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Evaluation of economic indicators for Czech dairy farms

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Abstract: Milk production is one of the most important areas of the Czech agrarian sector, as evidenced by its 50% share (at 2017 prices) in revenues from livestock production. As for any business, a certain level of profitability is a prerequisite for long-term and sustainable development of dairy farms. This study's aim was to evaluate the economic efficiency of milk production from both Czech Fleckvieh (C) and Holstein (H) cows based on data collected each year from 48 to 70 Czech dairy farms in the period from 2012 to 2017. Total costs per feeding day and litre of milk, level of profitability, and income over feed costs were calculated. The influences of herd size and milk yield on profitability and break-even points were examined while sensitivity analysis and model calculations were utilised to predict profitability. The farms with higher average milk yields (>7 500 and >9 500 L per lactation for C and H, respectively) had higher costs per feeding day, lower costs per litre of milk, and improved profitability ($p < 0.05$). Average break-even points were estimated for milk price (0.31 and 0.32 EUR) and milk yield (7 257 and 9 209 L) in C and H herds, respectively.

Keywords: break-even point; costs; milk; sensitivity analysis

The national dairy herd in the Czech Republic (CR) as of April 1, 2018 was 365 thousand cows, total milk production in 2017 was 2 998 million litres, and milk consumption per capita in 2017 was 246.5 kg. The average contribution of milk sales to the total revenues from livestock production amounted to 47% annually in the period from 2008 to 2017 (Czech Statistical Office 2018). Thus, milk production and dairy cow operations constitute one of the most important areas of the Czech agrarian sector. To maintain the current production level and to further develop the dairy herds, however, dairy farmers must achieve reasonable profitability over the long term.

Milk yield per cow is one of the main factors influencing the economics of dairy cattle production (Nemeckova et al. 2015; Krpalkova et al. 2016). High milk yields mean high incomes but might also contribute to poorer cow health and fertility and, as a result, to increased culling rate (Horvath et al. 2017a). The profitability of dairy farms also depends greatly on the reproductive efficiency of dairy cows and the optimal length of the calving interval (Dono et al. 2013). In addition, culling cows earlier or later than the optimal time reduces profitability (de Vries 2004) and thus is associated with the economic importance of cow longevity (Horvath et al. 2017b).

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The profitability of dairy operations is also greatly influenced by the volatility of input and output prices on agricultural markets (Heikkila et al. 2008), as well as by various subsidies (Zakova Kroupova 2016) intended to support agricultural production, preserve the landscape, utilise agricultural land, and promote economic growth (Sedlacek et al. 2012), by feed costs (Krpalkova et al. 2017), and by herd size (Mosheim and Lovell 2009; Krpalkova et al. 2016; Junge 2019).

The objectives of the present study were to analyse the economic parameters of milk production in the CR during the period 2012–2017, determine the relationships between production and economic results in dairy operations, and predict profitability using break-even points and sensitivity analyses.

MATERIAL AND METHODS

Data

Data were obtained from dairy cattle farms located in different regions of the CR for the period from 2012 to 2017 using a questionnaire structured in five parts: milk production, reproduction and herd turnover, subsidies, diet composition, and yearly costs. It contained a total of 62 questions that were modified between the years of evaluation only in relation to the changing rules for support payments received. For the individual years from 2012 to 2017, data were obtained from 48, 59, 64, 70, 69 and 68 commercial farms, respectively, having Czech Fleckvieh (C) or Holstein (H) cows. Only those farms providing data for at least 3 years of the observed period were included into the analysis. On average, data from 35 829 dairy cows were used each year, thus representing 10% of the Czech dairy cow population.

Methods

Costs and profits were determined in each year per feeding day (FD) and per litre of milk produced separately for farms with C and H cows. Total annual costs consisted of feed, labour, veterinary and breeding services, depreciation (assets and animals), and other costs (energy, overheads, insurance and repairs). The value of secondary outputs of animal production (i.e. of calves and manure) was deducted from total costs, which value was termed "costs after deduction"). Profit was determined as the difference between total milk revenues and total costs after deduction, and it was calculated both excluding subsidies and including net direct subsidies (voluntary coupled supports for cows with market milk production). Income over feed costs (IOFC) was calculated as the difference between total milk revenues and total feeding costs. Profitability was calculated as total profit inclusive of subsidies divided by total costs after deduction. Pooled data for the entire 2012–2017 period were used to examine the effects of herd size and milk yield on costs and profits separately for C and H farms.

The level of profitability in C and H herds was predicted using 8 different scenarios differing in assumed annual milk yield (6 000, 7 000, 8 000, or 9 000 L) and inclusion of subsidies (not included versus included).

