The assessment of the economic risks level of sugar beet growing for the farm economy

Josef Pulkrábek[1], Miroslav Kavka[1], Vladimír Rataj[2], Jaroslav Humpál[3], Ladislav Nozdrovický[2], Zdeněk Trávníček[3], Vladimír Pačuta[2]

[1]*Faculty of Engineering, Czech University of Life Sciences Prague, Prague, Czech Republic*
[2]*Slovak Agriculture University in Nitra, Nitra, Slovak Republic*
[3]*Institute of Agriculture Economics and Information, Prague, Czech Republic*

Abstract: The risk rate of sugar beet growing was analyzed by using the algorithm for modelling and generating the random numbers based on the conditions determined in advance and the statistical distribution of sugar beets yield, the total costs, earnings and gross profit. On the bases of results of the analysis of economic risks of sugar beet production in years 1995–2009, it follows that the sugar beet growing in all regions is highly risky in the Czech Republic. The subsidy SAPS and TOP-UP per 1 hectare of sugar beet have a positive impact on its economics though not sufficient enough. In practice, it means that it is highly probable that the break-even point will not be achieved and thereby it is highly probable that the fixed costs are not covered and the update of machines is significantly limited. This happens mainly in the marginal regions. If the agricultural companies count on the separate sugar payment, the sugar beet growing is in all regions of the Czech Republic with acceptable risk.

Key words: sugar beet, growing technology, production economic, risk

When analyzing the current economic situation in the resort of agriculture, it is evident that agriculture as a part of national economy can be characterized by a high level of economic instability (Škvorecká and Farkašova 2008; Strnadová 2009). The negative development of climatic conditions affects also the production conditions. Frequent changes of the prices of inputs and outputs do not create a stabile situation. It is possible to state that such situation is common also for other countries, and especially the countries of the Central Europe have similar problems (Černý et al. 2011). Sugar beet growing is significantly affected by the accepted regulatory measures and the market regulations controlling the price instruments. The risk rate of sugar beet growing was very high in the past, currently the price and sales are guaranteed till 2013/2014. From 2009/2010, there is guaranteed the minimum price of sold sugar beet 26.29 €/t at 16% of the sugar content. The second element that dramatically decreases the risk rate in general is sugar beet growing in best localities and on the fields with high natural soil richness (Hnilička et al. 2009). A fairly big contribution to the production stability – the sugar beet sales and the sugar content – and to the acceptable costs necessary for the achievements has the high professional level of producers. A significant contribution has also the use of new knowledge and money-saving growing technologies (Brandhuber et al. 2009; Krouský 2009).

Foltýn et al. 2009 have performed how the price of inputs during the production process transforms into the value of production costs. There are costs items that farmers cannot effect (purchasing prices, taxes, rent, fees) and items that the farmer can affect by hi/her managerial decisions (the number of operations, tractor-machine sets, allotments, etc.). The second group of cost items is connected to the used technological methods and often are expressed via the unit production costs. It is shown that not even these cost items in each region are comparable. The sugar beet belongs to the products with high production (so called highly intensive) but it is necessary to admit that the earnings are appropriate (Strnadová 2009). The total composition of costs is in contrast with other products very different. For example the sugar beet and the rape are the products

Supported by the Ministry of Education, Youth and Sports of the Czech Republic (Projects No. MSM 6046070901, MSM 6046070905) and by the Ministry of Agriculture of the Czech Republic (Projects No. MZE 0002725101).

with high production costs related to the application of chemicals. By contrast, the rape is a product where we can buy relatively cheap seeds, while regarding the sugar beet, it is other way round. Purchase of quality seed pelleting and dosing means very high purchasing costs (for example in 2009: 12.5–14.5%). Also the harvest costs are high. Into the costs items, it is necessary to include also the contribution for the sugar beet transport in the sugar-refinery or settlement of production allotments.

