Economic Indices for Various Breeds under Different Farming Systems and Price Uncertainty - Case Slovenia

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Abstract

Breeding indices need to be looked at periodically to evaluate the goal of the breeding program. In recent times the economic perspective of the breeding program has become more and more used in deciding the breeding objectives. However, prices are becoming more difficult to predict with increased fluctuations in all commodity prices which adds a level of complexity to the inclusion of economics into the selection index. With these challenges in mind a breeding program in the new EU country Slovenia was developed. All three Breeding Associations joined the deliberations. This paper studies the set-up of an economic selection index under price uncertainty, taking the Slovenia situation as a case study. The constructed economic indices, using a farm economic model (Moorepark Dairy Systems Model – MDSM - Shalloo *et al.,* 2004), ranked bulls in a significantly different manor than how the current Total Merit Indices rank the bulls. The economic indices were rather robust towards sensitivity in prices. Sensitivity towards the milk price showed the highest variation. Because the calculations are still not completely finished for some aspects, this paper only describes the present situation and part of the results. The Breeding Associations are very interested in the application of it.

Keywords: global market, breeding goals, economic index, sensitivity, prices, case study

Introduction

The goal of a breeding program will likely change over time as well as the focus on different traits, the economic perspective and as a consequence the traits included in the index. In this context, breeding indices are continually being developed and evaluated as new technologies and information becomes available. In recent times some model input prices have become much more difficult to project because of strongly fluctuating prices. This adds a challenge to the inclusion of economics into the selection index. Also the optimum farming system may change and therefore influence the composition of an economic selection index. As an illustration: about half of dairy farmers in Slovenia choose for specialisation in milk and about half for diversification in two questionnaires answered by 1,112 dairy farmers in 2005-2006 and 600 in 2007 (Klopčič *et al.,* 2006; 2008). With these challenges in mind, the breeding indices in the new EU country Slovenia were evaluated. This was also stimulated by the questionnaire under the same group of 1,112 dairy farmers, in which farmers expressed quite some interest in sustainable traits, like longevity, while the existing Total Merit Index (TMI) did not contain this trait (Klopčič and Kuipers, 2009). Also the economic situation in the dairy sector asked for reconsideration of the breeding goals. The Holstein-Friesian Association requested for action, and later on during the process the Simmental and Brown Swiss Associations joined the deliberations. Therefore, the general goal of this paper is to study economic indices under various farming systems and future uncertainty concerning costs and prices in a more global economy. The study is focused at the dairy herd and bull stud in the Central European country of Slovenia and encompasses the breeds Holstein-Friesian, Brown Swiss and Simmental. Because the work is still not completely finished for some aspects, this paper describes the present situation for all three breeds and results only for the Holstein-Friesian breed. The Breeding Associations are waiting for the final results.

Current indices in Slovenia

In year 2008 the dairy sector in Slovenia counted 8,600 dairy farms with on average 12.5 milking cows. Average milk production of recorded herds (75% of total dairy cows) was 6,043 kg with 4.05% fat and 3.26% protein in 305-days (KIS, 2009). A large variation in size exists. The strategies of farmers differ from specialization to diversification in about a 50 to 50 ratio (Klopčič *et al.*, 2006). Diversification is mainly practiced by including other animal branches than dairy cows in the farm operation. In this respect, fattening of bulls is one of the economically more successful branches (Kavčič *et al.*, 2009). Also a large suckler cow sector is present, although on very small farms. This causes a split of the dairy farmers in focus on milk and beef production and all intermediate choices. Nevertheless, the percentage of Holstein-Friesian cows is increasing indicating some focus on milk production. Interest of dairy farmers to go into local and organic products appeared to be still very limited, although a large influx of tourists is available. The landscape (flat, hilly and mountainous areas) also influences the choice of breed and probably the breeding goals (Klopčič *et al.*, 2008).

