

Economic efficiency of Slovak agriculture and its commodity sectors

ZUZANA CHRASTINOVÁ, VIERA BURIANOVÁ

*Research Institute of Agricultural and Food Economics, Bratislava,
Slovak Republic*

Abstract: The article brings out the findings about economic efficiency of agriculture and its commodity sectors after the accession of Slovakia into the EU. The adoption of the CAP had a positive impact on the growth of the off-market and total income but at the same time, its production efficiency decreased and the production structure has changed. Less efficient sectors of the crop and livestock production declined. Regarding the aspect of financing of the agricultural sector, the European resources, mainly the direct payments, were determined. The total subsidies into agriculture increased in comparison with the pre-accession period. The volume of direct payments including the complementary national direct payments reached the maximum level in 2007, 2008 and 2009.

Key words: economic efficiency, income, production structure, subsidies, commodity sectors

The institutional conditions of entrepreneurship have changed fundamentally after the EU accession. Subsidies formed a significant share in the income of farmers. Both pillars of the support system of the Common Agricultural Policy influenced the economic development of agricultural enterprises.

The direct payments play an important role (SAPS). The total area eligible for the SAPS reached 1 955 000 hectares. Slovakia, as most of the new Member States, after the EU accession started to administer the simplified Single Area Payment Scheme which is conditional on keeping land in the Good Agricultural and Environmental Condition.

Many authors focus on the efficiency of agriculture from various aspects, therefore, the concepts of economic, allocative and scale efficiency can be found in the current studies.

The allocative efficiency or the “price efficiency” is achieved when the enterprise is able to use inputs at the lowest cost. Scale efficiency means the reduction in the unit cost available to a firm when producing at a higher output volume.

Blaas (2006) assumes that entrepreneurs and managers within the primary agricultural production, after the first experience with the support system and market conditions of the EU, think ahead on targeting of the subsidies in the future. He states that only two alternatives exist: the alternative of extensive production with low inputs, the minimization of negative environmental impacts and the low

intensity of production that the EU “remunerates” in the form of stable income, such as the single area payments; or the second alternative focused on the growth in the competitiveness of production, which involves further capital and knowledge inputs and some of the Slovak entrepreneurial subjects already meet these criteria.

In many OECD countries, the main objective of the agricultural policies is to secure the income of farm households. To investigate the efficiency of policy instruments, the PEM (Policy Evaluation Model) was designed to examine the “transfer efficiency”, e.g. the efficiency of alternative support forms, increasing the income of farm households considering the costs of consumers and taxpayers.

Brooks and Dyer (2008) state that well-functioning the markets are distorted by the policies that intervene in their functioning by the means of price support and input subsidies. Also the measures which unfavourably influence the distribution effects, i.e. large and wealthy farmers receive more than the small and poor ones.

Rosochatecká et al. (2008) carried out analysis of internal sources of financing (profit after taxation, reserves, depreciation) in agricultural enterprises (legal persons) and pointed out certain issues related to capital facilities of Czech agriculture. In terms of economic efficiency, the agricultural land is considered to be a decisive factor but the largest part of agricultural land in Slovakia is owned by private

landowners and characterised by a high disintegration (Buday 2007). The landowners rent their land predominantly. The Disintegration of land plots and the unsettled ownership titles to land represent the crucial obstacle for land market development.

Foltýn et al. (2009), within the evaluation context of sustainable agriculture and rural areas in the CR in the conditions of the EU and European Model of Agriculture, present the model AENVI-2 and its use for the economic efficiency evaluation of the key commodity production and ecological aspects. The construction of the model AENVI-2 is based on the calculation of regression dependencies of the hectare yields and livestock efficiency on cost items of the individual commodities and at the same time regression relations between the cost items.

Chrastinová et al. (2010) deals with economic efficiency of agriculture and commodity sectors, its position within the national economy and institutional development factors in the period 2004–2008.

METODOLOGY

The decisive accent within the analysis was put on economic efficiency of agriculture and its basic commodity sectors. The official statistical and sectoral reporting was the main data source. The economic efficiency of commodity sectors was analysed on the basis of the processed data that were collected from agricultural enterprises.