The condition in the market is outlined by the outputs prices and revenues. Weather conditions and the level of technology discipline in the company on one side, and market environment on the other side significantly determine the condition and functioning of the market. The market production is since the EU accession increased by the SAPS subsidies and by the national TOP-UP, and since 2005 in some agricultural companies also by the so-called compensation sugar beet payment related to the referential area of sugar beet in the companies in 2005 (Adamec et al. 2010).

From the mutual relationship of costs, prices, revenues and subsidies in the market environment, there unwind the prosperity and competitiveness of a certain commodity production (Paudel and Matsouoka 2009). For the management decision making, it is therefore inevitable to steadily analyze and evaluate the risk rate – the factuality of planned results (Vaněk et al. 2008). Therefore, there is the analysis of economic risks of the sugar beet production in this report following from the statistical data in the time horizon of the last 15 years (1995 to 2009). The analysis is in particular focused on the production stability and the yield per hectare evaluation in the selected regions and serves for the expert formulation of marginal conditions in line with the below mentioned methodical procedures and analysis for calculation of the parameters.

MATERIAL AND METHODS

Applied methods

Gleissner and Berge (2004) have defined an algorithm of random numbers generation based on the in advance determined conditions and statistical distribution in order to model the risky situation. The efficiency of the sugar beet growing is affected by a large number of the potential risk situations (technical-technological, production, economic and market risks) and therefore Koenker et al. (2001) have used the method of quintiles allowing to resolve the distribution type.

It is necessary to set as a base the pessimistic and optimistic estimation of the expected situation. If it is real to set the most probable estimation of the expected situation which in the case of sugar beet is then that it is possible to use for modelling a triangular distribution (Evans et al. 2000).

There were selected parameters by which there can be expected the changes in order to provide modelling. On the side of market production, they are the changes concerning the sugar beet yields and farmer's price, on the side of the costs; they are the changes of outputs related to the demands in each year, price changes and the options of the agricultural companies. There were analyzed parameters for two regions (1) the Central-Bohemia region; (2) the Olomouc region and the Czech Republic as a whole. The conditions of these selected regions define in frame the situation and regions of sugar beet growing in the Czech Republic (1 – region average conditions and 2 – production regions of growing).

In order to analyze the extent of economic risk, there was used a compound index, i.e. the value of gross profit from sugar beet growing. The compound index can be considered as a comparative parameter. It can be calculated according to the equation 1 respectively in two models of the market production setting. Two models have been identified:

(1) **model I** assumes the inclusion into market production only via the subsidy SAPS and TOP-UP (relation 2),
(2) **model II** assumes in addition the inclusion of the separate sugar payment (relation 3).

The value of gross profit (GP) is determined as:

$$GP = MP - C_t \quad (1)$$

where:
MP = market production (€/ha)
C_t = overall costs (€/ha)

Market production (MP) is determined as:
Model I – separate sugar payment is not included into the market production:

$$MP = Y \times P + S \quad (€/ha) \quad (2)$$

Model II – separate sugar payment is included into market production:

$$MP = Y \times P + S + SSP \times Y \quad (€/ha) \quad (3)$$

where:
Y = yield (t/ha)
P = farmer's price (€/t)
S = subsidy SAPS + TOP – UP (€/ha)
SSP = separate sugar payment 13.93 €/t

The function of the model has been tested by using the question: "How big the risk is acceptable, provided that the value of the gross profit will be achieved at the expected value?" whereas a zero profit was considered as a break-even point. Calculations expect, in order to answer the question, that it is necessary to set a method of interpretation of the calculated risk values besides the calculations.

In general, the interpretation of risk (Wolke 2008; Smejkal and Rais 2009) has no definite directive. The scope of the allowed risk issues from subjective manager approach to the non-suggestible risk given by the price development in the world market. The scope of the allowed risk in business with one commodity often corresponds with the level of risk with other commodities which are in the portfolio of the manager subject. The assumption of the scope of risk (pessimistic, optimistic and the most expected) which are used in the analysis of the economic risk of sugar beet growing follow from competent analysis of production-market situation in the Czech Republic. To interpret the risk issue in area of plant production is in respect to the above mention possibilities to use appropriately a classification where the risk up to 20% is low, 21 to 40% acceptable, 41 to 60% high and above 60% very high (unacceptable).

