Calf price impacts dairy farm profit too

N. Mc Hugh[1]*, R.D. Evans*[2] *and D.P. Berry*[1]

[1]*Animal & Grassland Research and Innovation Centre, Teagasc, Moorepark, Fermoy, Co. Cork. Ireland*
[2]*Irish Cattle Breeding Federation, Bandon, Co. Cork. Ireland*

Abstract

Up to 20% of the gross income of a dairy farm is from the sale of surplus calves and cull cows. The availability of routinely collected data of calf price from the livestock auctions, coupled with the known genetic variation in calf price, suggest that calf price should be considered for inclusion in dairy cattle breeding objectives. The objective of this study was to quantify the impact of the current Irish dairy cattle breeding goal from adding calf price to the EBI. Selection index methodology was used. Previously estimated genetic and phenotypic parameters for the goal traits currently included in EBI and calf price were used; where not available, genetic correlations were inferred from the correlations between reliable estimated breeding values of the respective traits. The genetic correlations between calf price and the goal traits in the EBI ranged from, -0.21 (calf price and calving interval) to 0.54 (calf price and carcass conformation score). The inclusion of calf price increased genetic gain in calf price to €1.69. The inclusion of calf price in the EBI increased the rate of genetic gain for milk yield (-18.83 to -21.21 kg). The results for this study indicate that the inclusion of calf price in the EBI will not alter the response to selection of the current goal traits dramatically but will more accurately account for on-farm profitability in Irish dairy herds.

Keywords: calf price, selection indexes, breeding goal

Introduction

Irish livestock auctions, referred to as marts, remain an important marketing outlet for cattle in Ireland. In 2010, approximately 1.6 million cattle were sold through Irish marts (CMMS, 2010). Within the last ten years the breeding objective for dairy cattle in Ireland, the economic breeding index (EBI; Berry et al., 2007) has reduced emphasis on milk production and moved towards an economic index that reflects the overall productivity of the dairy cow. In 2004 a beef sub-index was added to the EBI to account for the gene flow between the dairy and beef sectors. At present, however, no direct weighting is given to the value of young calves from the dairy herd. Instead the value of carcass weight, conformation and fat score of slaughtered progeny are included in the EBI, the majority of which are realised by the beef farmer. The availability of routinely collected data on calf price from the livestock auctions, coupled with the known genetic variation in calf price, suggest that calf price should be considered for inclusion in dairy cattle breeding objectives. The objectives of this study was to quantify: 1) the impact of the current Irish dairy cattle breeding goal, the Economic Breeding Index (EBI), on genetic change in calf price, and 2) the impact on genetic gain in the performance traits already in the EBI from adding calf price and, 3) the impact on genetic gain when calf price replaced progeny carcass weight, conformation and fat score in the EBI.

Materials and Methods

Animal Care and Use Committee approval was not obtained for this study because the data were obtained from an existing database at the Irish Cattle Breeding Federation Database (ICBF), Bandon, Co. Cork, Ireland.

Selection index methodology

Selection indexes were developed (Hazel, 1943) where: 1) all current goal traits in the EBI were included, 2) calf price along with the current goal traits were included, and where 3) calf price replaced the progeny carcass traits as a goal trait. Previously estimated genetic and phenotypic parameters were used for the calculation of the response to selection for the goal traits (Table 1). For calf price heritability estimates have been reported previously using Irish mart data ($h2= 0.34\pm 0.03$; McHugh et al., 2011), and were included in the selection index. Previous reported genetic and phenotypic correlations between traits included in the EBI (Berry et al., 2007) were used in the calculation of selection index. The genetic correlations between calf price and the goal traits included in the EBI were inferred based on the correlations between reliable estimated breeding values of the respective traits.

The vector of optimal index weights (**b)** was calculated for the breeding objective as **b** = $\mathbf{P}^{-1}\mathbf{Ga}$ where $\mathbf{P}^{-1}$ **=** the inverse of the phenotypic (co)variance matrix of the traits in the selection index and accounts for the number of progeny used within the selection index, **G** = the genetic covariance matrix between all traits included in the selection index, and **a** = the vector containing the economic values of the goal traits. The correlated response to selection for each trait was calculated as:

$$CR = \frac{b'Ga}{\sqrt{b'Pb}}$$

where CR = the correlated response to selection, **b' =** the transpose of the vector containing the index weights, **G** = the genetic covariance matrix, and **a** = the vector containing the economic values, **P =** the phenotypic (co)variance matrix and **b** = the vector containing the index weights.

