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RISK CONSIDERATION IN THE INVESTMENT PLAN OF CREATING A VINEYARD

The paper is focused on creation and evaluation of the investment project of establishing vineyard with risk taken into consideration via a simulation model. The basis of this work was the creation of a multi period balance model and formation of different variants of the individual projects which differ in production volume and mean of financing. The model accepts to full extent initial decisions on the supposed yields, selling prices and the way of depreciation of vineyard and its fencing. In other parts of the model, the investor introduces only prices per unit of labour to services such as pre-agglomeration of land, vineyard plantation and its cultivation in different years, fencing and supporting construction and all other calculations are done automatically representing the intermediate results and model outputs. Part of the model covering the loan gives information on total initial costs of the projects including working capital and total capital costs. They are financed from equity, loans, and subsidies.

The main evaluation criterion of the deterministic calculations was the net present value which takes into consideration the time factor and belongs among the dynamic methods. By means of sensitivity and simulation analysis is possible to identify an appropriate investment strategy under the risk conditions. The risk factors, which were identified by sensitivity analysis, are defined as random variables with certain probability distribution. Critical values of target criterion give information value which we can expect with willingness to tolerate given risk quantification. The spreadsheet model allows to simulate various financial investment and credit and depreciation procedures.

The multi-period model allows for the assessment of individual investment intentions through the Net Present Value indicator and through the sensitivity and simulation analysis to identify the most appropriate investment strategy under risk conditions. The risk factors, which were identified by sensitivity analysis are defined as random variables with certain probability distribution in stochastic model. Critical values of target criterion give information which value can we expect with willingness to tolerate given risk quantification. The multi-period balance model can also be transformed into an optimization model by a suitable adjustment.

Key words: investment decision making, net present value, risk analysis, modeling analysis, risk, uncertainty, viticulture, investment project.

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Introduction. Evaluation and selection of investment projects often offers to firms answers to existential issues. An appropriate choice of investment project options can contribute to the development and increase of market value but, on the other hand, the wrong choice can cause bankruptcy or disappearance of the business. The company management needs to analyse the project, decide on the individual investment risks, determine the duration of the investment and determine the contribution of the investment to the company in deciding to realize the investment plan. Quality and timely information can accelerate and improve the decision-making process and gain a strategic advantage over the competition. Vineyard has a long tradition in Slovakia and is one of the important branches of Slovak agriculture. In the past, there has been a significant decline in the production area in our territory. The establishment of the vineyard is currently a challenging investment. Difficulty in this type of investment depends on the technology used, the number of seedlings and the way of planting. One of the supporting tools for creating and evaluating the effectiveness of investment plans is the application of modelling techniques, which is also applicable to the establishment of vineyards. The constructed model allows for a detailed analysis of the investment, including a risk analysis that contributes to increasing the likelihood of success and, on the contrary, reduces the risk of failure of the project. In terms of exactness, the net present value (NPV) method and the internal rate of return (IRR) method are the best methods for assessing the investment objective. Both methods, as input information, require initial expenditure, the relevant cash flow in each year, the estimated supposed lifetime and the quantification of the discount rate (in the case of the NPV method). These methods take into account the time value of money, which is influenced by future revenue uncertainty, inflation and lost opportunity costs, respectively opportunity costs of alternatives.

The advantages and potential problems faced while using such approaches are treated for example in the articles of Northcott [5], Lumby [4], McLaney [3].

Working with risk and uncertainty should overlap with the preparation of the business project, from its start to the final decision on project acceptance and implementation. The project may be rejected due to unsatisfactory economic advantage or because of too much risk [1]. Agricultural production is characterized by a more intense impact of risk factors than in other sectors of the national economy, which is mainly determined by the biological nature of production, the effects of climatic conditions and the effects of weather, or other factors. Some risk factors can be taken into account by simulation analysis [2, 8, 6].