A break-even point was calculated as a condition where the costs were equal to the revenues and there was zero profit (Strelecek and Kollar 2002). Break-even points were estimated for milk price, milk yield, total costs, and the level of subsidies. In addition, minimum parameter requirements were calculated for achieving 5 and 10% levels of profitability.

Sensitivity analysis was used to determine the potential effect of changes in different inputs on the overall economic result while holding constant the values of all other parameters (Giordano et al. 2011). It evaluated the effects of 20% changes in input parameters (milk price, milk yield, loss of calves, number of calves weaned, price of feed, labour costs, overhead and subsidies) on the total annual profit per cow.

Statistical analysis

The data were evaluated using a mixed linear model with repeated measures. Parameters were estimated by the REML (restricted maximum likelihood) method using a MIXED procedure in SAS (version 9.3; SAS Institute Inc., Cary, NC, USA). The model was structured to determine the fixed effect of milk yield, herd size, and year. The random effect of farm was also included and random (co)variances between years were summarised by residual R matrix. The autoregressive covariance structure of order 1 was found to be the most appropriate in accordance with the Akaike information criterion and Schwarz-Bayesian criterion (Littell et al. 2000). Least squares means were calculated and multiple comparisons were made, with p-values adjusted using Tukey's procedure.

Where appropriate, the following currency exchange rates corresponding to the average rates during the evaluation period were used: 1 EUR = 26.5 CZK, 1 EUR = 1.20 USD.

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Table 1. Basic indicators of farms evaluated

Item	Unit	2012	2013	2014	2015	2016	2017
Czech Fleckvieh cows							
Number of farms	n	17	20	22	29	26	27
Number of cows per farm	n	440	511	484	481	494	497
Annual milk yield	L	6 559	6 547	6 701	7 105	7 199	7 222
Price of milk	EUR/L	0.30	0.33	0.36	0.30	0.26	0.33
Holstein cows							
Number of farms	n	31	39	42	41	43	41
Number of cows per farm	n	616	588	604	634	621	642
Annual milk yield	L	8 676	8 595	8 939	9 247	9 466	9 566
Price of milk	EUR/L	0.29	0.32	0.35	0.29	0.25	0.32

Source: authors' calculations

RESULTS AND DISCUSSION

The number of farms providing data each year, basic production characteristics, and milk price development are given in Table 1. Across the analysed period, the average milk yield increased by approximately 10% for both C and H cows. As expected, the dual-purpose C cows produced less milk annually than did H cows but with higher contents of fat and protein. Annual milk prices fluctuated greatly around

Table 2. Costs and profit per litre of milk (L) and feeding day (FD) in Czech Fleckvieh cow farms (EUR)

Item	Unit	2012	2013	2014	2015	2016	2017	SEM
Feed costs	L	0.15	0.16	0.17	0.15	0.14	0.15	0.005
	FD	2.70	2.91	2.79	2.79	2.62	2.74	0.099
Labour costs	L	0.05	0.05	0.05	0.05	0.05	0.05	0.003
	FD	0.89	0.92	0.88	0.95	0.90	0.99	0.060
Veterinary and breeding costs	L	0.02	0.02	0.02	0.02	0.02	0.02	0.001
	FD	0.32	0.30	0.32	0.33	0.37	0.36	0.025
Depreciation	L	0.05	0.05	0.05	0.05	0.05	0.05	0.003
	FD	0.83	0.85	0.89	0.91	0.90	0.87	0.067
Other costs	L	0.09	0.09	0.09	0.09	0.09	0.09	0.007
	FD	1.70	1.60	1.65	1.72	1.64	1.61	0.142
Total costs	L	0.36	0.36	0.36	0.36	0.34	0.35	0.009
	FD	6.45	6.49	6.52	6.69	6.37	6.55	0.179
IOFC	L	0.15[b]	0.18[c]	0.21[d]	0.15[b]	0.12[a]	0.18[c]	0.006
	FD	2.67[b]	3.29[c]	3.92[d]	2.80[b]	2.20[a]	3.41[c]	0.114
Profit without subsidies	L	–0.04[ab]	–0.005[c]	0.03[d]	–0.04[b]	–0.06[a]	–0.001[c]	0.009
	FD	–0.78[ab]	–0.04[c]	0.55[d]	–0.71[b]	–1.17[a]	–0.01[c]	0.168
Profit including subsidies	L	–0.04[ab]	0.003[c]	0.04[d]	–0.02[b]	–0.04[a]	0.04[cd]	0.009
	FD	–0.64[ab]	0.09[c]	0.81[d]	–0.32[b]	–0.79[a]	0.66[cd]	0.171