Analysis of the parameters for calculation

The average yield of sugar beet was during the whole time of monitoring 48.89 t/ha in the Czech Republic, 46.76 t/ha in the Central Bohemia region and 53.49 t/ha in the Olomouc region. The development in each year is stated in the Figure 1. The revenues are relatively equal but it varies significantly in the particular companies between the minimum and maximum. Therefore, there was used a triangular distribution with marginal conditions stated in the Table 1.

The farmer's price of sugar beet (Figure 2) was till the EU accession directly dependant on the cultivation year and firstly on the sugar price in the inboard market and on the €/CZK rate too. The year 2004 meant a break in the guaranteed price and at the same time, on the supplies quotation. Also the considerations of further price development prognosis were taken into account. For the analysis, there were used the average prices from the CSO Prague. The price of each farmer is significantly dependant on the rate of the quoted sugar beet produced for the bio-ethanol or sold above the scope of the concluded contracts. It depends a lot on the transport distance and on the farmer's share in transport. It is necessary to deduct the fees related to the market regulation from the paid price. Based on the analysis of the data, there was used the triangular distribution with the marginal condition stated in the Table 2.

The value of costs is analyzed both based on the monitoring (Figure 3) by the FADN system (Adamec et al. 2010) and the expert estimation and analysis of calculations of the computer-based advisory system AgroConsult for different intensity of growing technologies. The development of costs for 15 years is

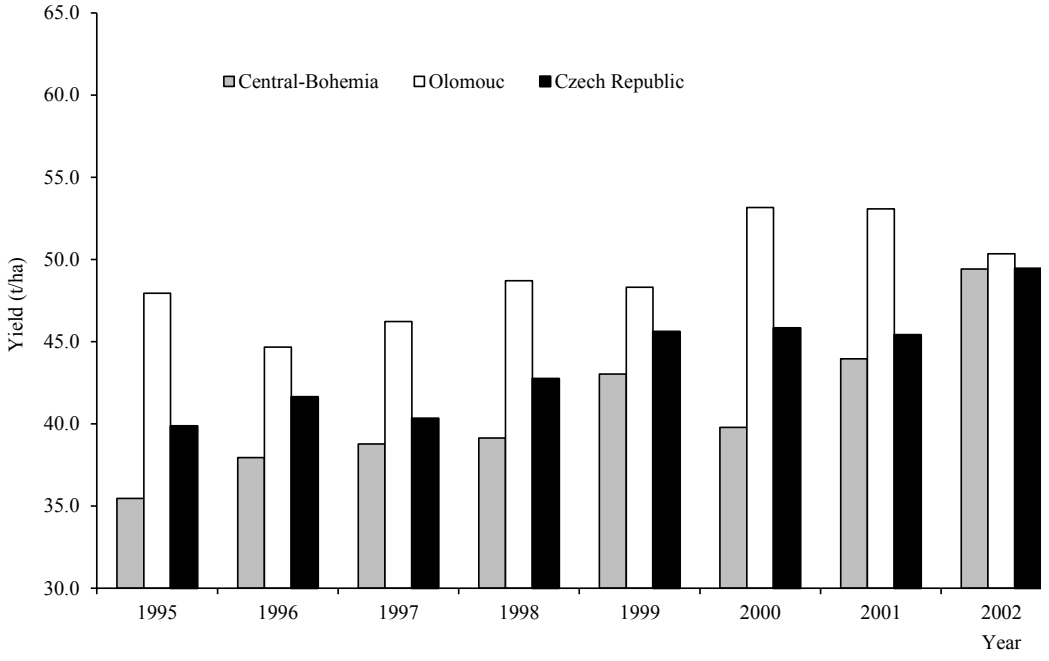

Figure 1. Development of sugar beet yields per hectare

Source: CSO (2010)

