Economic weights of production and functional traits in dairy cattle under a direct subsidy regime

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ABSTRACT: Economic weights (EW) for the Slovak dairy production system were calculated in Holstein, Slovak Simmental, and Slovak Pinzgau breeds under a direct support regime using a bio-economic approach. EW were calculated for three scenarios (A: without agricultural subsidies; B: agricultural subsidies included in revenues and C: agricultural subsidies included in feeding costs). Quota-free milk production was assumed in all scenarios. The base price of milk was corrected according to real fat, protein and somatic cell content. Under the given economic and production conditions, only the Holstein system in scenario A was economically profitable. All simulated systems were profit-making when agricultural subsidies were taken into account (B and C). No influence of subsidies on EW of traits in scenario B was found. Most of the evaluated traits (especially milk and functional traits) showed higher marginal economic weights when subsidies were considered in feeding costs (C). Regardless of the scenarios, milk components were of higher relative economic importance for Holstein cattle than for Slovak Simmental and Slovak Pinzgau cattle. The relative EW of mature weight of cows and daily gain of calves mostly declined in scenario C. A meaningful effect of direct subsidy and milk production level on the economic efficiency of Slovak Simmental and Slovak Pinzgau cattle was found. Handling direct subsidy in scenario C seems to be suitable methodology to avoid the underestimation of EW for milk and functional traits.

Keywords: dairy cattle; economic value; support regime; production traits; functional traits

Economic weights for dairy production systems using a bio-economic model were calculated recently (Koenen et al., 2000; Pärna et al., 2002; Vargas et al., 2002; Wolfová et al., 2007a). A strong impact of milk pricing system, quotas and production conditions on economic efficiency of dairy systems and on economic importance of evaluated traits was shown in many articles (Gibson, 1989; Groen, 1989; Harris and Freeman, 1993; Wolfová et al., 2001; Vargas et al., 2002; Kahi and Nitter, 2004; Wolfová et al., 2007a,b). In beef cattle some papers indicated a marketable impact of subsidies on profitability as well on the level of economic weights. The impact of subsidies on the economic value depended on how subsidies were connected with the production level, i.e. with the number of animals and milk yield (Krupa et al., 2005; Wolfová et al., 2006).

In Slovak conditions, economic values of milk production traits (Peškovičová et al., 1997; Huba et al., 2004) and of a complex of traits (Krupová et al., 2007) for dairy cattle were calculated for a system with and without quotas. A direct support per milk production was incorporated in these calculations.

No subsidies connected with production were provided to dairy farms in Slovakia in 2006. Only farmers received direct supports per agricultural land. In compliance with EC Regulation No. 1257/1999 (1999) agricultural subsidies covered single area payments (SAPs), support per crops grown on arable land (wheat, barley, oat, soya, rape, etc.) and support for less-favoured areas (LFA). LFA and other handicapped areas (mountain areas, low production soils, soils with specific disadvantages, etc.) covered 50% of agricultural land in Slovakia. The milk payment system varies in Slovak conditions to a large extent. The base price for milk with standardised fat and protein content is frequently established. The standardised milk content of realised milk is determined according to EC Regulation No. 853/2004 (2004), individual requirements of Slovak dairy industries and agreement between producers and manufacturing organizations. Dairy Holstein, dual-purpose Slovak Simmental and Slovak Pinzgau cattle mainly participate in milk production in Slovakia.

The aim of this study was: (a) to propose an approach for including direct subsidies in calculations of economic weights, (b) to compare the economic efficiency and economic weights of traits under different methods of including direct subsidies in a profit function. Analyses were provided for purebred Holstein, Slovak Simmental and Slovak Pinzgau cattle under Slovak conditions in 2006.

MATERIAL AND METHODS

Economic weights were calculated for purebred Holstein, Slovak Simmental and Slovak Pinzgau cattle (both dual-purpose). A classical indoor production system with milk production in a loose housing system, integrated intensive indoor fattening of surplus progeny and selling of surplus pregnant breeding heifers was assumed. Management of the system, production and reproduction traits of the respective breeds characterised in Slovak conditions in 2006 were applied.

Markov chain methodology (Reinsch and Dempfle, 1998) was used to calculate the herd dynamics and to derive the stationary state of the herd. Basic description of the program package, methodology used for the calculation of economic weights and explicit definition of the evaluated traits were summarised by Wolfová et al. (2007a) and Wolf et al. (2007).