[a, b, c, d] values with different superscripts differ significantly at $p < 0.05$; SEM – standard error of the mean; FD – feeding day; IOFC – income over feed costs

Source: authors' calculations

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Table 3. Costs and profit per litre of milk (L) and feeding day (FD) in Holstein cow farms (EUR)

Item	Unit	2012	2013	2014	2015	2016	2017	SEM
Feed costs	L	0.14	0.15	0.15	0.14	0.14	0.15	0.004
	FD	3.25[a]	3.42[ab]	3.54[b]	3.48[ab]	3.46[ab]	3.61[b]	0.099
Labour costs	L	0.05	0.05	0.05	0.05	0.05	0.05	0.003
	FD	1.07	1.06	1.09	1.12	1.15	1.16	0.060
Veterinary and breeding costs	L	0.02	0.02	0.02	0.02	0.02	0.02	0.001
	FD	0.49	0.48	0.48	0.51	0.46	0.49	0.025
Depreciation	L	0.05	0.05	0.05	0.05	0.05	0.05	0.002
	FD	1.17	1.10	1.08	1.10	1.16	1.19	0.057
Other costs	L	0.07	0.08	0.08	0.07	0.07	0.08	0.005
	FD	1.72	1.73	1.90	1.71	1.76	1.89	0.114
Total costs	L	0.33	0.34	0.36	0.33	0.33	0.35	0.009
	FD	7.74	7.81	8.11	7.94	7.95	8.34	0.186
IOFC	L	0.15[b]	0.18[c]	0.21[d]	0.15[b]	0.11[a]	0.18[c]	0.004
	FD	3.59[b]	4.14[c]	4.92[d]	3.58[b]	2.77[a]	4.43[c]	0.116
Profit without subsidies	L	–0.03[b]	0.002[c]	0.03[d]	–0.03[b]	–0.06[a]	0.002[bcd]	0.009
	FD	–0.59[b]	0.13[c]	0.72[d]	–0.51[b]	–1.37[a]	0.11[bcd]	0.199
Profit including subsidies	L	–0.02[ab]	0.01[c]	0.04[d]	–0.01[bc]	–0.04[a]	0.03[cd]	0.009
	FD	–0.46[ab]	0.25[c]	0.96[d]	–0.15[bc]	–1.01[a]	0.79[cd]	0.200

[a, b, c, d] values with different superscripts differ significantly at $p < 0.05$; SEM – standard error of the mean; FD – feeding day; IOFC – income over feed costs

Source: authors' calculations

their average levels of 0.314 and 0.305 EUR/L for the C and H herds, respectively, and the differences between the lowest and highest annual milk prices were 39 and 40% for C and H, respectively.

Costs and profits per litre of milk and per feeding day in different years

The costs for individual categories and total costs in the evaluated years are shown in Tables 2–3 on per litre milk and per feeding day bases. Feed costs constituted the major cost item every year (42 and 43% on average for C and H, respectively), which accords with previous studies analysing data for the CR (Nemeckova et al. 2015, Krpalkova et al. 2017) and for such neighbouring countries as Slovakia (Michalickova et al. 2014) and Germany (Junge 2019). Over the evaluated period, feed costs per FD increased in H herds by 11.1% ($p < 0.05$) whereas no such tendency was shown in C herds. The reason may be the higher proportion of concentrates used in H diets, the prices of which increased at a faster rate compared to the usually self-produced forage feeds. Due to increasing milk yields, however, only slight changes were observed in feeding costs per litre of milk. A similar pattern in herds of both breeds was seen for labour costs, which increased per feeding day over the analysed period as a result of wage growth across the economy but remained almost unchanged per unit of production due to the increasing average milk yields from cows.

Regardless of breed, the total costs averaged 0.345 EUR/L of milk (ranging from 0.334 to 0.349 EUR) and 7.4 EUR/FD (ranging from 7.1 to 7.7 EUR). The total costs per FD were higher in H compared to C herds (8.0 versus 6.5 EUR, respectively). When total costs were calculated per litre of milk, however, these were lower in H compared to C herds (0.34 versus 0.36 EUR, respectively) due to the higher milk yields from H cows. The numerically lowest total costs per unit of production were observed in 2016, in which year farmers were forced to cut expenses