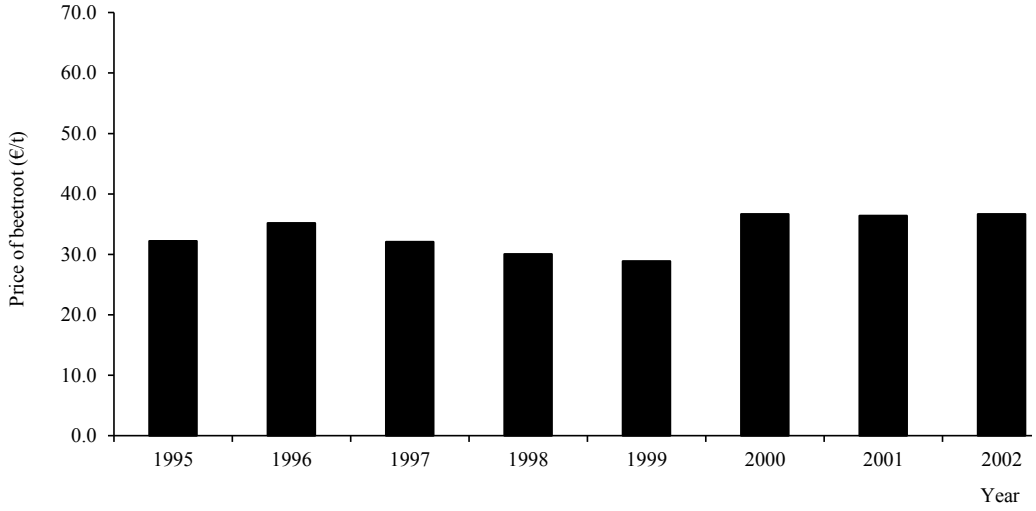

Figure 2. Statistical analysis of the development of farmer's price of sugar beet

Source: CSO (2010)

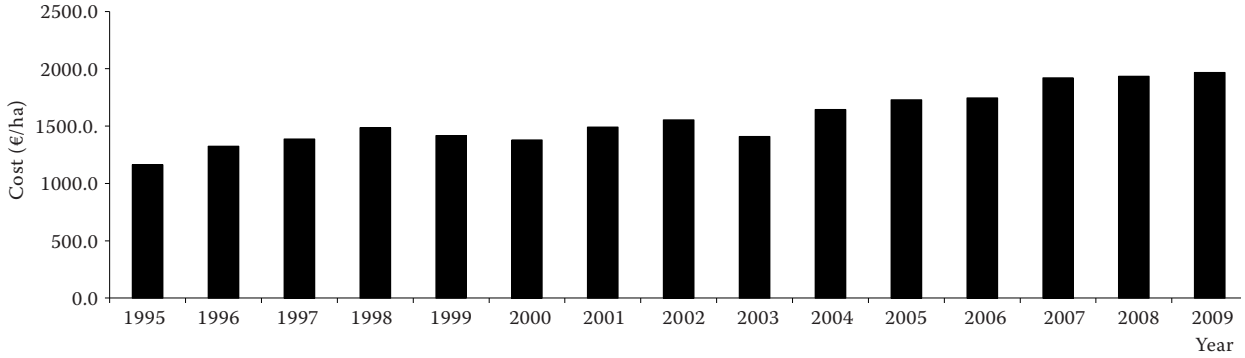

Figure 3. Statistical analysis of the development of sugar beet growing costs

Source: IAEI Prague

showed in the Figure 3. Based on the analysis of the data, there was used the triangular distribution with marginal condition stated in the Table 3.