A deterministic and stochastic approach was used in the model. Most of the traits were defined in average population values, but normal distribution

Table 1. Mean values and genetic standard deviations (GSD) of some traits for Holstein (H), Slovak Simmental (S) and Slovak Pinzgau (P) cattle

Trait	Breed					
	H		S		P	
	mean	GSD	mean	GSD	mean	GSD
Average milk yield per lactation (kg)	7 691	620	5 035	450	4 195	345
Milk fat content (%)	3.84	0.22	4.10	0.23	4.02	0.22
Milk protein content (%)	3.20	0.090	3.36	0.11	3.36	0.09
Somatic cell score	4.72	0.085	4.72	0.086	4.72	0.85
Calving performance (score)	1.29	0.06	1.26	0.05	1.26	0.05
Losses of calves at calving (%)	7.10	2.50	5.18	2.10	5.17	2.10
Losses of calves until weaning (%)	9.3	2.00	9.60	2.00	9.81	2.00
Productive lifetime of cows (years)	3.19	0.30	3.22	0.30	3.25	0.30
Birth weight of calves[1] (kg)	37	1.60	38	1.60	32	1.60
Mature weight of cows (kg)	635	17.50	615	17.50	580	17.50
Daily gain of calves in rearing[1] (g/day)	800	60	720	60	600	60
Daily gain in fattening[1] (g/day)	850	47	900	47	800	47
Dressing percentage[1] (%)	51	1.14	53	1.14	52	1.14
Carcass conformation[1] (class)	5.10	0.03	4.23	0.03	4.76	0.03
Fatness[1] (class)	3.12	0.02	2.62	0.02	2.76	0.02

[1]average values for female progeny

(variation) was supposed for some traits. Milk yield, fat content, protein content, and somatic cell score (*SCS*) were defined in average values and standard deviations. Likewise, the distribution of purebred dairy progeny over the individual commercial classes was simulated for carcass conformation (fleshiness) and fatness (fat covering) traits.

Economic weights were calculated for 17 traits which can be divided into four groups. Milk production traits were 305-day milk yield, milk fat content and milk protein content. Functional traits were calving performance, losses of calves at calving, losses of calves from 48 h of age until weaning, conception rate of heifers, conception rate of cows, productive lifetime of cows and somatic cell score. Productive lifetime of a cow was specified by the longevity of a cow in reproduction (from the first calving to culling or death of a cow). Somatic cell score (*SCS*) was calculated as the logarithm function of the average number of somatic cell count (*SCC*) in ml of milk:

$$SCS = \log_2\left(\frac{SCC}{100\,000}\right) + 3$$

Growth traits were birth weight of calves, mature weight of cows, average daily gain of calves in rearing, average daily gain in the fattening period. Carcass traits were dressing percentage, average class for carcass conformation and fatness. In the used carcass grading system, 6 classes for carcass conformation (SEUROP, S is the best class) and 5 classes for fatness (from 1 to 5) were specified. Level and genetic standard deviations of traits used for calculations are summarised in Table 1. Some values of genetic standard deviations were unavailable for the local populations; therefore, the values cited by Wolfová et al. (2007a) were applied.

Economic efficiency of the production system was calculated as the difference between total revenues and total costs per cow and year at the stationary herd structure. Total profit (*TP*) was calculated as the function of row vectors of revenues (*rev'*) and

Table 2. Basic input variables for the calculation of revenues for Holstein (H), Slovak Simmental (S) and Slovak Pinzgau (P) cattle

Variable	Values[1]		
	H	S	P
Number of milk quality classes according to *SCC*[2]		3	
Upper limit for *SCC* in class 2 (*SCC*/ml milk)		300 000	
Upper limit for *SCC* in class 3 (*SCC* /ml milk)		400 000	
Basic price for milk volume (cent[3]/kg)		25.21	
Bonus for milk fat content (cent/% fat)		1.34	
Bonus for milk protein content (cent/% protein)		2.68	
Fixed price for milk quality class 3 according to *SCC* (cent/kg)		18.74	
Price for carcass weight in the basic class[4] (EUR/kg)			
Bulls	3.03	2.95	2.87
Heifers	2.23	2.36	2.28
Cows	2.15	2.09	1.93
Price of pregnant breeding heifers (EUR/kg live weight)	2.55	2.66	2.55
Price of male breeding calf sold to the test station (EUR/animal)	429.55	429.55	335.59
Price for dung (EUR/100 kg)		0.54	