The current indices used in Slovenia are a TMI for milk for Holstein-Friesian (HF), and two TMIs for Brown Swiss (BS) and Simmental (SIM): one for milk and one for beef. The weights were established by a small group of experts and based on common sense, strategy and experience in cattle breeding. The weights for the milk and beef indices are listed in Table 1. The number of traits included in the indices is ranging from 18 for TMI-beef SIM till 30 for TMI-milk HF&SIM. In TMI-milk most emphasis is on the milk production and conformation traits. For example, the TMI for HF is composed of 5 milk production, 4 fertility, 20 conformation and 1 beef trait. There is a remarkable high weight on the conformation traits from 28% for TMI-milk BS till 52% for TMI-beef SIM.

In the current paper we only focus on an economic index for HF.

Table 1. Weights in % and number of traits used in Total Merit Indices (TMI) for milk and beef for Holstein-Friesian (HF), Brown Swiss (BS) and Simmental (SIM) breeds in Slovenia.

Category of traits	Weights in TMI-milk (%)			Weights in TMI-beef (%)	
	HF	BS	SIM	BS	SIM
Milk production	38	55	38	14	9
Fertility & calving ease	15	12	15	19	19
Conformation	42	28	42	47	52
Beef	5	5	5	20	20
No of traits	30	29	30	21	18

Methods

An economic index requires economic values of each trait to be used to calculate the economic weights. For calculating the economic values of traits, an Irish Farm-Economic-model was used (Veerkamp *et al.*, 2002; Shalloo *et al.*, 2004). The model had been previously applied to study the dairy cattle breeding objectives combining yield, survival and calving interval for pasture-based systems in Ireland under different milk quota scenarios. For the purpose of the present study this model was adapted to Slovenian genetic and economical circumstances.

The following costs and prices were used as economic parameters:

- Animal costs, labour, grass silage making, buildings, machinery, veterinarian.

Both fixed and variable costs were taken into account.

- Prices of milk, beef, concentrates, milk replacer, fertilizer, semen.

As base farming system for HF farms is a conventional farm in the flat area of Slovenia considered. Costs per cow place are euro 4000 when building a new barn. The average production is approximately 7200 kg in 305 days with 150.000 kg milk quota. Table 2 shows the current default costs and prices for HF farms in Slovenia. Also different farming situations were studied, being low-production *vs.* high-production (ranging from 6000 to 10.000 kg milk in 305d), low-cost *vs.* high-cost per cow-place (ranging from 1000 to 4000€), organic *vs.* conventional, and flat areas *vs.* hilly areas. For the latter two farming systems, the costs and prices from year 2009 were used, taking into account the additional subsidies from government that organic farms and farms in hilly areas receive.

Table 2. Current default herd characteristics, costs and prices for Holstein-Friesian farms in Slovenia.

	Unit	Price
Farm Size	ha	20.00
No. of cows	units	23.00
No. of Livestock Units (incl. youngstock)	units	31.25
Labour units	man	1.19
Milk per cow	305d kg	7,247.00
Fat yield per cow	305d kg	288.43
Protein per cow	305d kg	232.63
Concentrate per cow	kg / 305d	2,534.00
Culling percentage	proportion	0.25
Calving interval	days	365.00
Gross milk price	€ / kg	0.205
Fat price	€ / kg	2.24
Protein price	€ / kg	3.93
Total feed costs per cow (concentrates and roughage)	€	942.07
Replacement heifer price	€	1300.00
Culled cow price	€	500.00
Labour costs/month	€	1000.00

As traits to study for the economic index in Slovenia were taken: milk (kg), fat (kg), protein (kg), longevity, which can also be expressed as survival (%), and calving interval (d). These were considered as the traits which contribute the most to the economic returns of the farmer. The inclusion of daily gain (gr/d) for SIM and BF is still under construction. Udder health was taken in reserve with the plan to consider implementing it in the index later on. The economic values of traits were calculated as the net return of 1 unit more of a certain trait. To illustrate - the calculation of the economic value for longevity in %: How much do you earn when a cow lives 1% longer? Example: current involuntary culling% on farm is 20%, corresponding with a longevity of 80%; when involuntary culling is improved with 1%, this means 1% of 20%, which is 0.2%; then involuntary culling% on farm becomes 19.8%, and longevity 80.2%; the net return of this new situation is calculated.