The aim of the reseach. The basis of this work was the creation of a multi period balance model and formation of different variants of the individual projects which differ in production volume and mean of financing. The model accepts to full extent initial decisions on the supposed yields, selling prices and the way of depreciation of vineyard and its fencing.

Material and methods of research. The model solution allows for the deterministic assessment of the investment project for the establishment of vineyards, followed by the risk assessment of the investment project. The model is created in a Microsoft Excel spreadsheet for a period of 20 years. For the deterministic assessment of the investment model intent, a dynamic assessment method – Net Present Value (NPV) was used:

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} - I_0 ,$$

where: NPV – Net Present Value
i – discount rate
$1/(1+i)^t$ – discounted factor at time t
I_0 – initial investment costs
n – number of years of investment
CF_t – cash Flow from the investment in different years

The lifetime amount of the initial investment must provide for the reimbursement of the cash expense, the desired rate of return expressed by the interest rate and should increase the cash flow, thereby contributing to the increase in market value. The company achieves the status if the net present value is positive.

The risk of analysed investment intentions can be taken into account in a given model through a sensitive and simulation analysis [8, 6, 7]. The simulation analysis was realized as the following:

1. The construction of multiperiodical balance models of investment projects
2. Own analysis which lies in the subsequent phases:
   - Identification of the input variables, influencing the target criterion indicators,
   - Construction of the model for the criterion indicator calculation,
   - Risk factor specification,
   - Estimation of the shape of risk factors distribution and the estimation of distribution parameters,
   - Construction of the probability distribution of the analysed criterion indicator and determination of its basic characteristics.

Results from the two first phases of the own risk analysis are known from the deterministic model. The sensitivity analysis was used to conduct the third phase. On its basis as risk factors were identified the variables the change of which could result in a significant change of the final criterion indicator. It means that the risk factor is for instance the random variable, which 10 % change causes more than 10 % change of the observed criterion. In the fourth phase, for the distribution type estimates were used subjective estimates based on experts´ statements.

When developing the variants, we assume the possibility of using or not using EU support funds. Although the input variables of individual variables have been updated, due to the changing economic situation and the underlying input prices, it is necessary to anticipate their changes, but this does not affect the statistical significance of individual procedures. The flexibility of the model ensures easy adaptation of the changed situation and thus obtaining up-to-date and reliable outputs.

Research results. The multiperiodical balance model of the investment project of establishing vineyard includes the following main structural variables.

Structural variable of the model:

p1 plot with

p2 plot length

s1 buckle – distance between lines of vines

s2 buckle – distance within the line

k distance between stakes in construction

rs^t elected number of lines in period t where: t = 1, 2, ..., v

v investment period

c number of internal corridors

Balance conditions include 61 constrains

1. maximum planted area (ha): h
(p1 . p2) / 100 – h = 0,
2. maximum number of rows (pieces): r
p2 / s2- c – r = 0,
3. number of roots in a row(pcs): st1
p1 / s2- 1 – st1 = 0,
4. maximum number of roots(pcs): st2
r . st1- st2 = 0,
5. total number of planted roots in period t (pcs): $st3^t$

$rs^t \,.\, st1 - st3^t = 0$, for t = 1, 2, ..., v

6. length of planted parcel in period t (m): dl^t

$\left(rs^t + 1 + c\right).\, s1 - dl^t = 0$, for t = 1, 2, ..., v

7. area of planted parcel in period t (ha): ha^t

$dl^t \,.\, p1 - ha^t = 0$, for t = 1, 2, ..., v

8. costs of biological material: nbm^t

$st3^t \,.\, cbm - nbm^t = 0$, for t = 1, 2, ..., v

where:cbm cost of biological material,

9. the cost of pre-planting land preparation: npp^t

$\sum_{j \in N_1} a1_j \,.\, ha^t \,.\, jn_j - npp^t = 0$, for t = 1, 2, ..., v

where: $j \in N_1$ set of types of pre-planting works

$a1_j$ coefficients of conversion of work quantity per unit area

jn_j unit costs

10. treatment costs in the first, second and third years: $no1^t, no2^t, no3^t$

$\sum_{k \in N_2} a2_k \,.\, ha^t \,.\, jn_k - no1^t = 0$, for t = 1, 2, ..., v

$\sum_{l \in N_3} a3_l \,.\, ha^t \,.\, jn_i - no2^t = 0$,

$\sum_{m \in N_4} a4_m \,.\, ha^t \,.\, jn_m - no3^t = 0$,

where: $k \in N2$, $l \in N3$, $m \in N4$ set of types of work needed for treatment in the 1st, 2nd and 3rd year