Several ratio indicators were used for the assessment of economic efficiency; the cost to revenue ratio was the basic synthetic indicator generalising the economic efficiency. Also the basic mathematical-statistical methods, index method, comparative analysis were used.

For the analysis of economic efficiency development of the commodity sectors, the economic – mathematical model – EMM (modified model setup AENVI-2) was applied. The model is based on the long-term monitoring of the total production costs and production intensity of crop and livestock commodities. The database of the total production cost monitored by the RIAFE served as the input database. The database is limited in the number of respondents but single in the relation to the monitoring of the total production costs of the individual commodities.

The time series 2002–2007 of the total production costs of the selected sample formed the base of the model for economic efficiency assessment of the selected crop and livestock commodities in Slovakia.

RESULTS

Economic efficiency of agriculture

After the EU accession, the agriculture in Slovakia recorded a positive economic result on a yearly basis. The total subsidising of agricultural sector increased in comparison with the pre-accession period and amounted to 75.2 billion SKK (€ 2.5 billion) in the period 2004–2008.

The changes occurred in the economic situation of agricultural enterprises related to the change of support policy and the entry to the Single European Market.

Despite the above-mentioned tendencies, the Slovak agriculture is characterised by the differentiation in the achieved economic results in terms of:

- the size of agricultural enterprises measured by the number of employees and the agricultural land area,
- legal form of enterprises,
- natural conditions.

Economic results according to the size of enterprises – the number of employees

The variances at the economic result level among the groups of enterprises are caused by several factors. One of them is the different economic efficiency measured by the cost to revenue ratio, which proved that the enterprises with up to 19 employees were more efficient than the enterprises with 20 and more employees (Table 1).

Efficiency and profitability of the production in agriculture has resulted from the intervention of farm managers into the economy of enterprises; the intervention was focused on the restructuring of production and cost-saving measures (inputs, labour force), which significantly influence the economic result in general. In addition, support incentives, which increased the income of farmers, had a decisive impact on the improvement of the efficiency of agricultural enterprises considering the size of farmed land area of agricultural enterprises and the subsidising.

Economic results according to the size of enterprises – the area of managed agricultural land

Considering the distribution of the number of enterprises according to the size of the managed land in 2004–2008 (Table 2), we conclude that:

Table 1. Agricultural economic indicators grouped according to the number of employees

Indicator	2003	2004	2005	2006	2007	2008
Economic result in SKK per ha of agricultural land	-2 556	1 020	288	706	1 420	3 915
– enterprises with 20 and more employees	-2 415	328	-303	-192	880	2 075
– enterprises up to 19 employees	-141	692	591	898	540	1 840
Return on cost in %	-4.04	1.58	0.45	0.96	1.88	5.16
– enterprises with 20 and more employees	-4.35	0.60	-0.54	-0.33	1.48	3.43
– enterprises up to 19 employees	-0.22	1.07	0.91	1.22	0.72	2.42

Source: Statistical Office of the Slovak Republic, own calculations

- the major part of the enterprises managed the land area from 501 up to 1000 hectares and also from 1001 up to 1500 hectares of agricultural land; these enterprises achieved a high proportion in added value, equity, revenues and subsidies,
- the highest level of economic result per hectare of agricultural land was achieved not only in the case of enterprises managing smaller land area of agricultural land, i.e. up to 500 ha, but also in the case of enterprises managing 3500 ha and more,
- the highest economic result was achieved by the enterprises farming more than 4000 ha of agricultural land. Besides the small proportion in the whole sample, these enterprises indicated a substantial share (13%) in the current subsidies and

other indicators too. These enterprises also gained the highest values in revenues and added value per enterprise that was four times higher than the national average,

- enterprises farming cca 4000 ha of agricultural land are considered as the problematic ones.