[1]the value is given in one column when valid for all breeds
[2]*SCC* = somatic cell count
[3]100 cents = 1 EUR = 37.248 SKK (average exchange rate for the year 2006)
[4]S1 is the basic class for carcass quality

costs (*cost'*) per each category of animals and column vectors of the number of discounted expressions of revenues ($NDE^{(rev)}$) and costs ($NDE^{(cost)}$) as was defined by Wolfová et al. (2007a):

$$'P = rev' \times NDE^{(rev)} - cost' \times NDE^{(cost)} + \text{Subsidies}$$

All revenues and costs (occurring in cows and progeny in one year period) were discounted to the date of calving. The *NDE* included only one generation of progeny.

Revenues came from realised breeding heifers and bulls, fattened bulls, slaughtered cows and heifers, sold milk and manure. The sales price of animals depended on live weight at slaughter, dressing percentage, price per kg of carcass body based on the SEUROP grading system. Revenues from realised milk were calculated according to milk production (kg/cow/year) and average price per kg of milk. In the model, the base price 25.39 cents/kg was paid for standardised milk with fat content 3.3–3.6%,

Table 3. Basic input variables for the calculation of costs in Holstein (H), Slovak Simmental (S) and Slovak Pinzgau (P) cattle

Variable	Values[1]		
	H	S	P
Price of semen from AI (EUR[2]/insemination dose)	6.71	5.37	5.37
Maximum number of inseminations per cow/heifer		6/5	
Number of reinseminations		1	
Costs of removing a dead animal (EUR/animal)			
Mature animal	143.77	142.00	132.28
Young animal	83.39	81.67	71.87
Costs of veterinary treatment			
Cows (EUR/animal per reproduction cycle)	55.28	33.80	44.31
Reared calves (EUR/animal from the end of calf rearing to calving)	6.20	4.27	4.83
Breeding heifers (EUR/animal to calving)	24.40	24.38	28.00
Fattened bulls and heifers[3] (EUR/animal in fattening period)	12.23	11.44	11.83
Cost of dystocia (EUR/calving)			
Calving score 3[4]		26.42	
Calving score 4[4]		48.70	
Fixed costs[5] (EUR/animal per day)			
Cows	1.94	1.84	1.63
Reared calves	0.59	0.51	0.54
Breeding heifers	0.59	0.75	0.44
Fattened bulls and heifers[3]	0.73	0.68	0.67
Price for water (cents[2]/100 l)		8.05	
Price for straw for bedding (EUR/100 kg)		1.34	
Annual discount rate		0.025	

[1]value is given in one column when valid for all breeds
[2]100 cents = 1 EUR = 37.248 SKK (average exchange rate for the year 2006)
[3]cost of fattened animal is the average value of costs for bulls and heifers
[4]calving score 3 – calving with veterinary assistance, calving score 4 – calving with caesarean section
[5]fixed costs included labour, energy, fuels, reparations, insurance, interest on investments and overhead costs

protein content 2.8–3.2% and 300 000–400 000 SC per ml of milk. Bonuses 1.34 cents and 2.68 cents per each percent (10 g/kg) of milk fat and proteins were paid when the content was above the threshold value 3.6% for fat and 3.2% for proteins. A bonus 2.68 cents per kg of milk was paid when *SCC* was up to the value 300 000. The base price decreased by 26% when milk components did not reach the values 3.3% for milk fat content, 2.8% for milk protein content and *SCC* got over 400 000 cells/ml. Quota-free milk and milk fat production were assumed in the simulations. Price differences among SEUROP carcass classes and milk quality classes were taken over from the Agricultural Paying Agency for the year 2006.

Costs of housing, feeding, breeding, veterinary treatment and fixed costs (labour, energy, reparations, insurance, fuel, overhead) were calculated for each category of animals. Feeding costs were calculated according to the daily energy and protein requirement of each category; feeding ratios were calculated in Feedman program (Petrikovič et al., 2003). Purchasing prices for forages were taken over from the Agricultural Paying Agency and our own investigations. Breeding costs were connected with performance of artificial insemination. Costs parameters were taken over from Kubanková and Burianová (2007) and our own investigations. Input variables for calculations of revenues and costs in all scenarios are listed in Tables 2 and 3.