For a comprehensive illustration of situation in the sugar beet growing economics in the Czech Republic, there are in the Figures 4 and 5 showed statistical

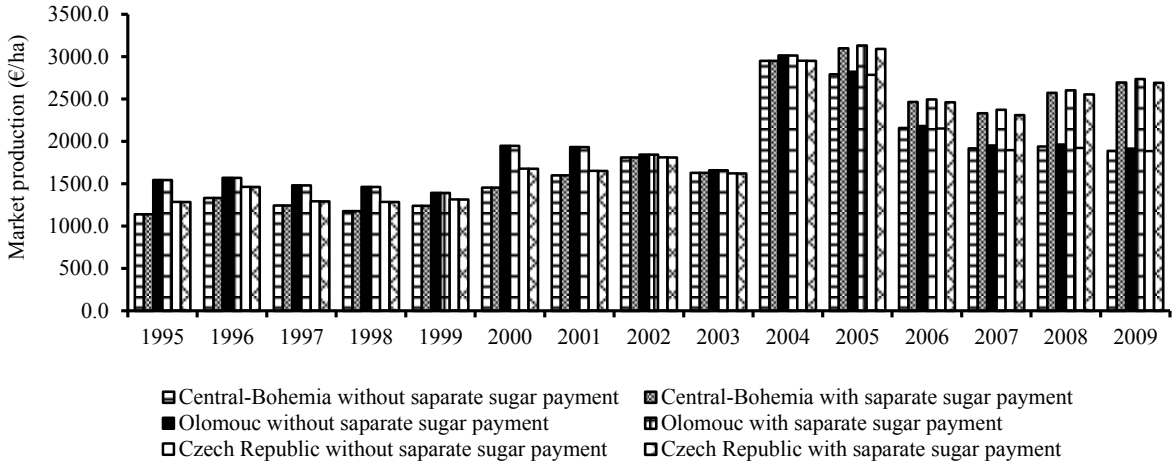

Figure 4. Market production of sugar beet growing including the subsidy SAPS and TOP-UP and with or without the separate sugar payment (static calculation)

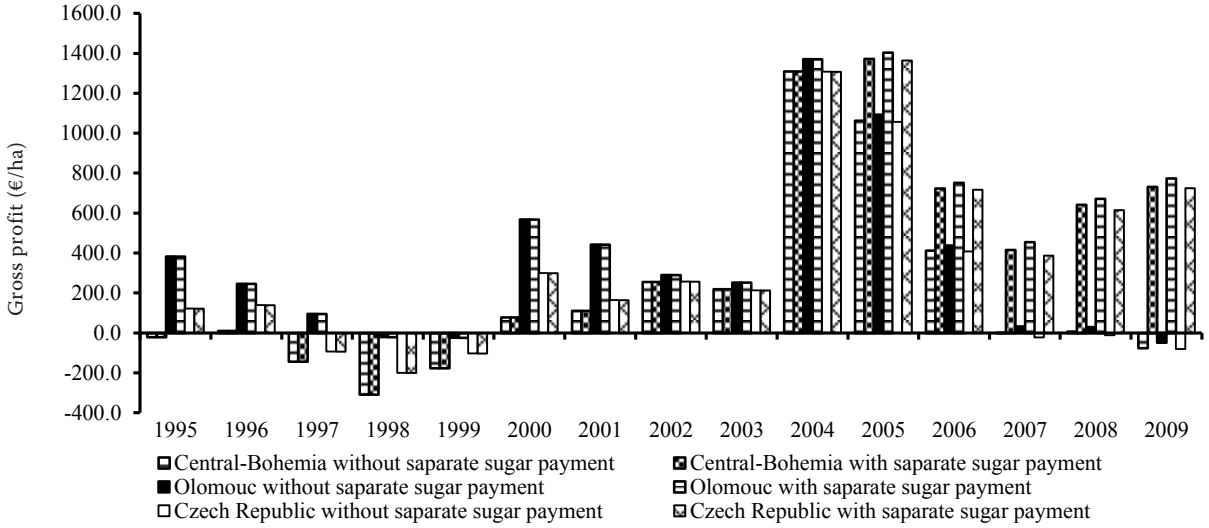

Figure 5. Gross profit of sugar beet growing including the subsidy SAPS and TOP-UP and with or without the separate sugar payment (static calculation)

calculations of market production and gross profit for both models of market production creation. The calculation follows from the values of input parameters showed in Tables 1 to 3 without the application of principal of the random values generation in the scope of marginal conditions as of triangular distribution.