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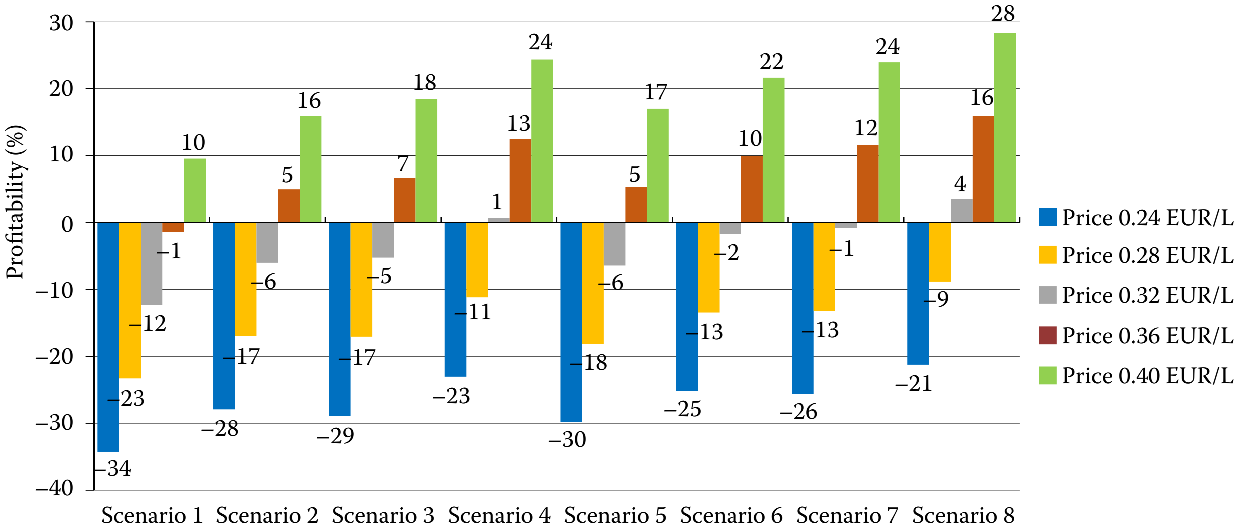

Figure 1. Model calculation of profitability of dairy cow farms

Scenario 1 – breed Czech Fleckvieh (C), milk yield 6 000 L, without subsidies; Scenario 2 – breed C, milk yield 6 000 L, including subsidies; Scenario 3 – breed C, milk yield 7 000 L, without subsidies; Scenario 4 – breed C, milk yield 7 000 L, including subsidies; Scenario 5 – breed Holstein (H), milk yield 8 000 L, without subsidies; Scenario 6 – breed H, milk yield 8 000 L, including subsidies; Scenario 7 – breed H, milk yield 9 000 L, without subsidies; Scenario 8 – breed H, milk yield 9 000 L, including subsidies

Source: authors' calculations

due to what was then termed a "milk crisis" caused by low purchase prices for milk.

Average total costs per litre of milk lower by 0.03 EUR compared to those of the present study had been reported earlier using data from the CR for the period 2004–2013 (Doucha et al. 2012). Lower costs per FD ranging from 5.6 to 7.5 EUR were reported in Slovakia for the period 2007–2011 (Michalickova et al. 2014), perhaps due to lower milk yields reflecting lower feed costs, which were 22% below those recorded in the present study. Average milk production costs observed for approximately 1 000 dairy farms in Schleswig-Holstein (Germany) from 2012 to 2017 were 0.07 EUR/L of milk greater than those in our study (Junge 2019).

Year-on-year fluctuation in milk prices was the cause of differences ($p < 0.05$) in IOFC indicators and in profits both without and including subsidies. The highest average profit was achieved in 2014, when the average milk price reached its maximum value.

A model calculation of profitability for C and H herds is shown in Figure 1. Eight scenarios at different levels of milk prices, milk yields, and subsidies availability were compared. The results show that negative profitability was observed when the milk price was lower than 0.28 EUR/L in all scenarios. At prices between 0.32 and 0.36 EUR/L, profits would have been achieved only at higher milk yields and with the inclusion of subsidies.

Cost and profitability depending on size of business and milk yield

Only small and insignificant differences were found in total costs per litre of milk and per FD between C herds differing in their size (Table 4). This may have been related to different annual average milk yields of 7 327, 6 931, and 6 635 L for herds with < 400, 400–550, and > 550 cows, respectively, that were included in the analysis. Although also not significant, the total costs per litre of milk were 0.02 EUR (7%) higher in the H herds with < 400 cows compared to those with > 800 cows. This is in agreement with the study by Krpalkova et al. (2016), who observed 13% higher costs in smaller herds (< 399 cows) compared to larger ones (> 750 cows) within the CR. As with the results we found for the H breed (Table 5), the differences were most pronounced in labour costs. Similarly, total costs per litre of milk were higher in the predominantly H herds with fewer cows in Turkey (20%; < 50 cows versus > 150 cows; Oguz and Yener

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Table 4. Economic indicators of Czech Fleckvieh cow farms as affected by herd size and milk yield (EUR)