In calculations, the following scenarios of including subsidies per agricultural land in the profit function were applied:

Table 4. The cow herd structure (% of cows on each lactation) for Holstein (H), Slovak Simmental (S) and Slovak Pinzgau (P) cattle

Lactation	H	S	P
1	31.32	31.02	30.74
2	22.10	22.13	22.02
3	15.11	11.16	11.16
4	10.48	8.87	8.90
5	7.26	7.14	7.18
6	5.03	5.74	5.80
7	3.48	4.62	4.68
8	2.41	3.77	3.83
9	1.66	3.06	3.13
10	1.15	2.49	2.55

(A) – no agricultural subsidies included
(B) – addition of agricultural subsidies to total revenues
(C) – inclusion of agricultural subsidies in the costs of feed production

Agricultural subsidies covered the SAPs support (66.65 EUR/ha) and support per crops grown on arable land (58.87 EUR/ha) which was the same for all breeds. Support values for LFA varied among breeds and were as follows: 26.85 EUR/ha for Holstein, 67.12 EUR/ha for Slovak Simmental and 107.39 EUR/ha for Slovak Pinzgau cattle. In scenario B, the total direct support of 139.26 EUR, 282.07 EUR and 321.80 EUR for Holstein, Simmental and Pinzgau cows, respectively, were added to the total revenues in each breed. In scenario C the support per each ha of crop was recalculated according to crop yield per ha (Kubanková and Burianová, 2007) to the support per kg of fresh matter of each crop. The actual costs per kg of fresh matter of crops were then lowered by the support per kg of crops.

The marginal economic weights l (ev_l), $l = 1,\ldots, L$ were calculated as partial derivations of the profit function (Wolfová et al., 2007a) with respect to trait l as follows:

$$ev_l = \frac{\Delta profit_l}{\Delta_l}$$

where:
l = the number of traits

All economic weights were expressed in Euro per unit of a trait, per cow and year.

The marginal economic weights of each trait were multiplied by genetic standard deviation of the trait (standardisation) and consequently expressed as the proportion of the standardised value of 305-day milk yield (in %). Economic weights were derived using the program ECOWEIGHT, version 3.0.1 module EWDC written by Wolf et al. (2007).

RESULTS AND DISCUSSION

The cow herd structure for individual breeds is shown in Table 4. The average number of calvings per cow ranged from 3.19 for Holstein to 3.25 for Slovak Pinzgau cattle, which is close to the interval 2.80 to 3.46 lactations reported for Slovak dairy farms in 2006 (http://www.pssr.sk/download/RocenkaHD05-06.pdf, accessed on November 24, 2008).

Table 5. The economic efficiency of systems simulated for Holstein (H), Slovak Simmental (S) and Slovak Pinzgau (P) cattle

Economic variable	Scenario A[1]			Scenario B[1]			Scenario C[1]		
	H	S	P	H	S	P	H	S	P
Total revenues[2] (EUR[3])	1 677.60	1 385.61	1 150.76	1 816.86	1 667.68	1 472.56	1 677.60	1 385.61	1 150.76
Total cost[2] (EUR)	1 546.49	1 614.19	1 408.63	1 546.49	1 614.19	1 408.63	1 407.23	1 332.12	1 086.83
Profit (EUR)	131.11	−228.58	−257.87	270.37	53.49	63.93	270.37	53.49	63.93
Profitability[4] (%)	8.50	−14.20	−18.30	17.48	3.31	4.54	19.20	4.00	5.90
Revenues for milk[5] (EUR)	1 415.97	1 050.64	879.01	1 415.97	1 050.64	879.01	1 415.97	1 050.64	879.01
Average costs of nutrition[6] (EUR)									
Cows (EUR/animal/reproduction cycle)	448.69	441.02	401.58	448.69	441.02	401.58	354.44	267.60	187.90
Reared calves (EUR/animal to the end of rearing period)	56.45	54.87	44.75	56.45	54.87	44.75	51.83	47.33	36.73
Breeding heifers (EUR/animal to calving)	182.85	217.42	217.45	182.85	217.42	217.45	141.65	119.56	113.23
Fattened bulls and heifers[7] (EUR/animal)	314.55	344.42	368.44	314.55	344.42	368.44	242.50	206.24	231.65

[1]scenario A: no agricultural subsidies included; scenario B: adding the agricultural subsidies to total revenues; scenario C: including agricultural subsidies in the costs of feed production

