Development of competitiveness and its determinants in Slovak dairy farms

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Abstract: The competitiveness and its determinants for Slovak dairy cattle farms during the years 2007 to 2011 was analysed. The economic database of the Research Institute for Animal Production Nitra was used as the basis. The profit in milk production with including the direct subsidies was assumed as the main parameter of the dairy farm competitiveness. The influence of the individual cost items and milk yield on the competitiveness was quantified using the multivariable linear regression model. Our results indicate that the farms were competitive in milk production only in 2007 and 2008. The highest profit (0.026 € per 1 kg of milk) was reached in 2007. It was mainly determined by the level of the milk price (+9%) and unit costs (–10%) in the evaluated period. The negative regression to the competitiveness was observed for the feed costs, labour costs, repairs and services, depreciations, other direct costs and overheads. On the other hand, the statistically positive impact of the milk yield was found. Generally, the effective utilization of the production potential of animals should be recommended as the main factor of the unit costs reduction as well as for the improvement of the dairy cattle farms profit.

Key words: costs, dairy cattle, milk production, profit/loss

The competitiveness of enterprise is one of the most important factors for the business sustainability. The exact definition of competitiveness has still not been given as it can be viewed from several perspectives. It is known as a long-term ability of the company to make profit (Arrow 1991; Turner 1997). Moreover, a profitable company stimulates other competitors in the area to reach profit, as well (Ostern 1990). In addition, the competition between the individual companies leads indirectly to their more stable position in the market (Módos 2001).

Competitiveness is influenced by many determinants. Their specification in the agricultural company is strongly influenced by economic parameters as well as the biological specifics of production (Látečková et al. 2009; Bohušová et al. 2012). The high quality of cost analysis along with the multi-dimensional analysis and monitoring of costs are the base premise for the opportunity of the competitiveness analysis. Furthermore, providing this information is a competitive advantage for the company (Kučera et al. 2005). The profitability monitoring will be more important in the future due to the abolition of milk quotas after 2015 (Kuipers 2006).

Profitability analyses of cattle farms were particularly the aim of some previous articles (Daňo et al. 2007; Krupová et al. 2012b). The aim of this study was to evaluate in detail the competitiveness and its determinants in Slovak dairy cattle farms for the period 2007 to 2011.

MATERIAL AND METHOD

Data and traits

Competitiveness of milk production and its determinants were evaluated in dairy cattle herds for

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Table 1. Development of average natural indicators of dairy farms in 2007–2011

Indicator	2007	2008	2009	2010	2011
Average altitude of the farm location (m above sea level)	515	462	500	460	440
Heads of dairy cows per farm	311	328	323	340	317
Fertility of cows (%)	86	90	89	87	96
Death loss of cows (%)	5.9	5.3	4.7	5.9	4.9
Milk yield of cow (kg per FD)	16.2	16.8	15.9	15.3	16.2
Marketability of milk (%)	95	97	90	92	96
Number of lactations per cow per life	3.1	3.1	3.0	3.2	2.6
Age at first calving of cow (days)	1018	919	921	924	878
Calving interval (days)	410	431	433	431	418

FD = feeding day

the years 2007 to 2011. The main production and economic (cost and revenues) parameters from the total of 94 observations recorded in the economic database of the RIAP Nitra were analysed. In addition, data of milk recording in dairy cattle were evaluated (the database of the BS SK, not published).

The studied farms (herds) were chosen randomly to represent all of the production regions (the average altitude of the location of the farm was 475 m above the level), all breeds of dairy cattle (Holstein, Slovak Spotted, Slovak Pinzgau) and their cross-breeds reared in Slovakia. For dairy cattle farms, a classical indoor production system in a free housing system was typical. The average production parameters of the farm for the evaluated period were as follows: 324 heads of dairy cows per 1 farm, 90% fertility of cows, 5% death loss of cows, 16.1 kg of milk yield per 1 feeding day (5877 kg per cow per year) and milk marketability of 94%. The average age of cows at first calving was 932 days, the calving interval reached 425 days and the average production life of cows was 3 lactations. A detailed trend of these indicators for the evaluated period is given in Table 1.

The value of profit or loss (with direct subsidies[1]) in milk production was quantified by the countdown calculation method. The costs per 1 feeding day of dairy cow was calculated when the by-product value (manure and live-born calf) was eliminated from the direct and indirect costs. The appreciation of the live-born calves as the main by-product was established on the basis of the energy consumption needed for the foetal growth in the last five months (152 days) of pregnancy. From the total cow consumption (i.e. total feed costs), about 60% is used for pregnancy in this period (Burian et al. 1981). The average birth weight was 35 kg and the average price 1.66 €/kg of liveweight was assumed. The value of manure as the second by-product in ruminant farming was appreciated based on the purchase price of the nutrients contained in manure (3.65 €/t of manure; Krupová et al. 2012b). In the next step, the costs per 1 kg of milk, as the ratio of costs and milk yield per 1 feeding day were calculated by the methodology used in Daňo et al. (2007).