Indicator	Unit	Cows (number)				Milk yield (L)			
		< 400	400–550	> 550	SEM	< 6 500	6 500–7 500	> 7 500	SEM
Number of farms	n	45	56	40	–	47	54	40	–
Feed costs	L	0.15	0.15	0.16	0.006	0.14	0.15	0.16	0.006
	FD	2.77	2.70	2.81	0.122	2.33[a]	2.76[b]	3.18[c]	0.108
Labour costs	L	0.05	0.05	0.05	0.004	0.06[a]	0.05[b]	0.05[ab]	0.004
	FD	0.95	0.96	0.85	0.080	0.90	0.88	1.00	0.065
Veterinary and breeding costs	L	0.02	0.02	0.02	0.002	0.019[b]	0.019[b]	0.015[a]	0.002
	FD	0.31	0.35	0.33	0.030	0.32	0.35	0.31	0.028
Depreciation	L	0.05	0.05	0.05	0.004	0.05	0.05	0.04	0.003
	FD	0.86	0.87	0.89	0.070	0.87	0.89	0.86	0.065
Other costs	L	0.09	0.09	0.10	0.009	0.10	0.09	0.08	0.007
	FD	1.69	1.54	1.73	0.170	1.64	1.67	1.65	0.142
Total costs	L	0.35	0.35	0.36	0.010	0.37	0.35	0.34	0.010
	FD	6.55	6.46	6.53	0.229	6.05[a]	6.56[b]	6.92[b]	0.199
IOFC	L	0.17	0.16	0.17	0.007	0.17	0.16	0.16	0.006
	FD	3.13	2.97	3.05	0.134	2.82[a]	3.06[b]	3.26[b]	0.123
Profit without subsidies	L	–0.01	–0.02	–0.02	0.011	–0.03	–0.02	–0.01	0.010
	FD	–0.24	–0.42	–0.42	0.202	–0.50	–0.35	–0.23	0.181
Profit including subsidies	L	0.002	–0.005	–0.005	0.011	–0.01	–0.002	0.01	0.010
	FD	0.07	–0.08	–0.08	0.204	–0.19	–0.02	0.13	0.184

[a, b, c, d] values with different superscripts differ significantly at $p < 0.05$; SEM – standard error of the mean; FD – feeding day; IOFC – income over feed costs

Source: authors' calculations

2017), Germany (23%; < 50 cows versus > 300 cows; Junge 2019), and the USA (29%; < 200 cows versus > 500 cows; USDA 2018).

The cost analysis revealed that increasing milk yields were associated with rising total costs per FD (correlation coefficient $r = 0.711$) but decreasing costs per litre of milk (correlation coefficient $r = -0.414$). In both breeds, the total costs per FD were lower ($p < 0.05$) in those herds with the lowest milk yields (< 6 500 L for C; < 8 500 L for H). The total costs per litre of milk were higher by 6.0% in the C herds yielding on average < 6 500 L of milk than in those yielding > 7 500 L of milk ($p = 0.18$), whereas these were higher by 6.9% in the H herds yielding < 8 500 L of milk compared to those yielding > 9 500 L of milk ($p < 0.05$). Daily revenues from milk sales increased with rising milk yields more rapidly than did daily feed costs, which was evidenced by higher IOFC per FD ($p < 0.05$) in both breeds. The results of this study indicate that higher milk yields improved the profitability of milk production due to lower unit costs and higher IOFC. This is in agreement with a number of previous studies. When the costs per litre of milk in predominantly H herds in the CR were compared, a difference of 9% was observed between herds with average milk yields < 7 500 L versus > 9 000 L (Krpalkova et al. 2016) and 22% between herds with average milk yields < 8 000 L versus > 9 500 L (Nemeckova et al. 2015). The cost difference observed in Germany between herds with milk yields of < 7 000 L versus yields of > 10 000 L was 17% (Junge 2019).

Break-even point analysis

The break-even points for annual milk yield per cow found in this study for the year 2017 were 7 257 L in C herds (Table 6) and 9 209 L in H herds (Table 7).