Economic values

Economic values for traits included in the EBI, were calculated using the Moorepark dairy systems model (MDSM; Shalloo et al., 2004) or as described by Berry et al. (2007), are summarised in Table 1 and briefly described below. Economic values were calculated based on a one unit change in each trait, while keeping all other traits constant to avoid double counting in the model. The economic values for milk, fat and protein yield, as well as, calving interval and survival (Shalloo et al., 2004) were calculated based on three, quota versus non-quota scenarios in the MDSM. The calving pattern in each scenario assumed that 50% of cows and heifers calved in February, 40% in March and 10% in April and the average calving interval was 365 days. Milk, fat and protein yield economic values were calculated by increasing yield for each of the calving groups across each month of lactation. For calving interval, a Markov chain was used to stimulate the effect of a one day increase in calving interval on the calving pattern (Veerkamp et al., 2002). The economic value for survival was calculated as the change in margin due to a change in the probability of survival during lactation.

The economic value for calving difficulty (direct and maternal) was derived from the costs associated with an increase in the incidence of difficult calvings from 6 to 7% and included the costs of increased stockman hours, veterinary interventions, cow mortality, disposal and infertility as well as of loss in milk sales. The economic value for gestation length was calculated based on a one day change in calving interval. The economic value for calf mortality was calculated as the cost of dead calf disposal plus the average price attainable for a live dairy calf in the Irish marts over a three year period. Since incidence of lameness in dairy cows is poorly recorded in Ireland locomotion scores are included in the breeding goal as a proxy for lameness. An economic value associated with the cost of lameness was calculated and then multiplied by the genetic regression of lameness on locomotion. This value was then multiplied by the standard deviation for locomotion to derive the economic value for locomotion score (Berry et al., 2007). The economic value for somatic cell count (SCC) is based on the economic effect on milk price due to changes in the proportion of herds falling into specific SCC bands taking into account the annual weighted milk price, the average cow milk yield and the penalties enforced by the milk processors for high SCC (Berry et al., 2007). The economic value for carcass weight was taken as the price attainable per kg carcass. The economic value for carcass conformation and carcass fat score were derived from the regression of meat cut yield on carcass conformation or fat score scored by persons in the meat factories. Cow carcass weight is a function of two separate factors that are divided into two separate economic values: cow carcass weight and cow maintenance. The economic value for cow carcass weight captures the costs and revenue associated with rearing a heifer with an additional kg of live-weight at slaughter. The economic value for cow maintenance is calculated based on the increased feed costs and reduced milk sales associated with carrying an additional kg of live-weight. An economic value was not calculated for calf price as a monetary value is assigned to each calf through data collected from the marts in Ireland. The economic value for calf price was therefore implicitly assumed in the breeding value of the bull.

Relative emphasis

The change in relative emphasis in the EBI following the inclusion of calf price was calculated for each trait as the economic value times its standard deviation divided by the sum of the absolute values of these products and then multiplied by 100 (Van Radan, 2002).

Table 1. Genetic standard deviation, heritability estimates and the economic values for each of the goal traits included in the EBI, as well as, calf price.

Trait[1]	σ_g	h^2	Economic value
Milk (kg)	215,054.00	0.35	-0.09
fat (kg)	303.10	0.35	1.01
Protein (kg)	177.10	0.35	6.26
Calving Interval	76.92	0.04	-11.89
Survival	7.30	0.02	12.05
Calving Difficulty	7.00	0.28	-3.52
Gestation Length	5.40	0.20	-7.49
Mortality	2.55	0.05	-2.58
Maternal Calving Diff	2.20	0.10	-1.73
Locomotion	4.34	0.07	1.13
SCC	0.04	0.11	-56.35
Carcass Weight	471.96	0.54	1.38
Carcass Conformation	0.97	0.59	10.32
Carcass Fat	0.49	0.31	-11.71
Cow maintenance	306.00	0.40	-1.49
Cow Carcass Weight	471.96	0.54	0.15
Calf Price	657.90	0.34	1.00

Results and discussion

Since the establishment of the EBI in 2001 the dairy breeding index has undergone many changes to better reflect overall farm profitability. Calf price remains an important financial contribution to overall farm profitability but to date has not been included in the EBI. Results from this study suggest that the inclusion of calf price in the dairy breeding goal provides a more accurate reflection of farm profitability and will also increase the overall rate of genetic gain for the diary industry.