Statistical methods

The quantification of competitiveness was based on the assumption that a competitive farm achieves profit (Arrow 1991; Turner 1997). An economic result of evaluated herds (profit or loss) was calculated as the difference between the revenues and costs per 1 kg of milk (Chrastinová 2011). The influence of variables (feeds, material costs, labour costs, repairs and services, depreciations, other direct costs, overheads and average milk yield) on the competitiveness value in milk production was quantified by the multivariable linear regression model (Arrow 1991) at the level of significance 95%. The forward selection procedure has been chosen to find the optimal model for the studied data. Characteristics of the

[1]Payment per livestock unit (2007–2011), additional national direct payment per dairy cow (2010–2011) and support per 1 dairy cow – help in milk crisis (2010), for more details see Krupová et al. (2014).

Table 2. Base characteristic of the inputs and outputs in dairy cattle farms in 2007–2011

Variable (in € per FD)	Statistics variable	2007	2008	2009	2010	2011
		n = 22	*n* = 13	*n* = 15	*n* = 17	*n* = 27
Milk yield (in kg per FD)	mean	16.2	16.8	15.9	15.3	16.2
	STD	4.28	2.65	2.08	2.14	3.26
Total feed costs	mean	2.29	2.85	2.34	2.36	2.92
	STD	0.70	0.73	0.42	2.36	0.90
Material costs	mean	0.21	0.22	0.17	0.19	0.35
	STD	0.09	0.09	0.13	0.19	0.21
Labour costs	mean	0.59	0.36	0.44	0.48	0.53
	STD	0.44	0.15	0.20	0.48	0.28
Repairs and service	mean	0.11	0.07	0.07	0.11	0.06
	STD	0.09	0.03	0.05	0.11	0.04
Depreciation	mean	0.98	0.98	0.97	0.99	1.25
	STD	0.35	0.20	0.19	0.99	0.50
Other direct costs	Mean	1.30	1.08	1.10	1.15	1.49
	STD	0.69	0.27	0.29	1.15	0.59
Overhead costs	mean	0.52	0.49	0.51	0.49	0.86
	STD	0.29	0.41	0.40	0.49	0.74

FD = feeding day; STD = standard deviation

individual components applied in the regression model are given in Table 2. The followed regression equation was used to examine the relationship between the variables and the competitiveness of milk production:

$$C_j = \beta_0 + \beta_1 x_{j1} + \beta_2 x_{j2} + \beta_3 x_{j3} + \beta_4 x_{j4} + \beta_5 x_{j5} + \\ + \beta_6 x_{j6} + \beta_7 x_{j7} + \beta_8 x_{j8} + \varepsilon_j \quad (1)$$

where C_j is the value of competitiveness (profit or loss) of j-th farm, β_0 is intercept, β_1 to β_7 are regression coefficients for the individual independent variables, x_{j1} are feed costs, x_{j2} are material costs, x_{j3} are labour costs, x_{j4} are repairs and services costs, x_{j5} are depreciations, x_{j6} are other direct costs, x_{j7} are overheads, x_{j8} is production of milk per 1 feeding day (FD) and ε_j is the residual. The regression line very well approximates the real data points by the value of the reached determination coefficient R^2 (0.8633). The obtained value of Pearson's correlation coefficient (0.929) confirms the existence of a high linear correlation among the variables in this equation. The procedure REG as implemented in the statistical package SAS (2008) was used for the regression analysis. The average exchange rate of 30.126 Slovak Crowns per € was used for the period 2007 to 2008 (Law No. 659/2007 on the introduction of the Euro in Slovakia).

RESULTS AND DISCUSSION

A direct comparison of the economical parameters of milk production in different studies is difficult because of the differences in the traits, methodology and conditions. Nevertheless, at least some general conclusions can be drawn from the literature.

As the most important cost items of the calculation formula, there were found feed costs (41%), other direct costs (20%) and depreciations (17%) in the analyzed period. This is in agreement with the findings of Ubrežiová and Mihina (1995, 1998). With respect to the change of the individual cost items, the value of material costs and overheads increased the most in the period 2007–2011 (+67% and +66%, respectively). As known, mainly overheads (production and management costs) should be assigned to the animal category to which they really belong. Moreover, the only overhead costs should be