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Table 5. Economic indicators of Holstein cow farms as affected by herd size and milk yield (EUR)

Indicator	Unit	Cows (number)				Milk yield (L)			
		< 450	450–800	> 800	SEM	< 8 500	8 500–9 500	> 9 500	SEM
Number	n	83	103	51	–	67	84	86	–
Feed costs	L	0.14	0.15	0.14	0.006	0.15	0.14	0.14	0.004
	FD	3.29	3.48	3.61	0.144	3.20[a]	3.43[b]	3.74[c]	0.099
Labour costs	L	0.05	0.05	0.04	0.005	0.05	0.05	0.05	0.003
	FD	1.20	1.05	1.08	0.094	1.08	1.08	1.20	0.060
Veterinary and breeding costs	L	0.02	0.02	0.02	0.002	0.022[b]	0.021[b]	0.018[a]	0.001
	FD	0.50	0.49	0.47	0.039	0.49	0.49	0.47	0.026
Depreciation	L	0.05	0.05	0.05	0.003	0.05	0.05	0.05	0.002
	FD	1.13	1.07	1.20	0.070	1.07	1.14	1.20	0.055
Other costs	L	0.08	0.07	0.07	0.005	0.08	0.08	0.07	0.004
	FD	1.93	1.75	1.68	0.125	1.70	1.81	1.85	0.105
Total costs	L	0.35	0.33	0.32	0.012	0.35[b]	0.33[ab]	0.32[a]	0.008
	FD	8.07	7.83	8.05	0.260	7.55[a]	7.97[b]	8.43[c]	0.183
IOFC	L	0.16	0.16	0.17	0.006	0.16	0.16	0.16	0.004
	FD	3.82	3.74	4.15	0.173	3.51[a]	3.95[b]	4.26[c]	0.118
Profit without subsidies	L	–0.03	–0.01	0.002	0.012	–0.02	–0.01	–0.01	0.008
	FD	–0.62	–0.23	0.09	0.275	–0.46	–0.21	–0.10	0.194
Profit including subsidies	L	–0.02	0.002	0.01	0.012	–0.01	0.003	0.01	0.008
	FD	–0.30	0.09	0.40	0.277	–0.16	0.11	0.24	0.196

[a, b, c, d] values with different superscripts differ significantly at $p < 0.05$; SEM – standard error of the mean; FD – feeding day; IOFC – income over feed costs

Source: authors' calculations

In order to achieve 5 and 10% profitability, it would have been necessary to increase the annual milk yield per cow to 8 176 (+18%) and 9 224 L (+33%), respectively, in C herds, and to 10 359 (+14%) and 11 673 L

Table 6. Break-even point analysis and the requirements for 5 and 10% profitability on Czech Fleckvieh cow farms

Item	Profitability (%)	2012	2013	2014	2015	2016	2017	Total
Milk price (EUR/L)	0 (break-even)	0.33	0.34	0.33	0.32	0.31	0.30	0.32
	5	0.35	0.36	0.35	0.33	0.33	0.31	0.34
	10	0.37	0.38	0.36	0.35	0.34	0.33	0.35
Milk yield (L/cow/year)	0 (break-even)	8 656	6 876	5 426	8 239	10 990	5 658	7 257
	5	9 794	7 682	6 012	9 356	12 777	6 354	8 176
	10	11 117	8 592	6 661	10 651	14 958	7 131	9 224
Total costs (EUR/cow)	0 (break-even)	2 021	2 278	2 586	2 333	2 113	2 721	2 362
	5	1 930	2 177	2 470	2 228	2 019	2 599	2 256
	10	1 848	2 084	2 365	2 134	1 934	2 487	2 160
Subsidies (EUR/cow)	0 (break-even)	300	98	–	286	484	8	177
	5	407	207	–	402	599	125	290
	10	514	316	92	518	715	241	404

Source: authors' calculations

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Table 7. Break-even point analysis and the requirements for 5 and 10% profitability on Holstein cow farms

Items	Profitability	2012	2013	2014	2015	2016	2017	Total
Milk price (EUR/L)	0 (break-even)	0.32	0.32	0.32	0.30	0.30	0.29	0.31
	5	0.34	0.34	0.34	0.31	0.31	0.31	0.32
	10	0.35	0.35	0.36	0.33	0.33	0.32	0.34
Milk yield (L/cow/year)	0 (break-even)	10 797	8 639	7 384	9 747	14 021	7 513	9 209
	5	12 178	9 663	8 184	11 052	16 294	8 419	10 359
	10	13 775	10 825	9 072	12 565	19 077	9 432	11 673
Total costs (EUR/cow)	0 (break-even)	2 591	2 847	3 275	2 894	2 609	3 428	2 954
	5	2 473	2 718	3 126	2 763	2 492	3 272	2 820
	10	2 366	2 601	2 990	2 644	2 385	3 130	2 698
Subsidies (EUR/cow)	0 (break-even)	301	–	–	197	533	–	137
	5	437	188	–	338	676	95	279
	10	573	323	110	478	819	244	420

Source: authors' calculations

(+28%), respectively, in H herds. An increase in milk yield is associated with a proportional increase in variable costs (in particular for feeds) whereas fixed costs remain largely unchanged, thus generating economies of scale.