[2]total revenues and total cost per cow included progeny born per year and are discounted to the calving date

[3]1 EUR = 37.248 SKK (average exchange rate for the year 2006)

[4]profitability is expressed as the proportion of profit in total costs given in per cent

[5]revenues for milk per cow and year are not discounted to the date of calving

[6]average costs of nutrition (cost of feed and water) calculated per animal in individual categories are not discounted to the date of calving

[7]cost of fattened animal is an average value of costs for fattened bulls and heifers

The economic parameters (total costs, total revenues, total profit and profitability) of simulated systems are listed in Table 5. Including subsidies in the revenues (scenario B) all costs remained the same. When crop subsidies were included in the feed costs (scenario C), overall nutrition costs fell down for all breeds. The biggest decline in nutrition costs was found for Slovak Pinzgau cattle (18–53% reduction among individual categories) kept in upland regions, where subsidies reached the highest values. A reduction in nutrition costs for Holstein cattle and Slovak Simmental ranged from 8 to 24% and from 14 to 46% among individual cattle categories (calves, heifers, bulls, and cows). The lowest reduction in nutrition costs (Table 5) was found for calves in the first period of rearing as feeding was based on expensive milk replacement (not influenced by subsidies).

Under the given economic conditions, only the Holstein system was economically profitable without subsidies (scenario A). This was in spite of the fact that total costs for Slovak Simmental and Slovak Pinzgau breeds were similar to total costs for Holstein cattle. However, lower revenues caused especially by lower milk production led to negative economic efficiency for the Simmental and Pinzgau population in scenario A. All simulated systems were profitable when subsidies were taken into account (scenario B and C). The meaningful impact of subsidies value on the economic efficiency of Slovak farms was also determined by Daňo et al. (2001), Bielik and Sojková (2006).

Most of the revenues in each breed came from milk realisation (Table 5). It is in agreement with findings of Visscher et al. (1994), Vargas et al. (2002) and Pärna et al. (2005), who reported in-

Table 6. Marginal economic values of traits (in EUR[1] per unit of the trait and per cow and year) for Holstein (H), Slovak Simmental (S) and Slovak Pinzgau (P) cattle

Trait	Scenario A[2] and B[2]			Scenario C[2]		
	H	S	P	H	S	P
305 days milk production (kg)	0.117	0.123	0.122	0.125	0.142	0.147
Fat content in milk (%)	189.84	75.14	75.53	196.10	83.92	85.78
Protein content in milk (%)	200.93	93.66	77.58	204.51	100.66	86.37
Somatic cell score	–338.88	–250.84	–209.96	–338.88	–250.84	–209.96
Calving performance (score)	–189.41	–214.96	–173.17	–206.49	–248.39	–217.57
Losses of calves at calving (%)	–1.01	–0.70	–0.61	–1.42	–1.41	–1.47
Losses of calves until weaning (%)	–1.59	–1.14	–1.20	–2.01	–2.07	–2.16
Conception rate of heifers (%)	1.45	1.37	1.32	1.42	1.30	1.25
Conception rate of cows (%)	11.74	8.55	11.93	11.96	8.75	12.58
Lifetime of cows (years)	111.84	112.92	96.63	115.19	117.42	105.43
Birth weight of calves (kg)	0.59	0.94	0.53	0.66	1.12	0.79
Mature weight of cows (kg)	–0.52	–0.75	–0.65	–0.38	–0.42	–0.28
Daily gain of calves in rearing (g/day)	0.26	0.47	0.40	0.24	0.40	0.31
Daily gain in fattening (g/day)	0.07	0.06	0.05	0.06	0.06	0.04
Dressing percentage (%)	3.97	4.63	3.62	3.97	4.63	3.62
Carcass conformation (per class)	–29.08	–20.16	–13.80	–29.08	–20.16	–13.80
Fatness (per class)	–1.91	–6.25	–3.21	–1.91	–6.25	–3.21

[1]1 EUR = 100 cents = 37.248 SKK (average exchange rate for the year 2006)

[2]scenario A: no agricultural subsidies included; scenario B: adding the agricultural subsidies in total revenues; scenario C: including agricultural subsidies in the costs of feed production

comes from realised milk from 83.4 to 94.8%. The average price per kg of milk calculated in our simulations was 24.54 cents for Holstein, 25.85 cents for Slovak Simmental and 25.64 cents for Slovak Pinzgau breed. Similarly to our results, Wolfová et al. (2007b) found that the higher milk price for dual-purpose cattle (Czech Fleckvieh) was nullified by lower milk production of this breed and consequently the breed reached lower profitability in comparison with Holstein cattle.