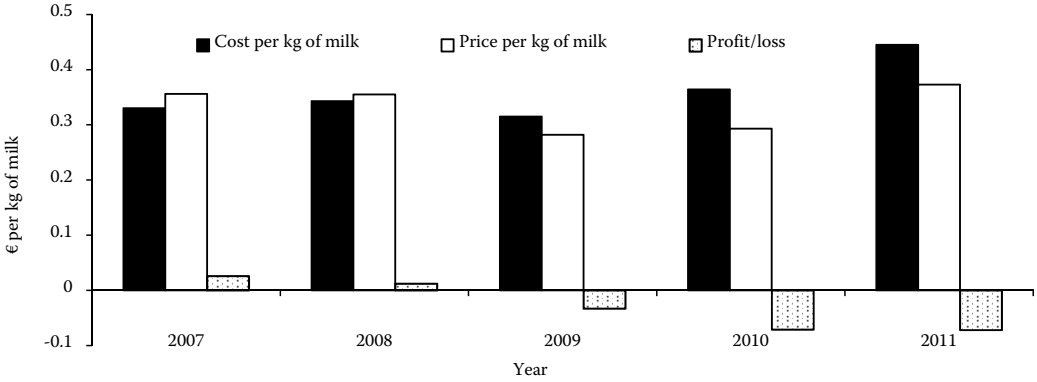

Figure 1. Development of competitiveness in milk production in 2007–2011

accounted in this calculation unit without considering of subsidies to define an objective value of these costs per one production unit. The depreciation of long term tangible property and of animals as well as the total feed costs increased (by 28% and 27%, respectively) during the analyzed period. However, depreciations can be defined as the implicit costs, which do not represent the direct financial expenses of the farm. Therefore, it can be assumed that including the depreciations of animals into the costs of the basic herd takes into consideration the costs simultaneously invested into the farming of young animals in the given time period (Krupová et al. 2012b). Regarding the value of own feed costs, they should be calculated only in the own costs value for given plant commodities. Finally, it seems to be a very useful solution to optimize the value of own feed costs in animal production.

Profit in milk production ranged from –0.072 to 0.026 € per 1 kg of milk in the analyzed period. A higher variability in the profit value (+0.023 to –0.130 €) was published by Ubrežiová and Mihina (1995, 1998) and Chrastinová et al. (2011). This was mainly due to the higher variability of production and economic indicators in the analyzed herds. For example, the milk yield varied from 7.6 kg to 16.7 kg per FD (221%) and the costs ranged from 0.270 to 0.380 € per 1 kg of milk (141%) in these papers. Contrary, a lower variability was found in these traits (118% and 141%, respectively) for the farms analysed by the RIAP Nitra. Figure 1 shows the trend in market prices, costs and profitability per 1 kg of milk observed during the period 2007–2011.

Table 3. Determinants of competitiveness in milk production in cattle farms

Variable	Parameter	Coefficient	*p*-value
Intercept	β_0	–0.0963	< 0.0001
Total feed costs	β_1	–0.0606	< 0.0001
Material costs	β_2	0.0172	0.6152
Labour costs	β_3	–0.0740	< 0.0001
Repairs and services	β_4	–0.1388	0.0233
Depreciation	β_5	–0.0425	0.0010
Other direct costs	β_6	–0.0537	< 0.0001
Overhead costs	β_7	–0.0649	< 0.0001
Milk yield	β_8	0.0252	< 0.0001

Competitiveness, i.e. the profit in milk production was achieved in the years 2007 and 2008 (Figure 1). The highest profit (0.026 €/kg of milk) in 2007 was determined mainly by the level of milk price (0.356 €/kg of milk) along with the low value of unit costs (0.330 €/kg of milk), which is in agreement with the findings of Chrastinová et al. (2011). Generally, it was due to the global situation in the milk market. The higher value of milk price increased the surpluses in the market in 2008 and finally resulted in the formation of global surpluses of the milk commodity in 2009 and 2010. On the other hand, the stable demand for milk (153.2 kg/head) caused a sharp drop in milk prices in 2009 (–21%) and in 2010 (–18%) compared to the year 2008 (Chrastinová et al. 2011). In addition, the value of the milk yield decreased by 15.3 kg per 1 FD and the value of unit costs raised by 6% in 2010. Due to the combination of these factors, the loss (–0.071 €/kg) was reached in milk production in 2010. The introduction of the additional national direct payment per 1 dairy cow and the support per 1 dairy cow known as the "help in milk crisis" particularly compensated the negative situation in the Slovak dairy sector in 2010 (Krupová et al. 2012a, Michaličková et al. 2013). In 2011, the positive trend of milk prices (+27%) and of the milk yield per 1 cow (+6%) was negatively elimi-

nated by the higher value of costs per 1 kg of milk (+22%). The value of unit costs in milk production increased mainly due to the higher feed prices and the cancellation of the tax benefits for fuel which were implicated in the agriculture sector in the previous years. The price of fuel creates the predominant part of costs for grain (60%) and forage (30%) feeds. These costs represent 30% to 35% of the total costs in milk production (Krupová et al. 2012b). The combination of the above mentioned factors in 2011 led to the highest value of loss in milk production (–0.072 €/kg) over the analyzed period.