$a2_k$, $a3_l$, $a4_m$ the coefficients of conversion of the quantity of work per unit area

cost of supporting structure:

11. number of vineyard columns (pcs): $ok1^t$

$$(p1_1 / k) \,.\, rs_1^t - ok1^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

12. steel wire (kg): $ok2^t$

$$(3 \,.\, st3_1^t \,.\, s2_1) / 20 - ok2^t = 0,$$

13. soil anchors (pcs): $ok3^t$

$$2 \,.\, rs_1^t - ok3^t = 0,$$

14. lanyards (nm): $ok4^t$

$$4 \,.\, ok3^t - ok4^t = 0,$$

15. vineyard handles (pcs): $ok5^t$

$$3 \,.\, st_1^t - ok5^t = 0,$$

16. wire stretching (nm): $ok6^t$

$$3 \,.\, st3_1 \,.\, s2_1 - ok6^t = 0,$$

17. installation of posts for wire without concrete (pcs): $ok7^t$

$$ok1^t - ok7^t = 0,$$

18. anchoring (pcs): $ok8^t$

$$2 \,.\, rs_1^t - ok8^t = 0,$$

19. costs of supporting structure: NOK^t

$$\sum_{r \in N_5} ok_r^t \,.\, jn_r - NOK^t = 0,$$

where: $r \in N_5$, a set of types of fencing support structure

fencing costs:

20. mesh (nm): op1

$$2 \,.\, (p1 + p2) - op1 = 0,$$

21. concrete columns (nm): op2

$$(op1 / 3 - 4) - op2 = 0,$$

22. wire steel guide (kg): $op3_i$

$$(3.op1) / 20 - op3 = 0,$$

23. barbed wire (kg): $op4_i$

$$(2.\ op1) / 20 - op4 = 0,$$

24. stretching the wire in the fence (nm): $op5_i$

$$5.\ op1 - op5 = 0,$$

25. fencing costs: NOP

$$\sum_{s \in N_6} op_s \,.\, jn_s - NOP = 0,$$

where: $S \in N_6$, set of fencing cost types

26. capital costs: KN^t

$$\sum_{i=1}^{2} \left(NLP^t + nbm^t + npp^t + no1^t + no2^t + no3^t + NOK^t + NOP^t + NKZ^t \right) - KN^t = 0,$$

fort = 1, 2, ..., v

where: NLP^t the cost of liquidating the previous crop,

NKZ^t the cost of drip irrigation

27. variable costs: VN^t

$$\sum_{n \in N_7} a5_n \,.\, ha^{t-3} \,.\, jn_n - VN^t = 0, \text{ for } t = 4, 5, ..., v$$

where: $n \in N_7$set of variable cost types

$a5_{i,n}$ coefficients of conversion of work quantity per unit area

28. fixed costs: FN^t

$$\sum_{f \in N_8} FN_f^t - FN^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

where: $f \in N_8$ set of fixed costs
FN fixed costs

29. physical working capital: FPK^t

$$\sum_{q \in N_9} fz_q^t - FPK^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

where: $q \in N_9$ set of raw materials and finished products
fz_q^t physical inventory

30. financial working capital: $FIPK^t$

$$po^t - za^t - FIPK^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

where: po^t accounts receivable (debtors)
za^t accounts payable (creditors)

