NPV will be calculated.

$$NPV=-P_0+\{K\cdot[JPC-(L+M)]\cdot(1-T)+Am\cdot T\}\cdot IV_k^n \qquad (2.1.)$$

A) $NPV=-150000+\{4000[30-(12+9)]0.8-25000\cdot 0,2\}IV_{11}^{6}=$
$=-150000+33800\cdot 4,2305=-7009,1$

B) $NPV=-150000+\{5000[30-(12+9)]0.8-25000\cdot 0,2\}IV_{11}^{6}=$
$=-150000+41000\cdot 4,2305=23450,5$

C) $NPV=-150000+\{5500[30-(12+9)]0.8-25000\cdot 0,2\}IV_{11}^{6}=$
$=-150000+44600\cdot 4,2305=38680,3$

It is estimated that there are three possible values of labour costs:

1. 11 € per product with a probability of 0,15
2. 12 € per product with a probability of 0,60
3. 13 € per product with a probability of 0,25

Table 3. Scenarios depending on sales volume, costs and probability (Authors 2020)

Production volume (unit of product)		**Labour costs (per unit of product)**		**Common probability**	**Scenarios**
4000	0,20	11	0,15	0,03	1
		12	0,60	0,12	2

		13	0,25	0,05	3
5000	0,50	11	0,15	0,075	4
		12	0,60	0,3	5
		13	0,25	0,125	6
5500	0,30	11	0,15	0,045	7
		12	0,60	0,18	8
		13	0,25	0,075	9

The calculation is complicated because there are 9 possible combinations.

The net present values of these nine cash flows will be:

1. $NPV = -150000 + \{4000[30 - (11+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = 6.528,5$

2.$NPV = -150000 + \{4000[30 - (12+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = -7009,1$

3. $NPV = -150000 + \{4000[30 - (13+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = -20546,7$

4. $NPV = -150000 + \{5000[30 - (11+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = 40372,5$

5. $NPV = -150000 + \{5000[30 - (12+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = 23450,5$

6. $NPV = -150000 + \{5000[30 - (13+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = 6528,5$

7. $NPV = -150000 + \{5500[30 - (11+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = 57294,5$

8. $NPV = -150000 + \{5500[30 - (12+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = 38680,3$

9. $NPV = -150000 + \{5500[30 - (13+9)]0.8 - 25000 \cdot 0,2\} IV_{11}^{6} = 20066,1$

The sequence of nine possible net present values is obtained.

For making of a final decision it is necessary to assess the risk of the project by calculating of the expected value and the standard deviation of the net present values, which is done in the following table:

Table 4. The calculation of expected value and standard deviation of the net present values (Author, 2020)

Probabilities	**NPV**	**Pi**	**NPV· Pi**	$\left(NPV_i - \overline{NPV}\right)^2 \cdot P_i$
3	-20546,7	0,050	-1027.34	83227683.42
2	-7009,1	0,120	-841,09	89181692,12
1	6528,5	0,030	195,86	5650232,83
6	6528,5	0,125	816,06	23542636,81
9	20066,1	0,075	1504,96	2598,66
5	23450,5	0,300	7035,15	3068656,27
8	38680,3	0,180	6962,45	61126797,90
4	40372,5	0,075	3027,94	30361858,65
7	57294,5	0,045	2578,25	61745799,50
		Σ	20252,24	357907956,16
			σ	18918,46

♦ The expected net present value will be:

$$\overline{NPV} = \sum_{i=1}^{n} (NPV_i \cdot P_i) = 20252{,}24$$

The expected net present value is possible to calculate directly if the average values of the key variables are calculated (McLaney 2003, 155) (in this case the volume of demand and labour costs):

An average demand volume =(4000·0,2)+(5000·0,5)+(5500·0,3)=4950 product units

Average labour costs =(11·0,15)+(12·0,60)+(13·0,25)=12,1

$$NPV = -150000 + \{4950\,[30 - (12{,}1 + 9)]\} IV_{10}^{6} = 20252{,}24$$

♦ The standard deviation is:

$$\sigma_{NPV} = \sqrt{\sum_{i=1}^{n} \left(NPV_i - \overline{NPV}\right)^2 P_i} = \sqrt{357907956{,}16} = 18918{,}46$$

♦ Coefficient of variation is:

$$Kv = \frac{\sigma_{NPV}}{\overline{NPV}} = 0{,}9341$$

The project can be assessed as high risk. The decision whether to accept a project depends on the investor's tendency to risk.

As a whole, the model enables obtaining of a fairly clear picture for different variants of the project realization, by giving information about possible deviations from the desired result. The application of tabular programmes allows us to significantly increase the effectiveness of the analysis through an unlimited increase in the number of scenarios and the introduction of additional variables. If the number of scenarios is large, immitation modelling is recommended. Investment risk assessment is directly connected with the possibility of determining of information about uncertainty. If the initial parameters are presented in the form of possibilities, then the efficiency indicators will also have the form of random variables with their probable distribution. However, the lower the degree of statistical conditionality of project parameters, the less informed about the market situation and the lower the degree of intuitive ability of the expert, the assessment of probable parameters is inadequate and carries a high risk of error analysis.
In that case the method of fuzzy intervals can be used. It is necessary to choose three scenarios in which the project reaches its minimum (NPV_{min}), average (NPV_{avg}) and maximum (NPV_{max}) of the net present value.