The marginal economic weights calculated for 17 traits are presented in Table 6. The addition of subsidies to total revenues (scenario B) did not change the economic weights of evaluated traits. Therefore these weights were the same as in scenario A (calculated without subsidies). Calf losses at calving and calf losses in the rearing period obtained negative economic weight, which was caused by positive economic efficiency of the following categories (e.g. fattened bulls, reared breeding heifers). Economic weights for milk yield and fat content were calculated assuming no quotas and additional costs were effectively compensated by the price bonus (1.34 and 2.68 cents/% fat and protein) in our simulations. Negative values for milk components were reported in literature, when inadequate bonuses were paid (Wolfová et al., 2007a) or no penalization was applied for non-standard milk (Krupová et al., 2007).

In our simulations the economic importance of evaluated traits depended on individual breeds and mean values of the trait in the population. Milk production had similar marginal importance among all breeds in scenario A and B, but in scenario C it had higher importance for breeds with a lower level of milk production (Simmental and Pinzgau). On the contrary, milk components were economically more important for Holstein cattle in all scenarios.

Table 7. Relative economic values of traits (in percent of standardized economic value of 305 day milk yield) for Holstein (H), Slovak Simmental (S) and Slovak Pinzgau (P) cattle

Trait	Scenario A and B[1]			Scenario C[1]		
	H	S	P	H	S	P
Average milk yield	100.0	100.0	100.0	100.0	100.0	100.0
Milk fat content	57.6	31.2	39.6	55.7	30.3	37.2
Milk protein content	24.9	18.6	16.6	23.8	17.4	15.3
Somatic cell score	–39.7	–38.9	–42.5	–37.2	–33.8	–35.2
Calving performance	–15.7	–19.4	–20.6	–16.0	–19.5	–21.5
Losses of calves at calving	–3.5	–2.7	–3.0	–4.6	–4.7	–6.1
Losses of calves until weaning	–4.4	–4.1	–5.7	–5.2	–6.5	–8.5
Conception rate of heifers	3.0	3.7	4.7	2.7	3.1	3.7
Conception rate of cows	32.4	30.8	56.8	30.9	27.4	49.6
Productive lifetime of cows	46.3	61.1	69.1	44.7	55.3	62.4
Birth weight of calves	1.3	2.7	2.0	1.4	2.8	2.5
Mature weight of cows	–12.5	–23.8	–27.0	–8.6	–11.6	–9.6
Daily gain of calves in rearing	21.4	50.9	56.9	18.4	37.7	37.2
Daily gain in fattening	4.5	5.5	5.8	3.9	4.1	4.2
Dressing percentage	6.2	9.5	10.0	5.9	8.3	8.1
Carcass conformation	–1.2	–1.1	–1.0	–1.1	–0.9	–0.8
Fatness	–0.1	–0.2	–0.2	0.0	–0.2	–0.1

[1]scenario A: no agricultural subsidies included; scenario B: adding the agricultural subsidies in total revenues; scenario C: including agricultural subsidies in the costs of feed production

A comparable importance ratio between milk production and milk components in different breeds was calculated in Slovak (Huba et al., 2004) and Czech conditions (Wolfová et al., 2007a,b).

When the scenarios were compared (Table 6), direct subsidy did not influence economic values for carcass traits and SCS because the costs of feeding were not included in the calculations for these traits. The reduction of feeding costs in scenario C was manifested in small a decrease in marginal weights for the conception rate of heifers and growth rates and in a substantial decrease in the marginal economic importance of mature weight especially in Pinzgau breed (by 57%). The other evaluated traits showed higher marginal economic weights when agricultural subsidies were included in feeding costs. In agreement with our finding, Groen (1989) observed lower economic weights for milk and beef traits when an increase in feed prices was simulated (both concentrates and roughage). A difference in feed prices influenced the economic values of calf losses which were mostly doubled and of beef production traits. As the author assumed, the change in economic importance of beef traits can also be influenced by a difference between roughage and concentrate prices. In our calculation, both prices were influenced by the direct subsidies to a different extent. On the contrary, Kahi and Nitter (2004) and Vargas et al. (2002) found a minor effect of feed price change on economic values for most of the evaluated traits because the feed amount was simulated as fixed and energy requirements were obtained mainly from forage. Similarly like Wolfová et al. (2006), we found that the total profit of the farm is not the most important factor that determines the real economic value of the traits (compare scenarios A and B). The profitability of each segment of the production system (rearing of animals, fattening) should be positive to avoid an underestimation of economic weights for functional traits. Including the direct subsidies in feeding costs (scenario C) seems to be a suitable method for the more accurate estimation of economic weights.