31. working capital: PK^t

$$FPK^t + FIPK^t - PK^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

32. total incremental working capital: NPK^t

$$PK^t - NPK^t = 0, \qquad \text{for } t = 1$$

$$FPK^t - FPK^{t-1} + FIPK^t - FIPK^{t-1} - NPK^t = 0, \qquad \text{for } t = 2, 3, ..., v$$

33. fencing acquisition cost (for depreciation purposes): KNOP

$$NOP - KNOP = 0,$$

34. vineyard acquisition cost (for depreciation purposes): $KNSA^t$

$$\left(nbm^{t-3} + npp^{t-3} + no1_i^{t-3} + no2^{t-2} + no3^{t-1} + NOK^{t-3} + NKZ^t\right) - KNSA^t = 0$$

for t = 4, 5, ..., v

35. vineyard depreciation: OS^t

$$\sum_{u=4}^{t} a6 * KNSA^u - OS^t = 0, \qquad \text{for } t = 4, 5, ..., v$$

where: a6 coefficient of depreciation of vineyard

36. fencing depreciation: OOP^t

$$a7^t * KNOP - OOP^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

where: $a7^t$ coefficient of depreciation of fencing

37. sales: TR^t

$$\sum_{u=4}^{t} a8 \,.\, a9 \;\; .\, ha^u - TR^t = 0, \qquad \text{for } t = 4, 5, ..., v$$

where: a8 price per unit of production
a9 hectare yield

38. sources of financial coverage: ZK^t

$$KNSA^t + KNOP^t + NPK^t - ZK^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

39. loans: uv^t

$$ZK^t - VZ^t - uv^t = 0, \qquad \text{pre } t = 1, 2, ..., v$$

where: VZ^t ownersequity
repayment schedule of individual loans

40. payments SP_u^t

$$SP_u^t = 0, \qquad \text{if } t - u + 1 < do_u + 1 \quad \text{or,}$$

$$t - u + 1 > ds_u + do_u$$

in other cases:

for even repayment $\left(uv_u + knu^{t-1}\right) / ds_u - SP_u^t = 0,$

in repayment with the same annuity $A_u^t - ur_u^t - SP_u^t = 0$

for u = 1, 2, ..., v a t = u, u + 1, ..., v

where: do_u grace period included in time u
ds_u loan period of the loan taken in time u

uv_u loan taken in time u
SP_u^t repayment at time t of credit taken at time u
A_u^t credit annuity taken at time u
ur_u^t interest on the loan taken at time u
knu^{t-1} cumulative unpaid interest

41. annuity: A_u^t

$$\left((1+r_u)^{ds_u} \,.\, r_u / (1+r_u)^{ds_u} - 1\right).\left(uv_u + knu^{t-1}\right) - A_u^t = 0,$$

for u = 1, 2, ..., v and t = u, u + 1 , ..., v

where: r_u interest rate borrowed at time u

42. interest: ur_u^t

$ur_u^t = 0$, if $t - u < do_u + 1$,for u = 1, 2, ..., v and t = u, u + 1 , ..., v

in other cases:

$uv_u \,.\, r_u - ur_u^t = 0,$ for t = u

$SNSPR_u^{t-1} \,.\, r_u - ur_u^t = 0,$ for t = u + 1, u + 2, ..., v

where: $SNSPR_u^{t-1}$ amount of unpaid payments at year-end

43. cumulative payments: KSP_u^t

$KSP_u^t = 0$, if $t - u + 1 < ds_u + do_u$

in other cases:

$SP_u^t + KSP_u^{t-1} - KSP_u^t = 0,$ for u = 1, 2, ..., v a t = u, u + 1 , ..., v

44. cumulated interest: KU_u^t

$KU_u^t = 0,$ if $t - u + 1 > ds_u + do_u$

in other cases:

