Utilizing Multibreed Commercial Slaughter Information in Beef Selection Indices in Ireland

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Abstract

The first aim of this study is to review the recent development of economic selection indices for beef cattle in Ireland, consisting of a beef production sub index (BPSI), beef and dairy calving sub indices (BPSI, DCSI), a maternal sub index (MSI), a weaned calf sub index (WCSI) and consequential total beef merit indices. The sub indices are designed to increase the profitability of different specific components of the beef industry. Secondly some initial results of a project that has begun, aiming to further optimize these developments, are presented. This project will focus on several issues including trait definition, modeling of breed effects in Irish data sets and determining appropriate fixed and random effects in a multibreed scenario. Initial heritabilities for carcase weight, carcase fat and carcase conformation as a function of age, using data gathered routinely in abattoirs, are presented. The data set was multibreed in nature. Fixed regressions on breed fractions were used to model breed effects. Carcase conformation for younger animals tended to have moderate to high heritabilities (0.32-0.50), while carcase fatness and carcase weight heritabilities for the same age range were slightly lower (0.23-0.39).

Introduction

To facilitate an Irish beef breeding program, recording systems, a central database, a genetic evaluation system, and economic indices have been put in place. The objectives of this paper are twofold. Firstly to briefly describe these developments in Ireland, and secondly to present the first results of a project that aims to further optimize genetic selection across breeds using abattoir information. Several questions will be addressed including appropriate fixed and random effects, modeling of breed effects in Irish data and trait definition. The initial focus is on trait definition as a function of age.

Data recording and genetic evaluation

The Irish genetic evaluation currently includes data on weights from pedigree herds and commercial weanling markets, weight and feed intake recorded on elite beef bulls at the Tully central testing station and carcase data recorded on pure and crossbred beef and dairy cattle in abattoirs by the national Cattle Movement and Monitoring System. Calving dates, sire and dam of calves and other valuable breeding and calving records are being captured from beef suckler farms, providing further information for genetic evaluation on maternal performance. These records are combined in a multitrait, across breed BLUP analysis providing breeding values for carcase conformation score, carcase fatness score, and carcase weight, feed intake, live weight and weaning weight. Linear type classification scores are also being investigated as early predictors of these traits. Furthermore, genetic evaluations of direct and maternal calving ease have been implemented across cattle breeds. Genetic evaluations for calving interval and survival are under development.

Economic indices

To simplify selection decisions, economic breeding indices, were released for widespread industry use in March 2005. The indices are partitioned into sub indices, each having common units (**€),** with positive always better**.** Information from the sub indices allows Irish cattle farmers (dairy and beef) to fine tune their selection decisions to their own specific needs. Discounted gene expressions (Berry *et al.,* 2005) and economics of beef production were accounted for (Amer *et al.,* 2001).

Beef Production Sub Index: The BPSI aims to select a profitable slaughter generation. Carcase weight accounts for approximately 57% of the index weight with 21%, 13%, 5% and 4% emphasis on dry matter intake, carcase conformation, weaning weight, and carcase fat respectively. In general the continental breeds perform better on this index but variation exists within breeds with consequential overlap between breeds (Figure 1).

Weaned Calf Sub Index: The WCSI aims to increase the genetic potential of calves sold at weaning. Calf quality has a weighting of 67% and weaning weight has a 33% weighting. Calf quality is currently predicted from weaning weight and carcase conformation score. Linear assessment scores in live pedigree animals will be added shortly. Continental breeds again perform better on this index but there is again considerable overlap between breeds for the rankings.

There is good agreement between performance on the BPSI and the WCSI because of a strong relationship between carcase weight and carcase conformation observed both within and across breeds.

Calving Sub Indices: The calving sub indices place direct costs on dystocia, increased gestation length and calf mortality. In beef the BCSI, dystocia receives 47.7% of the weight. A 12.5% weighting is placed on gestation length and 39.7% on mortality. For dairy, the DCSI is similar with larger relative weighting (46.9%) on gestation length, a 43.4% weight on calving difficulty and a 9.7% weight on calf mortality. The calving sub indices favor breeds which have not been heavily selected for growth and conformation, such as the Aberdeen Angus and Hereford.

Maternal Sub Index: The MSI will select profitable female replacements for the national beef herd. Calf mortality will receive 36.8% of the weight. Calving difficulty maternal (20.4%), calving difficulty direct (19.1%), cow survival (9.7%), gestation length direct (6.8%), calving interval direct (3.0%), weaning weight maternal (2.4%), weaning weight direct (0.15%) and cull cow carcase weight (0.2%) will receive progressively lesser weightings.

The different indices favor different breeds. This is evident when rankings of animals of different breeds for the BPSI and the WCSI are compared (Figure 1). The Aberdeen Angus performs well on the BCSI and less well on the BPSI. The reverse is true for the Charolais. Rankings on the BPSI, the WCSI and the calving indices were published in March 2005. Increasing the numbers of commercial beef herds from which pedigree data is collected, which will facilitate analysis of calving interval and survival, will allow publication of rankings on the MSI and a total beef index in the future. The total beef merit indices combine the different sub indices. Construction of these overall indices is based on the expected proportions of animals exported alive at weaning, retained for slaughter in Ireland, or retained as replacement females in the national herd.