In comparison to the economic model published by Veerkamp *et al.* (2002), the economic values are now calculated for a zero-profit situation. The number of cow-days producing per year is assumed to be fixed. With an extended calving interval, you have to adjust the number of cows down, to make sure that the number of cows´ milking days is the same in the default and changed scenario. Otherwise you simply produce more milk with extended calving interval and hide that you produce relatively more milk in a less economic part of the lactation. The change in profit of the farm originates then from a change in costs per animal, corrected for the change in costs due to a change in the number of animals (Groen *et al.*, 1997).

Results

The assumed costs and prices in the model are shown in Table 2. Changing one trait with one unit results in absolute economic weights. The absolute economic weights derived with the Economic-Farm-Model are shown for the Holstein-Friesian breed in Table 3. Based on this absolute economic weight and the genetic standard deviation of each trait, the weight in the index is determined as well, and also shown in Table 3. Similar analyses will also be performed for the Brown Swiss and Simmental breeds in Slovenia, including also a beef trait. These results cannot be shown yet.

Table 3. Weights on traits in % and absolute economic weights in euro for Holstein-Friesian breed.

	Weight on trait	Absolute economic weight
Milk (kg)	19%	- 0.04 euro
Fat (kg)	11%	+ 0.55 euro
Protein (kg)	40%	+ 2.89 euro
Longevity (%)	16%	+ 9.55 euro
Calving int. (d)	14%	- 0.99 euro

The ranking of 19 HF-sires based on their TMI and their economic index (E.I.) were compared. The Spearman correlation $r_{TMI-E.I.}$ for ranking of HF bulls was 0.393. Clearly, a low correlation between ranking with TMI and ranking with E.I. exists, indicating a significant re-ranking of sires. The reason for this is the fact that several traits in TMI are not affecting farm profit directly, but those traits have a strong weight in the current TMI. The E.I represents a more economical oriented philosophy towards animal breeding.

But the E.I. is dependant on the input of prices and costs, which fluctuate strongly these days. Moreover, selection in animal breeding should be in principle based on future prices, which complicates the choice of prices even more. Therefore, how sensitive were the results towards price changes? In Table 4 the re-ranking of bulls is presented by changing cost and prices. The base situation (E.I. base) with price levels used in the E.I. calculation is compared to a situation with changed prices (E.I.-changed).

Table 4. Effects of different costs and prices on ranking of a group of 19 bulls of HF breed; *Yes if correlation between ranking "E.I.-base" and "E.I.-changed" < 0.99*

Input	Price / cost level	
	-25% Re-ranking	+25% Re-ranking
Milk price	Yes	Yes
Value animal	Yes	No
Grass silage making	No	No
Labour	No	No
Concentrate	No	No
Veterinary	No	No

The ranking of sires is clearly the most sensitive to a changing milk price. Spearman rank correlations between rankings of HF-bulls based on the "E.I.-base" and on the "E.I.-changed was 0.71 for a reduction in milk price of 50%, 0.94 for a 25% reduction, 0.97 for a 25% increase 0.87% for a 50% increase and 0.82 for a 75% increase in milk price. The milk prices used in this study are illustrated in an overview of EU and world prices over a period of time in Figure 1 to assess the reality of these prices in a global environment. As shown, the plus price scenario's (27.5 till 38.5 euro /100 kg) are in the range of past price levels, while the negative price scenario's (16.5 till 11 euro /100 kg) have only been experienced in some periods on the world market of milk and the lowest level in figure is even below this.