$ur_u^t + KU_u^{t-1} - KU_u^t = 0,$ for u = 1, 2, ..., v a t = u, u + 1 , ..., v

45. the amount of unpaid payments: $SNSP_u^t$

$uv_u - SP_u^t - SNSP_u^t = 0,$ for t = u

$SNSPR_u^{t-1} - SP_u^t - SNSP_u^t = 0,$ for u = 1, 2, ..., v a t = u + 1, u + 2 , ..., v

where: $SNSPR_u^t$ amount of unpaid payments at year-end

46. cumulative unpaid interest: KNU_u^t

$SNU_u^t - KNU_u^t = 0,$ for t = u

$KNU_u^{t-1} + SNU_u^t - KNU_u^t = 0,$ for u = 1, 2, ..., v a t = u + 1, u + 2 , ..., v

where: SNU_u^t amount of unpaid interest

47. amount of unpaid interest: SNU_u^t

$r_u \,.\, SNSP_u^t - SNU_u^t = 0,$ if $t - u + 1 < do_u + 1,$

in other cases: $SNU_u^t = 0$

48. amount of unpaid payments at year-end: $SNSPR_u^t$

$SNSP_u^t + SNU_u^t - SNSPR_u^t = 0,$ for u = 1, 2, ..., v, and t = u + 1, u + 2 , ..., v

total repayment schedule

49. total loan repayments: CSP^t

$$\sum_{u=1}^{v} SP_u^t - CSP^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

50. total interest: CU^t

$$\sum_{u=1}^{v} ur_u^t - CU^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

51. total cumulative payments: $CKSP^t$

$$\sum_{u=1}^{v} KSP_u^t - CKSP^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

52. total cumulative interest: CKU^t

$$\sum_{u=1}^{v} KU_u^t - CKU^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

53. the total amount of unpaid payment: $CSNSP^t$

$$\sum_{u=1}^{v} SNSP_u^t - CSNSP^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

54. the total amount of unpaid interest: $CSNU^t$

$$\sum_{u=1}^{v} SNU_u^t - CSNU^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

55. the total amount of outstanding year-end payment :$CSNSPR^t$

$$\sum_{u=1}^{v} SNSPR_u^t - CSNSPR^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

56. gross profit: HZ^t

$$TR^t - VN^t - HZ^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

57. profit before tax: ZPZ^t

$$HZ^t - FN^t - OS^t - OOP^t - CU^t - ZPZ^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

58. retained profit: ZZ^t

$$ZPZ^t - ZPZ^t \,.\, PD - ZZ^t = 0, \qquad \text{for } t = 1, 2, ..., v$$

59. cash flow: CF^t

$$\left(TR^t + VZ^t + uv^t\right) -$$
$$\left(KN^t + VN^t + FN^t + \left(FIPK^t - FIPK^{t-1}\right) + CSP^t + CU^t + ZPZ^{t-1} \,.\, PD\right) - CF^t = 0,$$

for t = 1, 2, ..., v

60. cumulative cash flow: KCF^t

$$CF^t - KCF^t = 0, \qquad \text{for } t = 1$$
$$CF^t + KCF^{t-1} - KCF^t = 0, \qquad \text{for } t = 2, 3, ..., v$$

61. Net present value (equity): NPV

$$NPV = \sum_{t=1}^{n} \frac{(CF^t - VZ^t + ZC)}{(1 + DS)^t} \qquad t = 1, 2, ... n$$

where: n number of years of investment
CFt cash flow from the investment in different years
VZt own resources invested in the project (equity)
DS discount rate
ZC residual value of after-life investment (market value)

The presented model simulates a twenty-year business period. The multi-period balance model is created in a Microsoft Excel spreadsheet and is made up of the following interconnected parts of the model: input decisions, fencing, land pre-planting, support structure construction, vineyard planting and treatment in 1 – 4 years, working capital, depreciation, product sales, financing of investment and repayment schedule, projected profit and loss statement, projected cash flow statement, projected balance sheet.Initial decisions that are within the discretion of the decision maker are distinguished in bold, with each item indicating the unit of measure in which the parameters are entered.