RESULTS

The revenues of sugar beet, farmer's prices and costs were generated in line with the marginal conditions in Tables 1 to 3.

The top of distribution was at revenues set as an average of the years 2004 to 2009, which is the time from the EU accession when the cultivation areas and farmer's conditions were stabilized. The pessimistic estimation was set up as the minimum from 2004 and the optimistic estimation reflects the potential possibility of new species under the optimal cultivation conditions.

Farmer's prices follow from the minimum price (26.29 €/t = pessimistic estimation). At present, the world prices are quite high and sugar is even in the EU sold for higher prices and thereby the contribution for the farmers grows. The optimistic price reflects the so-called special compensation sugar payment related to the reference sugar beet area in companies in 2005. Model costs follow from the Figure 3. The optimistic estimation is based on the price decrease and the scope of usage of some pesticides, savings of working costs and a significant reduction of company's expenditures.

The number of interactions for each parameter within the model of market production and the adequate gross profit were 15 000.

Using these input parameters for the model, there were acquired the results set in the Table 4. Figures 6 show the final results for both models of the market production creation.

Table 1. Marginal conditions for modelling the sugar beet yield per hectare in t/ha

Region	Estimation		
	pessimistic	distribution top	optimistic
Central Bohemia	50.37	54.22	60
Olomouc	51.44	55.24	68
Czech Republic	50.34	54.13	65

Table 2. Marginal conditions for the farmer's price modelling in €/t

Region	Estimation		
	pessimistic	distribution top	optimistic
Without resolution	26.29	28.73	32.51

Table 3. Marginal conditions for the costs modelling in €/ha

Region	Estimation		
	pessimistic	distribution top	optimistic
Without resolution	2 268.45	1 890.35	1 512.30

Table 4. Characteristics of the calculated statistical indicators for gross profit

Gross profit (GP) (€/ha)	Central Bohemia		Olomouc		Czech Republic	
	Model I	Model II	Model I	Model II	Model I	Model II
Average (€/ha)	–94.86	669.52	2.60	813.52	–47.17	740.01
Standard deviation (€/ha)	179.45	190.56	200.50	230.23	192.16	215.94
Minimum (€/ha)	–634.59	79.17	–604.30	145.55	–613.99	104.51
Maximum (€/ha)	535.64	1 345.09	693.04	1 608.39	689.10	1 564.92
Risk (GP = 0) (%)	**68.67**	**0.00**	**49.98**	**0.00**	**59.28**	**0.00**

The interpretation is set by the statistical analysis of the calculated figures. The accomplishment of gross profit as it was set by the input parameters of calculation is possible with a risk responding to the cumulative frequency of the values occurrence. The interpretation of the risk analysis in the number expression is stated in the Table 5.

CONCLUSIONS

The analysis of the economic risk of sugar beet growing has allowed formulating the following conclusions:

(1) It is important to take into account the risk of achievement of the general planning of gross