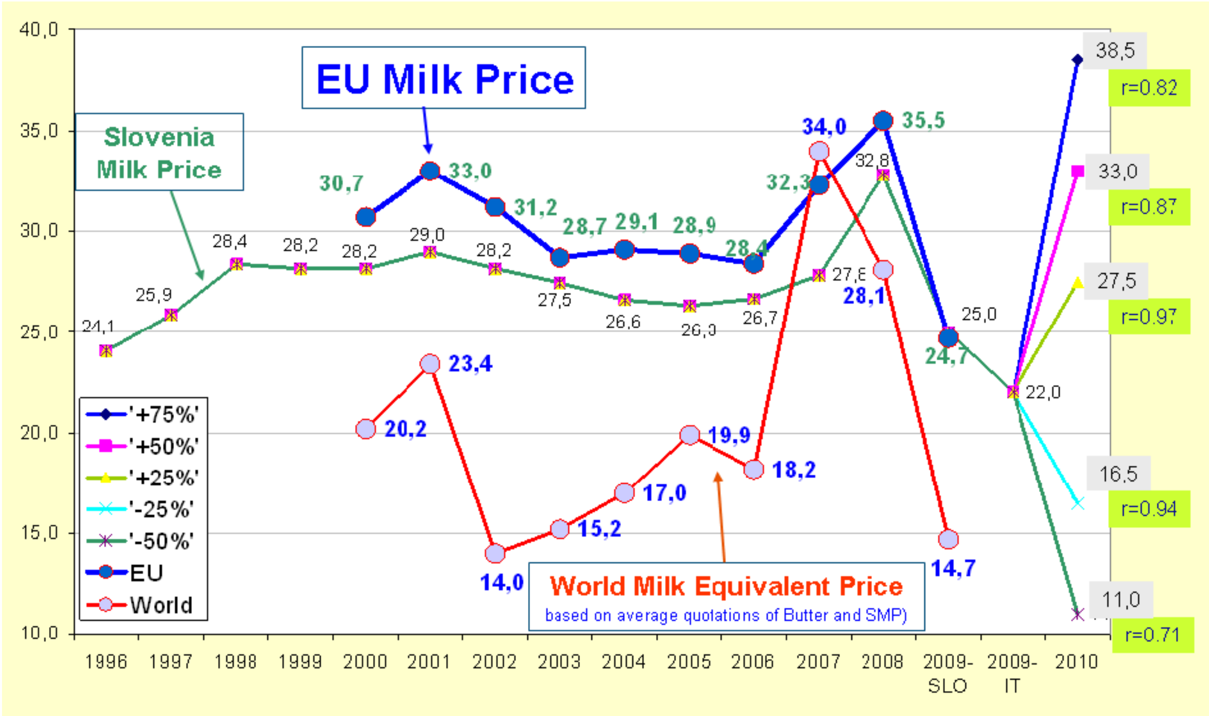

Figure 1. Five scenarios in milk price level studied embedded in the trend in prices in last 12 years in Slovenia, EU and the world; the alternative scenarios are listed in right side of figure with prices in euro /100 kg and correlations (r) between TMI and E.I.

The ranking of bulls on E.I. is also evaluated under various farming systems, like low-production *vs.* high-production, low-cost *vs.* high-cost per cow-place, organic *vs.* conventional and flat areas *vs.* hilly areas. When ranking of bulls is performed according to the calculated economic values, the first impressions indicate that $r_{TMI\text{-}E.I.}$ is insensitive for changes in farming system of Holstein-Friesians, only the organic and low cost system might cause a very slight re-ranking effect (see Table 5). Nauta *et al.* (2009) argue that the organic farming system may require an own index. Our calculations for HF-breed did not confirm this, but it should be noticed that milk price for organic and conventional milk is the same in Slovenia, resulting only in a higher return of organic milk because of additional subsidies.

Table 5. Spearman rank correlations between ranking of Holstein-Friesian sires based on the economic index E.I. and rankings of these sires based on indices for different farming systems.

Farming system	Correlation with rank on E.I.
Current TMI	0.39
Organic	0.98
Hilly	1.00
Cow place 1000€	0.98
Cow place 4000€	1.00
Milk yield 8000kg	1.00
Milk yield 10000kg	0.99
Milk yield 12000kg	0.99

Conclusions

- Economic index ranks bulls differently compared to current TMI
- Economic index appears to be robust towards most of prices and costs on the farm; the milk price level is important for results and the value of animals affects index only slightly
- . Economic index appears to be also robust towards a change in farming system for Holstein-Friesian cows
- Several research questions remain:
  - **Do we need a separate milk index** and beef index, especially for the BS and SIM breed, as they have now as well?
  - Testing programs and derivation of economic weights for beef from economic farm model for dual purpose breeds need more attention
  - Can somatic cell count (SCC) be added to the economic index as an udder health trait? Derivations of economic weights are not considered to be straightforward since the payment system for bulk tank SCC is binary, and also because breeding values are estimated based on log-transformed SCC, whereas the economic weight will be derived for real SCC.

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