Table 1 – **Initial decisions**

Plot with		**629**
Plot length		**700**
Way of keeping vines (construction)	middle trellis m	**h**
	high trellis h	
Buckle – distance between lines of vines		**3,00**
– distance within the line		**0,80**
Number of internal corridors		**1**
Distance between stakes in construction		**5,60**
Plot in ha		44,03
Number of lines		231
Real number of lines		230
Number of roots in a row		785
Total number of roots		180550
Elected number of lines in the 1. year		**40**
Total number of roots in the 1. year		31400
Length of the uses plot in the 1. year		126
Used plot in the 1. year		7,93
Land tax		**24**
Rent		
Selling price per 1 ton		**538**
Yield ton per 1 ha		**8,10**

Source: own calculations.

In the other parts of the model, the user only enters the actual unit prices and all other calculations are made automatically through defined relationships. One of the fundamental issues in investment decision-making besides the structure and scale of production is the optimal financial coverage of the investment.

Table 2 – **Investment financing** (euros)

year	1	2	3	4	5
Total initial costs					
Total capital costs	189774	311555	239122	181646	48038
Working capital	7303	7303	5311	5311	8962
sum	197077	318858	244433	186957	57000
Financed from					
Equity	49269	79714	61108	46739	28500
Loans	49269	79714	61108	46739	28500
Subsidies	98538	159429	122217	93479	0
sum	197077	318858	244433	186957	57000

Source: own calculations.

Table 2 provides information on total costs and represents one of the financing alternatives – using EU funding. At present, it is possible to raise funds to start a vineyard up to 80% of the initial investment cost. In the analysed investment project, we expect the possibility of obtaining 50% of EU funds. These funds would cover the first four years, the remainder would be 25% of own resources and 25% of commercial credit at an interest rate of 6.5% and a grace period of 5 years. In the following years, we assume a ratio of own and foreign sources of 1: 1, without the possibility of obtaining funds from the funds. The financing decision and the loan plan created with it result in the most important statement for the deterministic assessment of the effectiveness of the investment project – cash flow statement (Table 3). Based on this report, it is possible to quantify the net present value (NPV)to the equity which is calculated in a way that from the net cash flow in the individual years is deducted the investor´s own investment and consequently is the cash flow discounts to the present value.

Table 3 – **Projected cash flow statement** (euros)

Year	1	2	3	4	5
Cash inflow					
Equity	49269	79714	61108	46739	28500
Loans	49269	79714	61108	46739	28500
Subsidies	98538	159429	122217	93479	0
Sales of grape	0	0	0	0	24164
Total income:	197077	318858	244433	186957	81165
Cash outflow					
Total costs of capital	189774	311555	239122	181646	48038
Increase financial capital	3983	-1992	0	1992	1357
Costs excluding the depreciation	1052	1052	1052	1052	17216
Interest and loan payment	0	0	0	0	0
Income tax	0	0	0	0	0
Total amount:	194810	310616	240174	184690	66611
Net cash flow	2267	8242	4259	2267	14554
Cumulative cash flow	2267	10509	14768	17035	31589
Owners’ equity	49269	79714	61108	46739	28500
Equity return	-47002	-71472	-56850	-44472	-13946
Present value	-43520	-61276	-45129	-32688	-9491
Discount rate	8%				
NPV	34045				

Source: own calculations.

With the input parameters set and the expected financial coverage, the investment project can be considered acceptable in terms of the NPV method. NPV of the project is 34 045 euros. If the investor did not have the possibility to use EU funds, the positive NPV value could only be achieved if the project was financed exclusively from foreign sources at an interest rate of less than 2%. At present, none of the financial institutions provides interest rates in the above amount, so such a project can be considered unacceptable. Obviously, another could be an assessment of the investment plan if the actual production processing is considered, but this is beyond the scope of the present contribution.

The presented model is based on certain assumptions, which are represented by deterministic parameters based on the best estimates. However, it is useful and necessary to investigate by means of a sensitive analysis how the value of the output criterion changes when changing the individual input variables of the model while the ceteris paribus rule applies. By the procedure, risk factors can be identified, i.e. inputs whose change significantly affects the investment project efficiency criterion under review. In the presented project, the price of the grapes and the hectare yield can be considered as risk factors.