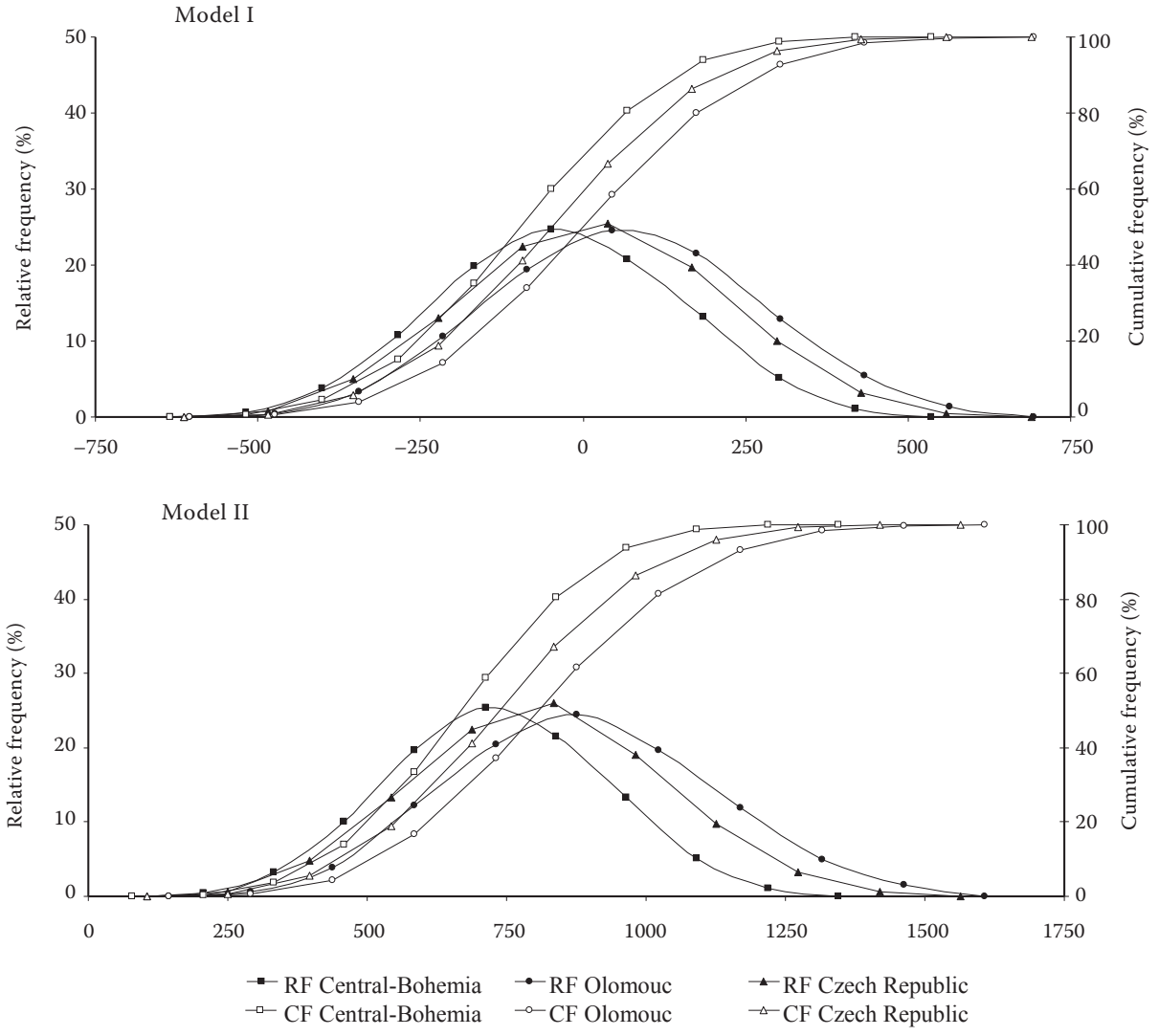

Figure 6. Graphic chart of the relative (RF) and cumulative (CF) frequency of the occurrence of gross profit values (cumulative frequency of occurrence monitors a risk of achieving the assumed gross profit) for the model I and II of market production creation

Table 5. Interpretation of risk analysis

Assumed gross profit (GP) (€/ha)	Risk of accomplishment of the assumed gross profit (%)					
	Central–Bohemia		Olomouc		Czech Republic	
	Model I	Model II	Model I	Model II	Model I	Model II
–500.00	1.17	x	0.39	x	0.64	x
–250.00	20.92	x	11.53	x	16.06	x
0	**68.67**	**x**	**49.98**	**x**	**59.28**	**x**
250.00	96.66	1.62	87.49	0.45	92.58	0.65
500.00	99.98	20.23	99.11	9.63	99.72	14.87
750.00	x	65.35	x	40.42	x	52.15
1000.00	x	95.17	x	78.16	x	87.56

profit gained from the crops. The results obtained confirm that the risk rate is growing with increasing of the planned gross profit.