The negative relation to the competitiveness was observed for the feed costs, labour costs, repairs and service costs, depreciation, other direct costs and overheads in the given regression model (Table 3). Similarly as Schroeder (2012), we found that the value of competitiveness in milk production declines (by 0.061 €) when the feed costs increase by 1 €. The price of pastures and meadows used for grazing of cattle is included into the feed costs along with own and purchased feeds. Moreover, the negative influence of this factor on the competitiveness could indicate the inefficient utilization of feeds (the balance of feed mixture, losses at storage, substitution of feeds) or the inefficient utilization of their production potential in relation to the given output level i.e. the milk yield (Kuipers 1999; Mihina et al. 2006; Michaličková et al. 2013).

The existence of over-employment in the production process of the analyzed farms can be indicated as well. The increase of labour costs by 1 € reduced the competitiveness of milk production by 0.074 €. This finding is in agreement with the lower value of labour productivity in the EU member states where the large cooperatives are typical. For example, the results for the Slovak Republic show over 5200 € of the gross value added per 1 annual work unit in 2010. The appropriate value of this productivity indicator for the EU countries was about 13 000 € and for the EU 27 countries (mainly in Denmark, France, Germany, the Netherlands and the United Kingdom) this parameter of labour performance was higher than 40 000 €. Generally, there is a big difference between the Western and Eastern parts of Europe. The influence of the farm structure on labour productivity can be noted as well. Only the regions in the Central and Eastern Europe along with three regions in Portugal (Norte, Centro and Madeira) show a lower value than 5000 € of the gross value added per 1 annual work unit. Moreover, in most of the Eastern (and also in some Southern) member states, the average farm sizes is small, the level of mechanisation is low, and a significant part of production is used for the on-farm consumption (European Commission 2010). Therefore, in the analyzed farms, there are possibilities to improve the competitiveness of the dairy cattle sector through the participation of employees in the higher utilization of inputs and in the profit in the milk production, e.g. through the motivation system to achieve a higher labour productivity (Mihina et al. 2006; Michaličková et al. 2013).

Social costs based on the value of labour costs are included into the other direct costs. With increasing of other direct cost by 1 €, the competitiveness will be decreased by 0.054 € as well. The increase the value of funds on the repairs and services of the long term tangible property (e.g. machines and equipment) by 1 € decreased the competitiveness by 0.139 €. These costs are in the direct relation to the depreciation of the long term tangible property (depreciation costs). Although the depreciations are non-financial costs, their increase by 1 € declined the competitiveness by –0.043 €. Similarly, the increase of overheads by 1 € decreased the competitiveness of milk production by 0.065 €. The negative relation of overheads costs and competitiveness in milk production can be particularly based on the allocation coefficients of the indirect costs used in the economic practice. According to our best knowledge, the coefficients converting the animal category to livestock units (LU)[2] and the number of feeding days per the individual animal category should be taken into account for the allocation the overheads costs. Moreover, the value of overhead costs should not exceed 10% (7% for production and 3% for management overhead, respectively) from the direct costs in the given category of cattle (Krupová et al. 2012b).

A positive and statistically significant effect of the milk yield on the competitiveness value was found in the regression model (Table 4). The increase of the milk yield by 1 kg improved the profit by 0.025 € per kg of milk. The effective utilization of the production potential of animals reduced the unit costs and improved the economic results of dairy farm (Schroeder 2012; Szabó et al. 2012).

[2]Calves from birth till the age of 6 months 0.2 LU, young cattle from 6 to 24 months of age 0.6 LU, young cattle (bulls, heifers and steers) over 24 months of age 1.0 LU, suckler cow over 24 months of age 1.0 LU; more details are given in the Slovak Government Regulation No. 516/2010.

CONCLUSIONS

The results of our study confirm that the optimal relationship between the value of inputs and the milk yield is a useful tool to achieve the competitiveness in milk production. Considering the costs, they should be calculated only for the categories they belong to. The value of the individual costs items should be reasonably drawn with respect to the production and other economic indicators to reach the rational consumption of inputs. The main aim of the milk production efficiency should be based on the definition of the objective value of costs per one production unit. The value of costs should be decreased by 9% for the given milk yield (16.1 kg per 1 feeding day) and for the analyzed farms to achieve the balanced economic result (with direct subsidies). Contrary to the costs, the milk price could be less influenced by the farmers. It is formed in the markets (international and national) through the interaction of supply and demand. It should be more influenced by the negotiating power of farmers. Dairy farmers should promote higher market prices of milk for example by marketing associations. In the future, a detailed analysis should be focused on the interaction of biological and economic parameters in the dairy cattle sector.

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