Factors that have been determined to be significant by sensitive analysis are consequently formulated in the stochastic model as random variables with certain probability distributions. To estimate these distributions, subjective estimates based on expert statements were used, supplemented by an analysis of realization prices as well as hectare yields from previous years. On the basis of the facts found, the realization price described by the triangular distribution and the hectare harvest was normal. The simulation itself was implemented using the @Risk for Excel program based on Monte Carlo method. The simulation analysis results in basic statistical indicators of NPV, distribution function and critical values of the target indicator. The distribution function itself, as well as the individual statistical indicators, only make a significant difference if several variants are compared. Distribution functions form the basis for a comprehensive comparative comparison of the effectiveness of individual strategies with respect to the risk of stochastic dominance. The effectiveness of investment objectives can also be assessed on the basis of the critical values of the target indicators (Table 4). Percentages indicate the probabilities for which the NPV falls below the value associated with the probability. Thus, with 20% probability, e.g. expect that the value of NPV variant A (use of EU funds) will be less than – 92075 euros and variant B (without any financial subsidy) less than – 483476 euros. In the case of negative NPV values, the investment intention for the decision-making entity is ineffective. Every investor is willing to bear only a certain risk. Assuming that the decision-making entity has risk aversion, the investor's willingness to bear 10% to 35% risk is being considered.

Table 4 – **NPV CF critical values** (euros)

% risk	Variant A	Variant B
10%	-171163	-574264
15%	-137388	-517542
20%	-92075	-483476
25%	-73590	-447977
30%	-33933	-419612
35%	-8773	-391595
40%	18583	-368980
45%	32341	-348373
50%	52544	-323058

Source: own calculations.

Thus, taking into account risk aversion, neither option is effective for the subject. NPV values of Variant A become positive at 40% risk level. At this level of risk, with a 40% probability that the NPV will be less than € 18,583 and with a 60% probability higher than the stated value and the investor willing to accept such risk may accept the intention. It is therefore up to the particular investor to what extent he is willing to bear a certain investment risk.

Conclusions. The spreadsheet model allows to simulate various financial investment and credit and depreciation procedures. The multi-period model allows for the assessment of individual investment intentions through the Net Present Value indicator and through the sensitivity and simulation analysis to identify the most appropriate investment strategy under risk conditions. The risk factors, which were identified by sensitivity analysis are defined as random variables with certain probability distribution in stochastic model. Critical values of target criterion give information which value can we expect with willingness to tolerate given risk quantification. The multi-period balance model can also be transformed into an optimization model by a suitable adjustment. A dedicated function would represent maximizing assets at the end of the period considered. In addition to the conditions respected in the balance sheet model, the set of constraints would be extended to include production and credit constraints, as well as conditions that ensure the company's liquidity in each time period through positive cumulative cash flow and sufficient resources to cover capital investment and working capital. With this type of model, it is possible to identify the optimal range of investment over the relevant time horizon, as well as the optimal financing of the investment. Applications of the above procedures can be found in Repiský [6].

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Обґрунтування ризику при розробці інвестиційного плану вирощування винограду
Джозеф Репински

Стаття присвячена створенню та оцінці інвестиційного проекту з вирощування виноградників з урахуванням ризику, за допомогою імітаційної моделі. Метою статті є створення багаторічної балансової моделі та формування різних варіантів індивідуальних проектів, які відрізняються за обсягом виробництва та засобом фінансування. Модель повністю приймає початкові рішення щодо передбачуваних прибутків, ціни реалізації і способу амортизації виноградників та його огорожі. В інших частинах моделі інвестор вводить тільки ціни на одиницю продукції на такі послуги як попередня агломерація землі, виноградникова плантація та її вирощування в різні роки, огородження і допоміжне будівництво, а всі інші розрахунки робляться автоматично, представляючи проміжні результати і вихідні дані моделі. Частина моделі, що охоплює кредит, надає інформацію про загальні початкові витрати на проекти, включаючи оборотні кошти та загальні капітальні витрати. Вони фінансуються за рахунок власного капіталу, позик та субсидій.

