Economic Values in the Danish Total Merit Index

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Abstract

From January 2002 a revised total merit index for sires and cows has been introduced to the Danish cattle breeders. The weights of the traits in the new total merit index are based on a total analyse of economic values of milk production calculated in a profit model using deterministic data simulation. The new total merit index includes two new groups of traits: "*Other diseases*" (other than udder diseases) and "*Functional longevity*". The values for most functional traits have been increased whereas the values for type traits have been reduced considerably.

Introduction

Since 1983 Danish dairy cattle breeding has been based on a total merit index that include production traits, type traits and functional traits such as fertility and calving performance and from 1990 also resistance to mastitis.

The economic weights were revised in 1990 and a new major revision has just been made. The "new" total merit index was published for the first time in January 2002. The revision had become necessary because:

- The economic predictions made in 1990 were not valid anymore. Especially the relationship between sales value of milk and beef has changed drastically, but also costs of input factors related to labour costs have increased more than expected.
- Two new groups of traits have been included in the evaluation system. They are: "Functional longevity" and "Other diseases" than udder health (Nielsen *et al.*, 2000; Pedersen & Nielsen, 2002).

The Danish total merit index

Figure 1 gives a survey of the current Danish evaluation system (Pedersen & Aamand, 1999) Additional information can be found at www.lr.dk/kvaeg/diverse/principles.pdf.

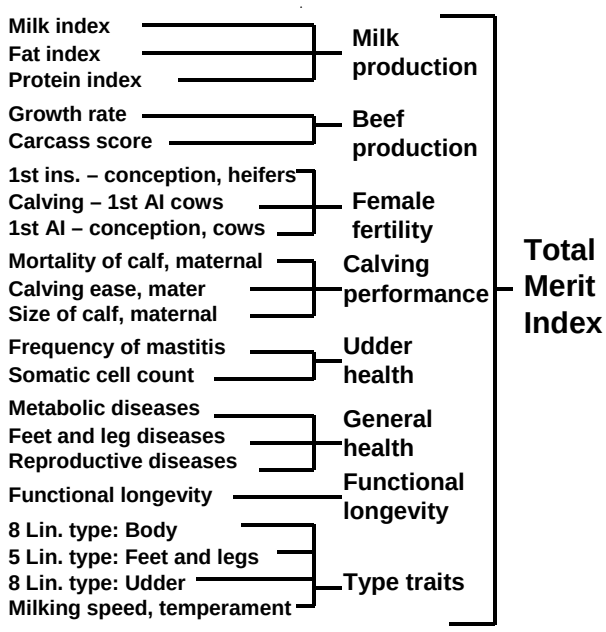

Figure 1. Survey of traits and sub-indexes in the Danish evaluation system 2002.

Currently, a total of 46 traits are included in the Danish total merit index. They can be summarized in eight different groups of traits:

- Milk production
- Beef production
- Fertility
- Calving performance

- Udder health
- Other diseases
- Functional longevity
- Type traits

Beside the total merit index, a number of different sub-indexes are calculated. The basis for calculation of all the different sub-indexes and the total merit index is the economic values of the traits.

Methods and economic assumptions

The analyses of the economic values were made by deterministic data simulation using a profit model for a typical Danish dairy cattle production system. The model was adapted from an existing economic model developed for analyses of production systems. The economic value of a trait was expressed as marginal profit per year per cow.

Figure 2 shows the development in the most important economic relationships for output and input factors during the last 20 years. Relative to sales value of milk, the sales value of beef has declined steadily during this period, whereas labour costs have increased relative to sales value of milk. In the model labour costs are a determinant of costs of all external services, such as veterinarian assistance and AI. The costs of concentrates relative to milk have been constant during the last 5-10 years. A similar development was observed for other types of feed. Based on the development shown in Figure 2 the future economic relations were estimated using the results for 2005.

Beside these basic economic relationships, the model included a long list of technical assumptions. Only some special assumption are pointed out:

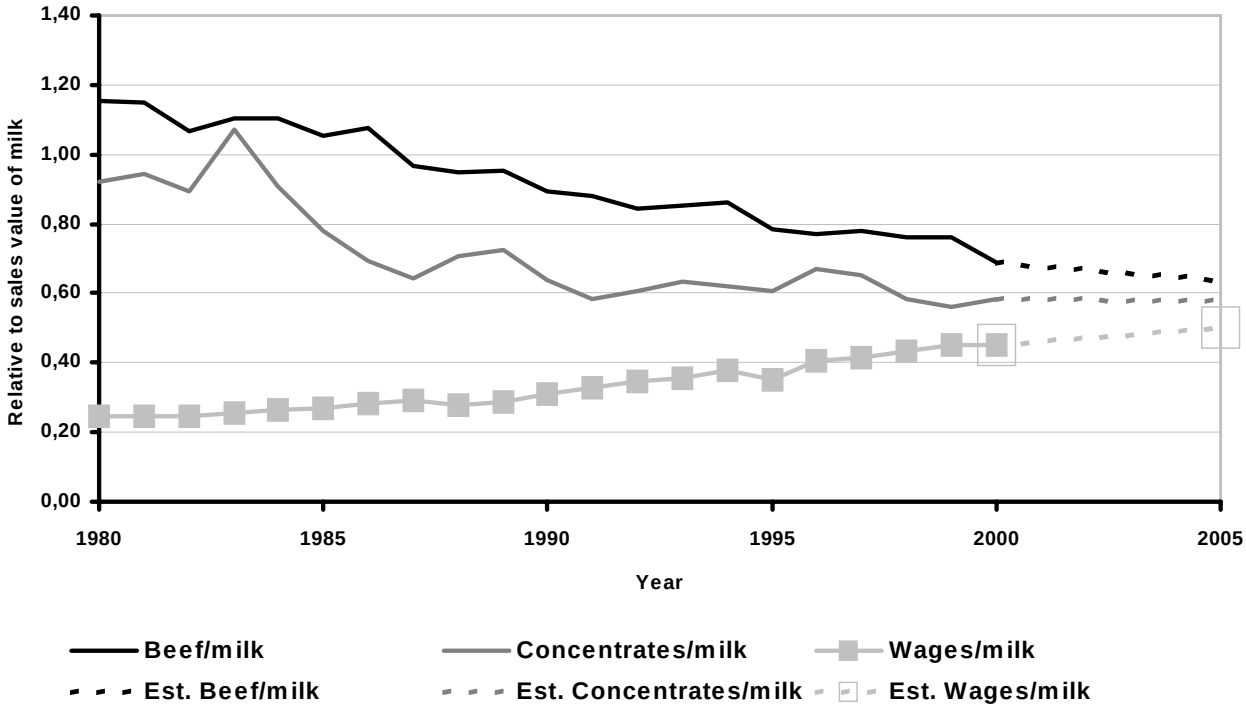

Figure 2. Basis economic assumptions expressed relative to sales value of milk (Beef: 0.1*value value/kg; Labour costs: 0,01 * hourly wage).

- *Milk production traits:* The economic values of the components of milk are influenced by sales value of the components but only current sales value was used.
- *Beef production traits:* Value of growth rate depends on feed costs but not on sales value of beef because most Danish calves are slaughtered at a fixed weight. Correlated effect on value of culled cows was not included.
- *Calving performance.* Economic value of percent calves born alive are based on the assumption that all bull calves are raised and slaughtered.
- *Type traits:* The economic value of type traits are based on an evaluation of the extra working hours related to one unit of change in linear type score of all the traits within each group (Body, Feet and Legs, Udder).
- *Udder health and other diseases*: For all the health traits an important factor is the quality of disease registrations. If only a part of the diseases are recorded, the variation of estimates of breeding will be reduced correspondingly, but genetic improvement influence all cows, and therefore the reduced variation must be taken into account when the economic values are calculated.

In the economic model used in this project it was not possible to implement the effect of fertility, diseases and other traits on culling rate. Therefore the effect of changes in replacement costs is not included when the economic value of fertility and diseases are calculated.

An additional analysis of the relationship between index for function longevity and for the other traits in the total merit index was carried out. The most important indexes were: Fertility, Udder health and Type score for feet and legs. Those three indexes explained 2/3 of the variation in index for functional longevity.

Results and Discussion

Table 1 show the main results from the analyses of economic values of the traits included in the total merit index. The following results are listed in Table 1:

- New economic values for Danish Holsteins and Danish Jerseys (NEW). Economic values have been calculated for all the Danish dairy breeds, but the results were very similar for Red Danish Dairy Breed, Danish Red Holsteins and Danish Holsteins.
- Economic values used by Danish Holsteins and Danish Jerseys up to 2002 (OLD). The values are adjusted such that the new and old value are equal per kg total milk of average composition. These values are the values that were actually used. Some of the values are "political", especially values for beef production. The "old" economic values for type traits were determined by a desired gain approach.

Our recommendation to breed organisations were to transfer 2/3 of the weight on index for functional longevity to index for fertility, udder health and type of feet and legs and retaining only 1/3 of the value for functional longevity. This transfer of value would increase the weight of the index for fertility, for udder health and for type score of feet and legs considerably compared to the values shown in Table 1. The factors for adjustment are shown in Table 1.

Having these results in mind, the comparison between the new and old values in Table 1 shows that:

- The economic values of most of the functional traits are increased. This is especially true for the new traits included in the analyses (other diseases and functional longevity), but also value of fertility and udder health are increased.
- For calving performance the economic value percent calves born alive (or mortality) has decreased whereas the value of calving ease has increased such that the weight of the total calving performance index remain nearly unchanged.
- The economic value of beef production is much higher that used in the old total merit index, but that is only because in Danish Holsteins and Danish Jerseys a "political" decision was made to exclude beef production traits.

Table 1. Economic values per cow per year (EURO/unit)
NEW = new economic values, OLD = economic values used up to 2002.