The degree of risk (V&M) of innefficiency of investments is obtained from the equation:

$$V\,\&\,M = R\left(1 + \frac{1-a}{a}\ln(1-a)\right) \qquad (2.2.)$$

Where:

$$a = -\frac{NPV_{min}}{NPV_{avg} - NPV_{min}} \qquad (2.3.)$$

$$R = -\frac{NPV_{min}}{NPV_{max} - NPV_{min}} \qquad (2.4.)$$

The degree of risk V&M can be found in the range from 0 do 1. Every investor can, on the bases of risk tendency to classify values V&M, and to determine the acceptance criteria.

Example: The project is taken into consideration and its duration is estimated to be about two years. The initial capital expenditure is 150.000 €. The discount rate during the planned period can vary from min=10% to imax=15%. The expected net cash flows range from 100000 to 150000 €.

The minimum, maximum and average NPV are evaluated according to the following formulas:

$$NPV_{min} = P_0 + \frac{Amin}{(1+i_{min})} + \frac{Amin}{(1+i_{min})^2} = 12570,88$$

$$NPV_{max} = P_0 + \frac{Amax}{(1+i_{max})} + \frac{Amax}{(1+i_{max})^2} = 110330,58$$

$$NPV_{avg} = P_0 + \frac{Aavg}{(1+i_{avg})} + \frac{Aavg}{(1+i_{avg})^2} = 59876,54$$

Where:

$$P_{avg} = \frac{P_{max} + P_{min}}{2}$$

$$i_{avg} = \frac{i_{max} + i_{min}}{2}$$

The degree of risk according to the previous formula is V&M=0,0188 (1,88%)

The degree of risk of V&M is not an accurate indicator and represents a field of interval values with its schedule of expectations.
The advantage of this method is that the solution is made on the basis of the minimum and maximum value of project effectiveness and it allows us to evaluate the integral measure of negative results of the investment project, that is the degree of investment risk.

CONCLUSION

Sensitivity analysis is the most common method of individual project risk analysis and does not require information about the trend of key variables flow, that is, their probability distribution. This means that it does not require data about the real probability that some change in the variable will occur. Yet, the fact that it does not take into account the distribution of the probability of some changes is considered to be the main drawback of the sensitivity analysis. However, by changing the percentage of a certain variable it can be established that the project is not very sensitive to the change of that variable, but if the distribution of the change of that variable shows that there is no high probability of changing that variable, our sensitivity analysis is unnecessary. For example, varying the percentage of income tax may be shown by sensitivity analysis that the observed project is sustainable even if the rate increases by 80%, but in legaly safe countries, it is unlikely that the income tax would grow by 80%. This makes the analysis unnecessary; it can even be misleading if it is presented to someone who does not have good economic knowledge, and if he is told that the project is insensitive to changes up to 80% of the amount of profit tax. Or, for example, if a sensitivity analysis is performed with a projection of a decrease in the volume of the sold products for 30% and it is concluded that the project is sustainable even with a decrease in the volume of products sold by 30%, and if it is not included in the analysis of the trend of a decline in the volume of the products sold because of obsolescence (eg. information industry) where a decrease in sales by probability distribution is expected up to 70%; it can be wrongly concluded about the sensitivity of the project. Therefore, in addition to sensitivity analysis, it is recommended to make the probability analysis. The aim of the probability analysis is to find the probability range of the values of the key variables, and thus the probability range of the expected values of the project performance indicators. The probability distribution of the key project parameters is not some fact that can be obtained from the books. It is the result of professional work based on the knowledge, experience and following of trends of the investment designer.

The main characteristics of the sensitivity analysis are presented; the main advantage of the sensitivity analysis over other methods of measuring of project risks is the simplicity of development and the importance of conclusions that draws. The main disadvantage of sensitivity analysis is that it does not examine the probability distribution of variables. That shortcoming is corrected by the scenario method and that is why these two methods are often conducted together, that is, the sensitivity analysis first, and after that the scenario method.

Scenario method is an upgraded sensitivity analysis. Unlike sensitivity analysis, which varies in some individual key variables and monitors their impact on the project as a whole, scenario method also calculates probability of that changes. Therefore it takes into account the probability and amount of changes in some key variables. In that way we get the data about the range of values of the net present value of some project with the values of standard deviation, that is, deviations from that base net present value from the project. In the scenario model, three scenarios are usually composed: base as the most probable, pessimistic and optimistic. The base scenario takes into account the most probable values of individual variables. The pessimistic scenario takes into account the values of individual variables that are worse than the most probable, and the optimistic values that are better than probable. Based on such determined scenarios the deviation of the worse and the best net present value with the base or the most probable net present value can be compared.

Many projects seem perfect, the payback period is acceptable, the net present value is high, the internal rate of return is satisfactory, they are good for environment, but they break down to the slightest change in business conditions. This happens because the quality sensitivity analysis has not been made to possible changes in project variables. There are no projects that can be insensitive to market, political or economic influences. There are no investors that can be clairvoyant so they could certainly know the future trends. That is why a good idea should be „put" through simulations of possible events, to know what are the maximum limits that are sustainable. To pay attention on the market, to predict the changes and to adapt to new conditions. The best example of uncertainty is the pandemic that affected the whole world and changed the business conditions on the market in three months for all, even the most prepared business systems. In many ways, the pandemic has influenced the sensitivity analysis and scenario method to be used more in assessing of the effectiveness of investment projects. The biggest global investors have been criticized just because they predicted some possible scenarios in the world and they were criticized by many political leaders and the public that they created some scenarios that are now being realized. It remains to be seen whether they predicted the possible scenarios or created them by themselves and influenced on the realization of such scenarios. The question is whether globalization has reached the point where global investors have become so influential and powerful that they can stop the entire business world and introduce their own business rules according to the scenario that suits them the best.

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