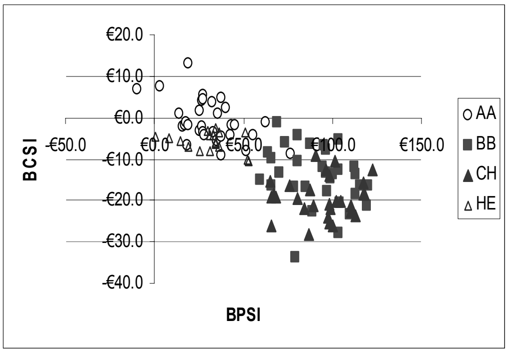

Figure 1. Performance of the bulls of four breeds, the Charolais (CH), the Aberdeen Angus (AA), the Hereford (HE) and the Belgian Blue (BB, on the beef production sub index (BPSI) and the beef calving sub index (BCSI).

Further developments: Materials and methods

The 521,579 records, used to estimate heritabilities for age class carcase traits, were gathered in Irish abattoirs. Edits ensured that animals had records of carcase fat (CF), carcase conformation (CC) and carcase weight (CW), birth herd, fattening herd, abattoir, slaughter age and at most two lifetime movements between farms. The pedigree was traced back 10 generations if possible. Records were then divided into 9 classes based on age at slaughter (Table 1). Age classes placed animals slaughtered at progressively later stages of life in separate classes or into two classes of young and old animals. Animals with a CW record >3 standard deviations from the mean of each age class were removed. Within age classes, 3 contemporary groups were formed, based on birth herd, year and season, finishing herd, year and season and factory year and season (Crump *et al.,* 1997). Breed fractions were then calculated by accumulating the primary breeds of ancestors from the 5 previous generations. Animals with an unknown breed fraction of >0.375 were removed.

Table 1. Age class and number of records for the defined traits.

Age class	No. of rec.
371-520	4800
521-665	6785
666-765	36187
766-865	25329
866-916	10526
917-1095	4864
1096-11660	14909
300-875	88052
876-4000	37026

160,333 animals remained for genetic analysis. CF and CC records were on either a 15 point scale or on a 5 point EUROP scale for CC or a 7 point 1,2,3,4L,4,4H and 5 scale for CF. Each score was given a value on a linear scale (Table 2). For CF scores this was based on extensions of Kempster *et al.* (1986). CW, CF and CC within each age class were defined as different traits. For each trait, univariate analyses with a sire model, was carried out in ASReml (Gilmour *et al.,* 2000). Fixed effects for sex, a fourth order polynomial on age at slaughter, the interaction between these two effects, contemporary groups of birth, fattening and slaughter and fixed regressions on fractions of seventeen breeds, on unknown breed fraction, on heterosis and on recombination were included.

Table 2. Scaling of conformation (CC) and fat classes (CF) to a continuous scale.

CC			CF		
15 point scale	*5 point scale*		*15 point scale*	*7 point scale*	
E+		15	5+		15
E=	E	14	5=	5	14
E-		13	5-		12
U+		12	4+	4H	9.8
U=	U	11	4=	4	9
U-		10	4-	4L	8.3
R+		9	3+		7.13
R=	R	8	3=	3	6
R-		7	3-		6
O+		6	2+		5
O=	O	5	2=	2	4.5
O-		4	2-		4
P+		3	1+		4
P=	P	2	**1=**	1	3
P-		1	**1-**		3

Results and Discussion

CC traits have higher heritabilities than CF or CW traits (Table 3). The oldest classes of animals 1096 – 11660 and 876 – 4000 have lower heritabilities, being 0.10-0.13 and 0.18-0.32 respectively. Irregular treatment of older animals within herds resulting in inflated phenotypic variance could be a reason for these lower heritabilities. Cows slaughtered in the same contemporary groups may cease lactation at different times and consequently having different opportunities to gain body reserves.

Conclusion

Different breeds perform better on different indices. There is variation within breeds in their performance on indices. Consequently breeds overlap in their performance on the different indices. Age does not appear to cause a trend in the heritability of carcase traits measured on the

EUROP scale in animals slaughtered at less than 30 months of age.

Table 3. Heritabilities (h^2) and standard errors (as subscripts) for carcase conformation (CC), carcase fat (CF) and carcase weight (CW) traits measured on animals of different ages.

	CC	CF	CW
Age class	h^2	h^2	h^2
371 - 520	$0.50_{0.04}$	$0.29_{0.05}$	$0.23_{0.05}$
521 - 665	$0.37_{0.04}$	$0.25_{0.04}$	$0.39_{0.04}$
666 - 765	$0.44_{0.02}$	$0.33_{0.02}$	$0.35_{0.02}$
766 - 865	$0.49_{0.02}$	$0.25_{0.02}$	$0.28_{0.02}$
866 - 916	$0.37_{0.04}$	$0.24_{0.04}$	$0.31_{0.04}$
917 - 1095	$0.42_{0.04}$	$0.25_{0.04}$	$0.15_{0.05}$
1096 - 11660	$0.10_{0.03}$	$0.12_{0.02}$	$0.13_{0.03}$
300 - 875	$0.50_{0.01}$	$0.32_{0.01}$	$0.36_{0.01}$
876 – 4000	$0.32_{0.02}$	$0.16_{0.02}$	$0.18_{0.02}$

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