	Danish Holsteins		Danish Jerseys	
Trait	**NEW**	**Adj. OLD**	**NEW**	**Adj. OLD**
Milk, kg	**-0.0531**	-0.0230	**-0.0493**	-0.0692
Protein, kg	**4.76**	4.51	**4.78**	5.20
Fat, kg	**2.33**	1.78	**2.32**	2.38
Total milk, avg. composition, kg	**0.1972**	0.1972	**0.2777**	0.2777
Net gain/day	**0.29**	0.07	**0.13**	0.00
EUROP score (15 classes)	**15.54**	5.54	**13.42**	0.00
Days open after 1st AI, heifers	**0.54**	0.93	**0.35**	0.84
Days open before 1st AI, cows	**0.92**	2.50	**0.59**	1.27
Days open after 1st AI, cows	**1.80**	2.50	**1.48**	1.27
Live born calves 1st, percent	**0.94**	1.58	**0.49**	0.89
Live born calves, later, percent	**1.19**	2.21	**0.70**	1.77
Calving ease, 1st , percent	**0.98**	0.76	**0.91**	0.87
Calving ease, later, percent	**1.25**	1.26	**1.32**	0.95
Udder diseases, 1st, percent	**-1.44**	-2.09	**-1.30**	-1.20
Udder diseases, later, percent	**-1.83**	-2.92	**-1.87**	-1.68
Metabolic diseases, 1st, percent	**-1.35**	-	**-1.22**	-
Metabolic diseases, later, percent	**-1.72**	-	**-1.75**	-
Feet & leg diseases, 1st, percent	**-0.91**	-	**-0.82**	-
Feet & leg diseases, later, percent	**-1.15**	-	**-1.17**	-
Reproductive diseases 1st, percent	**-0.26**	-	**-0.24**	-
Reproductive diseases, later, percent	**-0.33**	-	**-0.35**	-
Longevity, days	**0.43**	-	**0.38**	-
Type: Body**	**0.00**	44.83	**0.00**	0.00
Type: Feet & legs**	**14,48**	113.96	**14.48**	76.31
Type: Udder**	**21.67**	149.20	**21.67**	117.66
Milking speed, score	**14.48**	16.66	**14.48**	21.12
Temperament, score	**7.25**	7.28	**7.25**	34.61
	Change in weights due to effect on longevity(factor)			
Index for fertility	1.76		2.07	
Index for udder health	1.58		1.78	
Index for feet and legs	1.50		3.75	
Index for functional longevity	0.33		0.33	

* Old values adjusted to equal values of total milk of average composition
Adjustment: Danish Holsteins = 1.6325; Danish Jerseys = 1.8448
****** Unit = change of one type score for all trait within each group

- The economic value of type traits is generally reduced drastically. This apply to type score of feet and legs, even with effect on replacement costs taken into account. The reduction in economic values of type traits is a logical consequence of including other diseases and functional longevity in the total merit index. One could suspect that the desired gain approach that was used for determination of economic values of these traits in the old total merit index might have led to overestimation of the values.

The new values listed in Table 1 were recommendations to the breed organisations. These recommendations were generally accepted. In Danish Holsteins the index for type score of body has been given a small weight. In Danish Jerseys the decision not to include beef production in the total merit index was maintained. The weights actually used by the Danish dairy breeds are published at www.lr.dk/kvaeg/diverse/principles.pdf. In Table 2 the correlations between the Danish total merit index and some sub-indexes are shown.

Table 2. Correlations (x100) between the total merit index and some sub-indexes for Danish AI sires born after 1992.

	Danish Holsteins	Danish Jerseys
Milk production	73	78
Beef production	12	13
Female fertility	19	31
Calving performance	23	-20
Udder heath	35	41
Res to other diseases	31	49
Longevity	51	39
Type: Body	11	2
Type: Feet and Legs	22	17
Type: Udder	30	35
Milking speed	24	6
Temperament	11	24

A number of analyses of sensitivity to alternative assumptions have been carried out. The main results were that:

- Including the current milk quota system and related costs would decrease value of milk production traits by 25% .
- Including current EU subsidies for beef production would increase value of calves born alive by 75%, also value of fertility would increase slightly whereas value of longevity decreases.
- Increasing feed costs would decrease value of milk and beef production and increase value of fertility and longevity.

Increasing labour costs and costs of other external services would increase value of most functional traits and of type traits.

Due to the shortcomings of the economic model used in the project it was decided to develop a new economic model that:

- Uses stochastic simulation of the culling process
- Includes other aspects than strict production economy e.g. sustainable production systems ethical questions and public opinion
- Can analyse alternative definitions of the economic results

Conclusion

From January 2002 all the Danish dairy breed have introduced a new total merit index. The weights of the traits are generally based on the value presented in this paper. In the new total merit index the economic weights of functional traits are increased whereas the weights on type traits are reduced drastically.

The interrelationship between longevity, culling due to fertility, udder health, diseases and other traits included in the total merit index cannot be modelled satisfactory by the economic model used in this project. Therefore a project on development of a new stochastic model has been initiated. This project will also include more comprehensive analyses of economic values including other aspects than production economy.

One very important set of traits that have not yet been included in the total merit index are traits related to feed conversion and feed efficiency.

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