Break-even point fluctuated over the analysed period mainly due to year-to-year changes of milk purchase prices. In the years with high milk prices, the requirements for zero profitability were considerably lower. Therefore, whereas the break-even points for milk yield per year observed in C and H herds were only 5 426 and 7 384 L in 2014, markedly higher values of 10 990 and 14 021 L, respectively, were seen in the "milk crisis" year of 2016. These results were broadly in agreement with those of Krpalkova et al. (2017) who reported that the break-even points for milk yields based on the data from Czech farms over the period from 2006 to 2014 varied between 5 855 and 13 147 L per cow per year. The average break-even point for milk yield calculated for H herds from

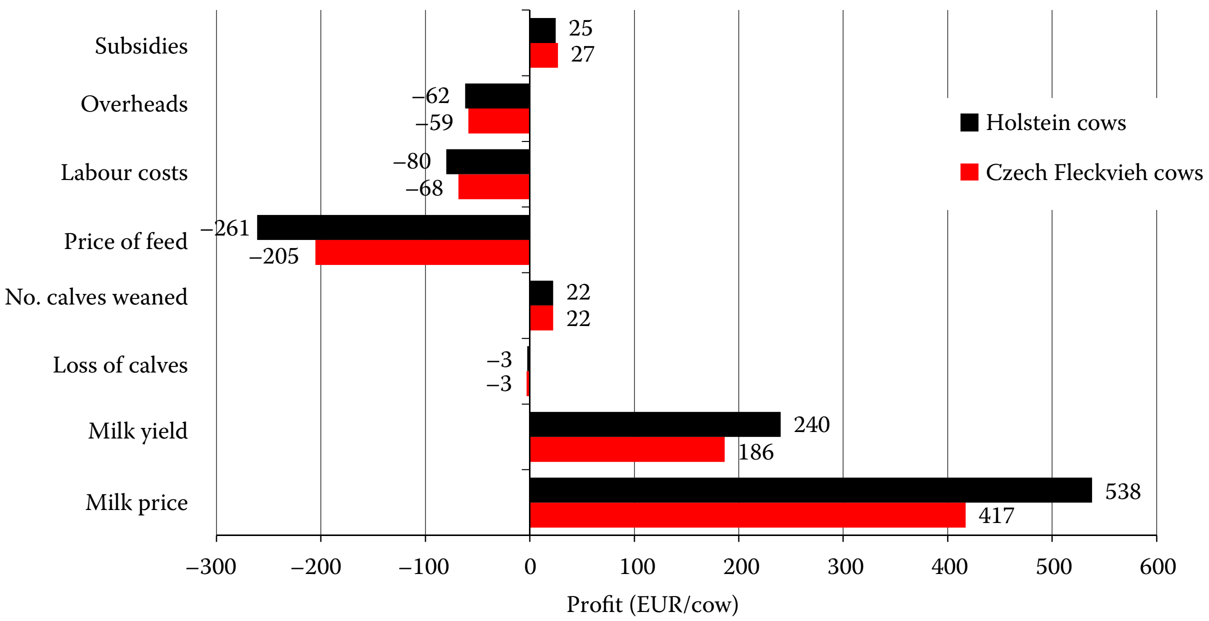

Figure 2. Sensitivity analysis – effect on profit of +20% change in various input values

Source: authors' calculation

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southern Hungary over the period from 2006 to 2014 was 8 439 L (Horvath et al. 2017b). The most successful year in terms of profitability was that of 2014, when the break-even points for total costs were higher than the costs actually incurred in both C and H farms and the 5% profit was generated even without including subsidies. In the other years, however, a certain level of subsidies was a prerequisite for achieving profitability.

Sensitivity analysis

The sensitivity analysis allows evaluating the impact of changes in input values on the overall profitability of dairy cattle operations (de Vries 2006; Giordano et al. 2011). In this study, the sensitivity analysis revealed that over the analysed period the profitability was mainly influenced by the milk price at both C and H farms (Figure 2). This result coincides with the outcomes of sensitivity analyses conducted by Heikkila et al. (2008) and Krpalkova et al. (2017). In other studies, however, milk yield was determined to be the most important factor (de Vries 2006). In our study, an increase in milk yield of 20% increased profitability on average by 8%. Based on this model, an increase in milk yield by 1 000 L would increase the profit by 0.02 EUR/L, i.e. 133 EUR/cow/year. In the present study, feed costs were the most sensitive cost item, which is consistent with most previous studies (Michalickova et al. 2014; Krpalkova et al. 2017).