(2) For the model I, i.e. without the separate sugar payment, sugar beet growing in all regions of the Czech Republic is highly risky. The subsidies SAPS and TOP UP per 1 hectare of sugar beet have indeed a positive impact on economics, but not sufficient enough. In practice, it means that the break-even point will not be achieved and therefore it is very probable that the fixed costs will not be covered and the machine devices renewal is significantly restricted. This is reflected mainly in the marginal regions.

(3) For model II, i.e. with the separate sugar payment, sugar beet growing in all regions in the Czech Republic is with an acceptable risk.

REFERENCES

Adamec R., Froněk D., Divišová E. (2010) Situační a výhledová zpráva: cukr, cukrová řepa (Situation and forvard-looking report sugar, sugar-beet). Ministry of Agriculture of the Czech Republic, Praha; ISBN 978-80-902-4; ISSN 1211-7692.

Brandhuber R., Demmel M., Koch H.-J., Brunotte J. (2009): Bodenschonender Einsatz von Landmaschinen – Empfehlungen für die Praxis (Exploitation of farm machines focused on soil protection – Recommendations for practice). Zuckerindustrie, *134*: 255–259.

Černý I., Pačuta V., Pospišil R., Ondrišík P., Kováčik P. (2011): Vplyv Atoniku a Pentakeepu-V na produkčné parametre repy cukrovej a plodiny rotujúcej v osevnom postupe (The effect of atonic and pentakeep-V on the production parameters of sugar beet and crop rotating in crop rotation). Listy cukorvarnické a řepařské, *127*: 174–177.

Evans M., Hastings N., Peacock B. (2000): Statistical Distributions. 3rd ed. John Wiley & Sons Inc., New York; ISBN 978-0-471-37124-3.

Foltýn I., Kopeček P., Zedníčková I., Vávra V. (2009): Profitability development of key Czech agricultural commodities in the period 2002–2006. Agricultural Economics – Czech, *55*: 181–199.

Gleissner W., Berger T. (2004): Auf nach Monte Carlo: Simulationsverfahren zur Risiko-Aggregation (According to Monte Carlo method: Simulation methods for risk-aggregation). Risknews, *1*: 30–37.

Hnilička F., Urban J., Pulkrabek J., Hniličková H. (2009): Energetická bilance pěstování cukrové řepy (Energy balance of sugar-beet growing). Listy cukrovarnické a řepařské, *125*: 260–266.

Koenker R., Hallock K. (2001): Quantile Regression: An Introduction. Journal of Economic Perspectives, *15*: 143–156.

Krousky J. (2009): Cukrová řepa v roce 2009 (Sugar-beet in the year 2009). Listy cukrovarnické a řepařské, *125*: 256–259.

Paudel P., Matsuoka A. (2009): Cost efficiency estimates of maize production in Nepal: a case study of the Chitwan district. Agricultural Economics – Czech, *55*: 139–148.

Smejkal V., Rais K. (2009): Řízení rizik ve firmách a organizacích (Risk Management in Firms and Companies). Grada, Praha; ISBN 978-80-247-3051-6.

Strnadlová H. (2009): Dosavadní vývoj a perspektivy trhu s cukrovkou a cukrem (Actual progress and perspective of sugar-beet and sugar market). Listy cukrovarnické a řepařské, *125*: 334–340.

Škvorecká E., Farkašová M. (2008): Variant calculation system – the instrument of economic performance management of multifunctional agricultural enterprise. Agricultural Economics. – Czech, *54*: 376–383.

Vaněk J., Červenková E., Jarolímek J., Šimek P. (2010): State and evaluation of information and communication

technologies development in agricultural enterprises in the Czech Republic. Plant, Soil and Environment, *56*: 144–147.

Wolke T. (2008): Risikomanagement (Risk Management). Oldenburg Wissenschaftverlag GmbH, München; ISBN 978-3-486-58714-2.

Arrived on 24th August 2010

Contact address:

Miroslav Kavka, Czech University of Life Sciences, Prague, Kamýcká 129, 165 21 Prague 6, Czech Republic
e-mail: kvk@tf.czu.cz