Genetic correlations

The genetic correlations between the current goal traits included in the EBI ranged from -0.74 between cow carcass weight and carcass fat to 0.80 milk and protein yield. The genetic correlations between calf price and the EBI goal traits ranged from, -0.21 (calf price and calving interval) to 0.54 (calf price and carcass conformation score). Negative correlations were recorded between calf price and production traits (Table 2) and varied from -0.17 (milk yield and calf price) to -0.09 (fat yield and calf price). Similar to previous results (Pabiou et al., 2012), positive correlations were recorded between calf price and progeny carcass weight (0.22) and cull cow carcass weight (0.15). Traits associated with higher calf birth-weight (i.e. higher calving difficulty and longer gestation lengths) were also positively correlated with calf price. McHugh et al. (2010) has shown previously that cows with higher calving difficulty scores produced calves with higher market price.

Table 2. Genetic correlations between the traits included in the EBI and calf price.

Trait	Milk	Fat	Protein	CIV	Survival	CD	Gest	Mort	MCD	Loco	SCC	CWT	CConf	CFat	Maint	Cowwt	Price
Milk	1																
Fat	0.58	1															
Protein	0.80	0.74	1														
CIV	0.56	0.44	0.46	1													
Survival	0.00	0.00	0.00	-0.20	1												
CD	0.20	0.13	0.10	0.29	-0.16	1											
Gest	0.20	0.05	0.12	0.26	-0.13	0.26	1										
Mort	-0.06	-0.20	-0.11	-0.05	0.04	0.18	0.16	1									
MCD	-0.20	-0.20	-0.20	-0.27	0.01	-0.50	-0.23	-0.31	1								
Loco	0.04	-0.11	-0.05	0.10	0.10	0.13	0.00	0.10	-0.20	1							
SCC	0.20	0.19	0.23	0.18	-0.23	0.09	-0.01	-0.05	0.03	-0.06	1						
CWT	0.26	0.19	0.27	0.15	-0.14	0.10	0.06	-0.01	-0.11	0.02	0.01	1					
CConf	-0.47	-0.44	-0.48	-0.30	0.26	-0.09	0.01	0.18	0.17	-0.16	-0.21	0.49	1				
CFat	-0.21	-0.13	-0.17	-0.29	0.15	-0.19	-0.19	0.00	0.22	-0.07	-0.09	-0.29	-0.16	1			
Main	0.02	0.14	0.14	-0.08	0.05	-0.004	0.06	0.05	-0.09	-0.02	-0.05	0.29	-0.01	0.19	1		
Cowwt	0.44	-0.04	0.24	0.37	-0.28	0.32	0.09	-0.32	-0.36	0.06	-0.10	0.77	-0.08	-0.74	0.14	1	
Price	-0.17	-0.09	-0.10	-0.21	0.07	0.22	0.26	0.22	-0.16	-0.03	-0.07	0.22	0.54	-0.05	0.15	0.15	1

[1]CIV= calving interval, CD= direct calving difficulty, Gest = gestation length, Mort= calf mortality, MCD= maternal calving difficulty, Loco= locomotion, SCC= somatic cell count, CWT= carcass weight, CConf= carcass conformation, CFat= carcass fat, Maint= cow maintenance, Cowwt= cull cow carcass weight.

Response to selection

The current EBI is increasing the rate of genetic gain for calf price by approximately €1.11 per annum (assuming 0.22 genetic standard deviation change per year). The inclusion of calf price increased genetic gain in calf price by a further €1.06 per annum to €2.17. The removal of the progeny carcass traits (carcass weight, conformation and fat) reduced the response to selection on calf price slightly but still remained relatively high (€1.69; Table 3). The inclusion of calf price had little impact on the genetic gain of the current goal traits in the EBI. The inclusion of calf price in the EBI increased the rate of genetic gain for milk yield (-18.83 to -21.21 kg) and is similar to the response to selection calculated by Berry et al. (2007). The exclusion of the progeny carcass traits increased the rate of genetic gain for milk yield further to -26.06 kg. The annual gain in fat and protein yield was reduced when calf price replaced the progeny carcass traits in the EBI, but were still higher than those previously reported for fat (0.5 kg) and protein yield (0.6 kg; Berry et al., 2007). When the progeny carcass traits were removed from the breeding goal the response to selection for carcass weight was reduced (1.00 to -0.25) but had little impact on carcass fat and conformation. Dairy farmers are unlikely however, to be rewarded for heavier progeny carcasses as most surplus animals are sold off farm at an early stage. The inclusion of calf price increased the response to selection on fertility traits (calving interval, survival and gestation length) but had no impact on mortality, maternal calving difficulty, locomotion or SCC. Although genetic gain for calf price increased, the overall genetic gain in profit may be reduced since genetic gain for both protein and fat yield were decreased.