The relative importance of traits (Table 7) changed in scenario C. Differences between scenarios were more noticeable for the Slovak Pinzgau population probably due to the highest marginal economic value for milk production (0.147 EUR/kg/cow/year) and the largest decline in feeding cost (18–53%) in scenario C. Jagannatha et al. (1998), using field data, found similar results which showed that lower feed prices were connected with lower relative weights for milk production traits. Comparing scenario C with scenarios A and B, the highest changes in the relative economic values were found for mature weight of cows and daily gain of calves in rearing. In scenarios A and B the mature weight of cows reached about 24% and 27% of the standardized economic value of milk yield in Slovak Simmental and Slovak Pinzgau cattle, respectively, but only 12% and 10% in scenario C. The relative importance of daily gain in these breeds declines in scenario C by about 13% and 20%. The reduction in the importance of growth traits (12–20%) was higher than the reduction in the importance of milk components especially in Slovak Simmental and Slovak Pinzgau population. It is assumed that growth and functional traits are the key factors of economic efficiency mainly in beef and suckling herds (Mwansa et al., 2002; Albera et al., 2004; Wolfová et al., 2004; Krupa et al., 2005) whereas in dairy herds their relative importance is minor (Pärna et al., 2002).

The relative economic importance of individual traits (expressed as the percent of standardised economic weights for milk yield) differed among breeds. For Holstein cattle, apart from milk yield, the most important traits were milk fat content (55.7% of milk yield), productive lifetime of cows (44.7%), SCS (–37.2%) and conception rate of cows (30.9%) in scenario C. Some growth and functional traits reached higher economic importance for dual-purpose breeds in comparison with Holstein. For Slovak Simmental, the second most important trait was productive lifetime of cows (55.3%), followed by daily gain of calves until weaning (37.7%), SCS (–33.8%) and milk fat content (30.3%). For Slovak Pinzgau cattle, productive lifetime of cows (62.4%) was followed by conception rate of cows (49.6%), daily gain of calves until weaning (37.2%) and milk fat content (37.2%). On the other hand, Wolfová et al. (2007a) determined the most important traits (milk yield, SCS, length of productive life, calf growth) identical for both Holstein and Czech Fleckvieh cattle. The difference can be due to higher milk production reached in Fleckvieh (5 700 kg) than in Slovak Simmental population (5 035 kg). In our simulations different economic importance of traits is mainly due to the real biological differences between dairy and dual-purpose breeds in Slovak conditions as well as to a positive economic impact of growth traits on farm economics of dual-purpose breeds. According to findings of Reinsch and Dempfle (1998) for Simmental cattle, dairy traits have dominant importance, but some health traits can have the same importance as fat yield in the first lactation, depending on quota prices and genetic standard deviations. Further, Visscher et al. (1994) found milk protein yield, survival traits and mature body size to be the most important traits for Holstein cattle in pasture based production systems. Fat and milk yield were less important in this system.

CONCLUSION

The results of this study showed that including the agricultural subsidies, which are independent of production, in feeding costs seems to be a suitable approach to economic simulations of dairy systems and to calculations of economic weights of traits. The mean values of evaluated traits in a population and biological predisposition of individual breeds are more appropriately reflected in economic values. Using this methodology, the positive effect on economic efficiency of simulated systems as well on marginal economic values for milk and functional traits was obtained. To calculate economic weights for more specific milk payment systems and for specific support regimes, further research is needed. To obtain the accurate relative economic weights for traits in specific breeds, the estimation of real genetic parameters for these breeds is needed.

Acknowledgements

The authors would like to thank Breeding Service of the Slovak Republic for making the data from performance testing available and M. Wolfová from the Research Institute of Animal Production Prague-Uhříněves for her helpful comments.

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Received: 2008–03–03
Accepted after corrections: 2008–12–04

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