Economic results according to diverse natural conditions

The agricultural production in Slovakia is realised in diverse natural conditions. This fact significantly influences the production focus and efficiency of the production. On the basis of soil-climate conditions

Table 2. Results of agricultural enterprises grouped according to the intervals of agricultural land area

Interval of land area (ha)	Share of agricultural cooperatives (%)						Economic result (thous. SKK per enterprise)	Economic result (SKK per ha of agricultural land)	Number of enterprises
	number	area	returns	production	subsidies, total	added value			
No land	0.9	–	0.1	0.0	0.0	0.0	240	–	5
Up to 100	3.2	0.1	1.8	1.9	0.3	1.3	1 867	43 034	17
101–500	9.4	2.0	1.8	1.8	1.9	1.7	-192	-602	50
501–1 000	25.1	12.9	11.3	10.9	13.2	10.7	12	15	130
1 001–1 500	23.0	18.9	20.0	20.4	18.7	21.7	275	224	120
1 501–2 000	13.2	15.3	15.2	14.9	15.5	14.9	152	88	70
2 001–2 500	10.8	16.3	14.3	14.2	16.8	13.2	406	180	57
2 501–3 000	4.9	9.0	9.1	8.3	9.7	8.1	3 699	1 351	26
3 001–3 500	3.8	8.2	7.5	7.0	8.5	5.9	1 801	557	20
3 501–4 000	1.1	2.8	2.9	3.0	2.5	3.1	-4 754	-1 286	6
4 001 and more	4.5	14.6	16.2	17.5	12.9	19.4	11 251	2 329	24
Total	100.0	100.0	100.0	100.0	100.0	100.0	879	588	525

Source: Information Lists of the Ministry of Agriculture of the Slovak Republic, Central database – RIAFE

such as soil category, soil type, land slope, depth, soil granularity, altitude, exposure of land blocks as well as climate conditions (average annual temperature, annual rainfall totals, wind) and many others, the territory of Slovakia is divided into the areas with better natural conditions (productive regions) and the areas with handicapped natural conditions – the less favoured areas (LFA).

The highest economic efficiency was achieved in the agricultural enterprises concentrated on the territory of western Slovakia with the highest proportion of productive land. On the territory of central and eastern Slovakia, where the less favoured areas prevail, the economic efficiency of agricultural enterprises was lower.

Up to 67.4% of agricultural enterprises operated in less favoured areas and managed nearly two thirds of the total agricultural land. The values of the most economic indicators were several fold higher in productive regions in comparison with the less favoured areas.

The decisive factors influencing the level of economic results in the less favoured areas were identified as follows: the lower productive soil potential, the shorter vegetation period and the limited commodity structure of agricultural production as well as other criteria which were taken into consideration in the process of less favoured areas categorisation.

After the EU accession, the number of loss-making enterprises started to decline in both types of areas – the less favoured and productive regions too.

The subsidies ensure a decisive portion of the income to the owners of agricultural enterprises allocated in less favoured areas. The CAP of the EU has a positive impact overall but in the individual regions has caused differentiated effects. Under its influence, the intensive (productive areas) and extensive (less

favoured areas) tendencies within the agriculture have been formed.

Economic efficiency evaluation of commodity sectors through the EMM

The construction of the EMM is based on the monitoring of the total production costs according to the individual production regions and the whole territory of Slovakia in the time series 2002–2007 for all monitored commodities. The regression dependencies examining the influence of the individual cost items on the production intensity and consequently on the economic efficiency of the selected commodities are presented as the results of finding. The hectare yield (y) was set as a dependent variable and individual cost items (x_1 – x_9) as independent variables:

- x_1 – seeds purchased
- x_2 – seeds produced
- x_3 – fertilisers purchased
- x_4 – fertilisers own
- x_5 – pesticides
- x_6 – cost to mechanisation
- x_7 – other direct cost and services
- x_8 – wages and other personal cost
- x_9 – fixed cost

From the several eventual function types, the most appropriate function in the following form $y = a \times x^2 + b \times x + c$ has been identified.

In the next step, the interdependencies between the individual indicators within the selected set of the RIAFE enterprises were analysed by the means of the selected statistical methods (Pearson's correlation coefficient, Table 3).