Table 3. Response to selection for: 1) current goal traits included in the EBI, 2) with calf price included as a goal trait and 3) with calf price replacing progeny carcass weight, fat and conformation as goal traits.

Trait	Curent goal traits	With calf price included	With calf price replacing carcass traits
Milk (kg)	-18.83	-21.21	-26.06
fat (kg)	0.25	0.16	0.10
Protein (kg)	0.35	0.27	0.17
Calving Interval	-1.27	-1.28	-1.40
Survival	0.23	0.22	0.24
Calving Difficulty	-0.21	-0.17	-0.19
Gestation Length	-0.20	-0.16	-0.18
Mortality	-0.04	-0.04	-0.04
Maternal Calving Diff	0.06	0.05	0.06
Locomotion	-0.05	-0.05	-0.05
SCC	-0.01	-0.01	-0.01
Carcass Weight	1.00	1.15	-0.25
Carcass Conformation	0.07	0.09	0.05
Carcass Fat	0.01	0.01	0.03
Cow maintenance	0.14	0.28	0.07
Cow Carcass Weight	-0.75	-0.71	-1.85
Calf Price	1.11	2.17	1.69

Relative emphasis

The inclusion of calf price in the EBI led to a decrease in the relative emphasis on "beef progeny" traits compared to progeny carcass weight, fat and conformation (14% to 8%). The inclusion of calf price also resulted in a higher relative emphasis on the production and fertility traits, with calving interval achieving the highest increase (29% to 31%). However, overall the replacement of the progeny carcass traits with calf price had little impact on the relative emphasis of each trait.

Conclusions

The results for this study indicate that the inclusion of calf price in the EBI will not alter the response to selection of the current goal traits dramatically but will more accurately reflect on-farm profitability in Irish dairy herds.

References

Berry, D. P., L. Shallo, A. R. Cromie, V. Olori, R. F. Veerkamp, P. Dillon, P. R. Amer, R. D. Evans, J. F. Kearney, and B. Wickham. 2007. The economic breeding index: a generation on. Technical report to the Irish Cattle Breeding Federation. http://www.icbf.com/publications/files/The_Economic_breeding_a_generation_on_Dec_2007.pdf

Hazel, L.N. 1943. The genetic basis for constructing selection indexes. Genetics. 28:476- 490.

McHugh, N., A.G. Fahey, R.D., Evans, and D.P. Berry. 2010. Factors associated with selling price of cattle at livestock auctions. Animal. 8:1378-1389.

Mc Hugh, N., Evans, R.D., Amer, P.R., Fahey, A.G., and D.P. Berry. 2011. Genetic parameters for cattle price and live-weight from routinely collected data at livestock auctions and commercial farms. J. Anim. Sci. 89:29-39.

Pabiou T., W.F., Fikse, P.R. Amer, A.R. Cromie, A. Näsholm and D.P. Berry. 2011. Genetic relationships between carcass cut weights predicted from video image analysis and other performance traits in cattle. Animal. *In press*.

Shalloo, L., P. Dillon, M. Rath, and M. Wallace. 2003. Description and validation of the Moorepark dairy system model. Journal of Dairy Science. 87:1945-1959.

VanRaden, P.M. 2002. Selection of dairy cattle for lifetime profit, Proc. 8th WCGALP, Montpellier, France

Veerkamp, R.F., P. Dillon, E. Kelly, A.R. Cromie, and A.F. Groen. 2002. Dairy cattle objectives combining yield, survival and calving interval for pasture-based systems in Ireland under different milk quota scenarios. Livestock Production Science 76:137-151.