Основним критерієм оцінки детермінованих розрахунків була чиста приведена вартість, яка враховує фактор часу і належить до числа динамічних методів. За допомогою аналізу чутливості та імітаційного моделювання можна визначити відповідну інвестиційну стратегію в умовах ризику. Фактори ризику, які були визначені за допомогою аналізу чутливості, визначаються як випадкові величини з певним розподілом ймовірностей. Критичні значення цільового критерію дають інформаційну цінність, яку ми можемо отримати з максимально можливим кількісним визначенням ризику. Модель таблиці дозволяє імітувати різні фінансові інвестиційні, кредитні та амортизаційні процедури.

Багаторічна модель дозволяє оцінювати індивідуальні інвестиційні можливості через показник чистої теперішньої вартості та через аналіз чутливості та імітаційного моделювання для визначення найбільш прийнятної інвестиційної стратегії в умовах ризику. Фактори ризику, які були визначені за допомогою аналізу чутливості, визначаються як випадкові величини з певним розподілом ймовірностей в стохастичній моделі. Критичні значення цільового критерію дають інформацію, значення якої можна очікувати для кількісного визначення ризику. Багаторазова модель балансу також може бути перетворена в оптимізаційну модель за допомогою відповідного регулювання.

Ключові слова: процес прийняття інвестиційного рішення, чиста приведена вартість, аналіз ризику, аналіз моделювання, ризик, невизначеність, виноградарство, інвестиційний проект.

Обоснование риска при разработке инвестиционного плана выращивания винограда
Джозеф Репински

Статья посвящена созданию и оценке инвестиционного проекта по выращиванию виноградника с учетом риска с помощью имитационной модели. Основой этой статьи явилось создание многопериодной балансовой модели и формирование различных вариантов отдельных проектов, которые отличаются объемом производства и средствами финансирования. Модель в полной мере принимает первоначальные решения о предполагаемой урожайности, отпускных ценах и способе амортизации виноградника и его ограждении. В других частях модели инвестор вводит только цены за единицу рабочей силы для таких услуг как предварительная агломерация земли, насаждение виноградников и его возделывание в разные годы, ограждение и вспомогательное строительство, а все остальные расчеты выполняются автоматически, представляя промежуточные результаты и выходы модели. Часть модели, охватывающей кредит, дает информацию об общих первоначальных затратах проектов, включая оборотный капитал и общие капитальные затраты. Они финансируются за счет капитала, займов и субсидий.

Основным критерием оценки детерминированных расчетов была чистая приведенная стоимость, которая учитывает фактор времени и относится к динамическим методам. С помощью анализа чувствительности и симуляции возможно определить подходящую инвестиционную стратегию в условиях риска. Факторы риска, которые были определены с помощью анализа чувствительности, определяются как случайные величины с определенным распределением вероятности. Критические значения целевого критерия дают информационную ценность, значение которой мы можем получить с максимально возможной количественной оценкой риска. Модель электронных таблиц позволяет имитировать различные финансовые вложения и процедуры кредитования и амортизации. Многопериодная модель позволяет оценивать индивидуальные инвестиционные возможности с помощью индикатора NetPresentValue, а также с помощью анализа чувствительности и симуляции для определения наиболее подходящей инвестиционной стратегии в условиях риска. Факторы риска, которые были определены с помощью анализа чувствительности, определяются как случайные величины с определенным распределением вероятностей в стохастической модели. Многопериодная модель баланса также может быть преобразована в модель оптимизации путем соответствующей корректировки.

Ключевые слова: процесс принятия инвестиционного решения, чистая приведенная стоимость, анализ риска, анализ моделирования, риск, неопределенность, виноградарство, инвестиционный проект.

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