Table 3. Pearson's correlation coefficient for crop and animal commodities

Commodity	Hectare yield – production efficiency					
	TPC/t, TPC/l, TPC/kg of weight gain	TPC/ha TPC/100FD	seeds feeds	cost on mechanisation	pesticides medical products	fertilisers
Wheat	–0.82	0.26	–0.59	0.18	0.37	0.19
Barley	–0.84	0.14	–0.14	0.32	0.28	–0.41
Maize	–0.79	0.63	0.10	0.57	0.04	0.06
Rape	–0.75	0.46	0.25	0.35	0.22	0.15
Milk	–0.49	0.74	0.75	0.23	0.67	
Fattening of cattle	–0.59	0.06	0.12	–0.07	0.71	
Pigs	0.06	0.72	0.49	0.10	–0.14	

TPC = total production costs

Source: Database of own costs of agricultural products, RIAFE, own calculations

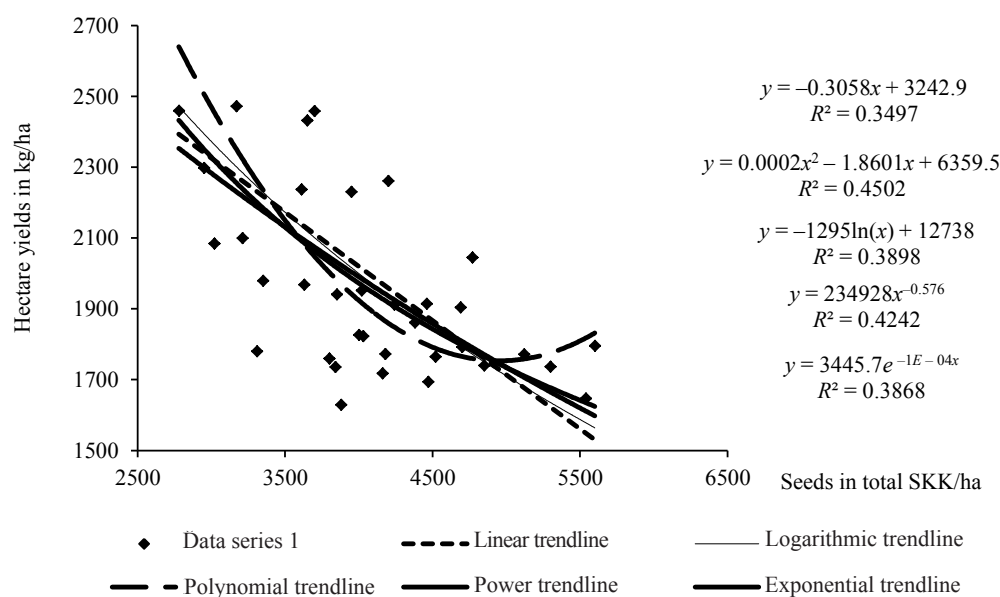


Figure 1. Cost of seeds, per hectare yields of wheat in 2002–2007 and regression function

The simple linear dependency, which is the simplest form of correlation expressed as the regression function, was used. The correlation was used for testing the dependencies between two data rows (variables). If large values of the first row were associated with large values of the other, the correlation was positive. If small values of one row were associated with large values of the other row, the correlation was negative. If the values of both rows were independent, the correlation coefficient was close to zero.

The highest dependency was observed in the case of maize and rape between the hectare yields and the

individual cost items and costs; within the animal production in the case of dairy cows – milk and pigs between the production efficiency and the cost of feeds. In case of the unit costs (TPC/t, TPC/litre, TPC/kg of weight gain), the hectare yield and efficiency the negative correlation was observed.

In the next section of the analysis, the figures are presented that illustrate the regression function of wheat between hectare yields and individual cost items (seeds cost, fertilisers, mechanisation cost, cost per tonne) which have the largest factor weight (Figure 1). The Figure 2 presents the regression