CONCLUSION

As in any other type of business, a primary goal of every dairy farmer is to achieve a profit by maximising sales at a minimum cost level. However, it is necessary to take into account that, in some cases, the effort to lower costs may reduce the milk yield or deteriorate reproduction parameters in the herd. Due to the unstable situation on world milk and dairy product markets, significant fluctuation over time exists in the purchase prices paid for milk. As a result, and despite farmers' efforts to produce milk as efficiently as possible, the profitability is greatly variable and low milk prices often result in economic losses for dairy cow operations. The results of this study revealed marked differences between individual years of the analysed period in terms of profitability levels and break-even points at which total costs were covered by total revenues. The sensitivity analysis identified milk prices, milk yields, and feed costs as the main factors influencing profitability.

REFERENCES

Czech Statistical Office (2018): Statistical Yearbook of the Czech Republic – 2018. Available at https://www.czso.cz/csu/czso/statistical-yearbook-of-the-czech-republic-2018 (accessed Oct 8, 2018).

de Vries A. (2004): Economics of delayed replacement when cow performance is seasonal. Journal of Dairy Science, 87: 2947–2958.

de Vries A. (2006): Economic value of pregnancy in dairy cattle. Journal of Dairy Science, 89: 3876–3885.

Dono G., Giraldo L., Nazzaro E. (2013): Contribution of the calving interval to dairy farm profitability: results of a cluster analysis of FADN data for a major milk production area in southern Italy. Spanish Journal of Agricultural Research, 11: 857–868.

Doucha T., Foltyn I., Humpal J. (2012): Profitability of dairy and suckler cows breeding on Czech farms. Agricultural Economics – Czech, 58: 397–408.

Giordano J.O., Fricke P.M., Wiltbank M.C., Cabrera V.E. (2011): An economic decision-making support system for selection of reproductive management programs on dairy farms. Journal of Dairy Science, 94: 6216–6232.

Heikkila A.M., Nousiainen J.I., Jauhiainen L. (2008): Optimal replacement policy and economic value of dairy cows with diverse health status and production capacity. Journal of Dairy Science, 91: 2342–2352.

Horvath J., Toth Z., Miko E. (2017a): The analysis of production and culling rate with regard to the profitability in a dairy herd. Advanced Research in Life Sciences, 1: 48–52.

Horvath J., Tóth Z., Miko E. (2017b): The economic importance of productive lifetime in dairy cattle breeding. Agricultural Management, 19: 73–78.

Junge I. (2019): Ergebnisse der Vollkostenauswertung der Rinderspezialberatungsringe in Schleswig-Holstein. Available at https://www.lksh.de/fileadmin/dokumente/AADownloadcenter/Archiv_Tier/Rinderreporte/Rinder-Report_2018.pdf (accessed May 9, 2019).

Krpalkova L., Cabrera V.E., Kvapilik J., Burdych J. (2016): Dairy farm profit according to the herd size, milk yield, and number of cows per worker. Agricultural Economics – Czech, 62: 225–234.

Krpalkova L., Syrucek J., Kvapilik J., Burdych J. (2017): Analysis of milk production, age at first calving, calving interval and economic parameters in dairy cattle management. Mljekarstvo, 67: 58–70.

Littell R.C., Pendergast J., Natarajan R. (2000): Modelling covariance structure in the analysis of repeated measures data. Statistics in Medicine, 19: 1793–1819.

Michalickova M., Krupova Z., Polak P., Hetenyi L., Krupa E. (2014): Development of competitiveness and its deter-

https://doi.org/10.17221/136/2019-AGRICECON

minants in Slovak dairy farms. Agricultural Economics – Czech, 60: 82–88.

Mosheim R., Lovell C.A.K. (2009): Scale economies and inefficiency of US dairy farms. American Journal of Agricultural Economics, 91: 777–794.

Nemeckova D., Stadnik L., Citek J. (2015): Associations between milk production level, calving interval length, lactation curve parameters and economic results in Holstein cows. Mljekarstvo, 65: 243–250.

Oguz C., Yener A. (2017): Economic analysis of dairy cattle enterprises: The case of Konya Province. The Journal of Mendel University in Brno, 9: 263–273.

Sedlacek J., Kourilova J., Psencik J. (2012): Models of the realistic reporting of subsidies in the farm accounting. Agricultural Economics – Czech, 58: 34–40.

Strelecek F., Kollar P. (2002): Searching the proportional level of operating costs –specification of the minimum volume of production. Agricultural Economics – Czech, 48: 106–116.

USDA (2018): Milk Cost of Production Estimates. USDA. Available at https://www.ers.usda.gov/data-products/milk-cost-of-production-estimates (accessed Oct 5, 2018).

Zakova Kroupova Z. (2016): Profitability development of Czech dairy farms. Agricultural Economics – Czech, 62: 269–279.

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