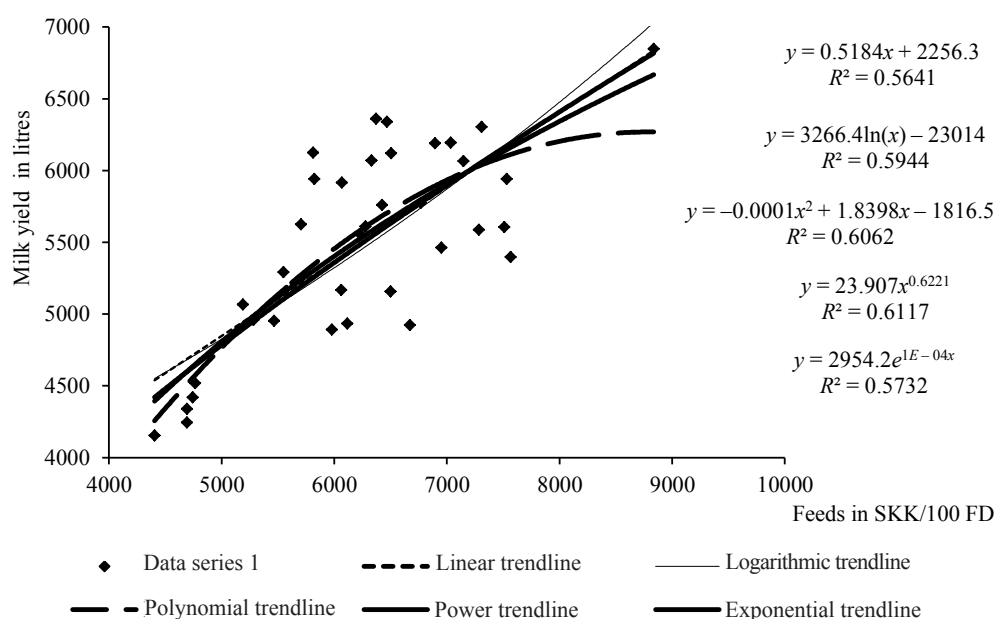


Figure 2. Feed cost, milk yield of dairy cows in 2002–2007 and regression function

function of the annual efficiency of dairy cows and feeds.

The polynomial function of second degree parabola recorded the highest value. The equation of the regression function is formulated as $y = 10\,164.4 - 4419.6x + 660.0x^2$.

Statistical cost and revenue analysis of wheat in 2008

The weighted arithmetic average, where the weight is represented by the harvested land area, was used for the selected cost and hectare yield indicators.

Another mean value used in the analysis is the median which is defined as the middle value of the given numbers or distribution in their ascending order. Median is the average value of the two middle elements when the size of the distribution is even. The median, as the other mean values, characterises the sample in the best way if the individual values are concentrated around the mean with a little variation among them.

The values of the arithmetic average and median of the monitored indicators were similar (Table 4) and that approved the homogeneity of the sample. The most homogenous results were achieved in the maize production region, which is the most suitable for wheat cultivation.

For the assessment of cost and hectare yield variability, the variance and variation coefficients were used. The variance and its square root (standard deviation) signal how far the values lie from the mean. The standard deviation is defined as the square root of its variance. The relative variability was measured by the variance coefficient, which is expressed in percentage.

Potato production region proved the lowest level of the total wheat production cost variability; the potato, potato-oat and maize production region proved the lowest level of the per hectare yield variability. The highest variability was observed in the case of the total production costs per unit for all production regions (except sugar beet production region) as well as for the whole territory of Slovakia.

The relation between the wheat unit cost and the production volume was illustrated graphically and mathematically through the correlation and regression analysis which present the development of the regression function and the dependency tightness.

The development of dependency has a form of the polynomial of the second degree, i.e. the parabolic regression expressed as $y = a + b \times x + cx^2$ where the costs per unit (y) are dependent on the per hectare yield (x). The correlation index, which is scaled into the interval range $< 0, 1 >$, was used for the dependency description.

If its value was close to one, the correlation dependence was close to the function dependence. The index of determination was used as a criterion for making a choice of the regression function mode. The polynomial function of second degree expressed by parabola had the highest value of the determination coefficient R^2 . The equation of the regression function has the following form $y = 7746.6 - 508.6x - 1639.4x^2$. The regression function was used to estimate “ y ” value, i.e. the costs per unit corresponding to certain “ x ” values i.e. the production or hectare yields (Table 5). We assumed that the regression function would assess the total production costs related to the relevant hectare yields. The estimates would be more precise if the correlation dependence was close to the function dependence (correlation index is 1). The computed regression equations could be

Table 4. Arithmetic mean and median of the selected indicators of wheat in 2008 according to production regions

Indicators	Production region					Slovakia
	maize	sugar beet	potato	potato-oat	mountain	
Arithmetic mean						
PC, total in SKK/ha	24 499	25 360	21 036	21 239	20 644	23 940
Hectare yield in tonnes	5.56	5.85	4.88	4.67	3.71	5.41
PC per tonne	4 251	4 169	4 204	4 202	5 190	4 255
Median						
PC, total in SKK/ha	24 406	23 459	22 227	22 546	22 454	22 942
Hectare yield in tonnes	5.34	5.00	4.96	4.83	3.75	4.93
PC per tonne	4 150	4 219	4 336	4 611	5 236	4 253

Source: Cost and revenues of agricultural products in the SR in 2008, own calculations

Table 5. Equation of the total production cost regression function considering different per hectare yields

Production region	Regression function equation	Yields (t/ha)			
		3.0	4.0	5.0	6.0
Maize and sugar beet	$Y = 8414.3 - 717.9x + 11.6x^2$	6 365	5 728	5 123	4 525
Potato	$Y = 4957.6 + 283.4x - 67.3x^2$	5 202	5 012	4 692	4 235
Potato-oat and mountain	$Y = 4971.9 - 133.4x - 8.4x^2$	5 449	4 573	4 515	4 474
Slovakia, in total	$Y = 7746.6 - 508.6x - 1639.4x^2$	5 763	5 288	4 821	4 362

Source: Cost and revenues of agricultural products in the SR in 2008, own calculation

used at the farm or above-farm level to estimate the production cost per unit.

The maize and sugar beet production regions were included in one equation, so as the potato-oat and mountain production regions.

Based on the calculations, the level of profitability computed by the EMM and by the classic method did not vary significantly and that proved the correctness of the exerted calculation.

Examining the dependence of the per hectare yield on the individual cost items showed that the per hectare yield is mostly effected by the mechanisation cost (high-capacity machinery, their value was reflected in costs).

The dependence of the wheat hectare yields within all monitored enterprises in 2008 illustrated that the allocation of wheat production in the individual production regions proved its suitability for the efficient production in maize, rape and potato regions.

CONCLUSION

After the accession of Slovakia into the EU, the agriculture has achieved a positive economic result that was influenced by the CAP support incentives. The higher income of farmers was not reflected in wages of the employees substantially; the wages in agriculture were cca 20% under the average wage level within the national economy. The stabilisation of labour force or the increase in employment has not occurred.

The differentiation in economic efficiency was observed also in the case of the size structure of enterprises and diverse natural conditions. The enterprises with a lower number of employees were more efficient. There were existing differences within the efficiency of enterprises and the efficiency of commodities. The major part of enterprises and commodity sectors were efficient only with subsidies.

The most of enterprises ranged from 500 thousand SKK of loss to 1 million SKK of profit. These

enterprises had the biggest share in revenues, own property and land. The enterprises with the profit 10 million SKK and more, managed approximately 5% of the total agricultural land and their share in the total profit was almost 40%. The enterprises with large agricultural land areas, over 4000 ha, managed 16.3% of the total agricultural land and represented about 3.8% of the total number of enterprises (legal persons).

Agricultural enterprises farming large land areas (3500–4000 ha) were considered as a problematic group. The number of enterprises in the group is low but their economic loss is high and that fact significantly affects the economic results of the Slovak agricultural sector in total. Within the entrepreneurial structure of agriculture, the number of agricultural cooperatives decreased and the number of business companies increased on the contrary. Considering the average land area per 1 enterprise, the agricultural cooperatives dominated with higher land areas.

The combination of several factors influenced the economic efficiency of commodity sectors. Among the most important factors, there were: the growth in intensity of the commodity production or performance of livestock at cost savings (what was proved as a decrease in the unit cost), the increase in prices of agricultural commodities (considering the permanent growth in the agricultural input prices) and the subsidising. The production of main agricultural commodities would be inefficient without subsidies. The cereals represented the only exemption recently. The total subsidies, including the SAPS and the LFA support, improved the production efficiency in the conditions with natural handicaps mainly.

The inefficiency of milk production was alleviated by subsidizing large cattle units; in 2006 and 2007 the production was profitable in productive regions. In 2008 the production of milk proved a loss-making performance again. The payments per 1 large cattle unit alleviated but not eliminated the loss-making performance of cattle fattening.

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Contact address:

Zuzana Chrastinová, Viera Burianová, Research Institute of Agricultural and Food Economics, Trenčianska 55, 824 80 Bratislava, Slovak Republic
e-mail: zuzana.chrastinova@vuepp.sk, viera.burianova@vuepp.sk
