

# DEVELOPMENT OF CONVERSION FORMULAE FOR TRAITS RELATED TO BEEF PRODUCTION IN IRELAND

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## Introduction

The Republic of Ireland has just over one million suckler and one million dairy cows (DAF-CMMS, 2006). Table 1 summarises the mating practice in Ireland: 59% of the calves born in 2006 were beef and/or dairy crossbred. Charolais (43%) was the most predominant sire breed used on suckler beef cows, followed by Limousin (30%), Angus (8%), Simmental (7%), Hereford (5%) and Belgian Blue (4%). The 'minor' beef breeds present in Ireland include the Blonde d'Aquitaine, Salers, Aubrac, Parthenaise, Piemontese and Maine Anjou. As most of these breeds originate from outside Ireland, a considerable amount of germplasm is imported annually to Ireland from Europe. In 2006, the Interbull centre in Uppsala (Sweden) extended its services to beef by creating InterBeef, the international genetic evaluation for beef cattle (InterBeef, 2007). Ireland is part of the InterBeef project and participated, in spring 2007, in the first international genetic evaluation for weaning weight between France, Ireland and The United Kingdom (Venot, 2007). While participating in the international genetic evaluation, Ireland has actively developed methods to give beef farmers, in the interim, access to foreign proofs on the Irish scale. The present paper will show the Republic of Ireland's approach to international genetic evaluation through conversion formulae. This approach will be phased out as AMACI for each trait becomes part of routine evaluations.

## Material and Methods

### French data

The data from France was extracted in April 2007 from the national database following the IBOVAL spring 2007 genetic evaluation. The data file contains the Estimated Breeding Values (EBV) and their accuracy for the following traits: direct (CNd) and maternal (AVel) calving difficulties, direct (CRsev) and maternal (ALait) weaning weights, muscle (DMsev) and skeletal (DSsev) composites. Data from the beef and progeny 2006-2007 evaluations was also extracted and the following traits were part of the study: carcass conformation (CONFjbs), carcass fat (GRASjbs) and carcass weight (PCARjbs).

### Irish data

The Irish data was extracted from the ICBF database in May 2007 following the national genetic evaluation. The predicted differences (PD) and their reliabilities used for this study were: direct (DCAL) and maternal (MCAL) calving difficulties, direct (DWW) and maternal (MWW) weaning weights, muscle (MUSC) and skeletal (SKEL)

composites, carcass weight (CWEI), carcass conformation (CCON), carcass fat (CFAT) and calf quality<sup>1</sup> (CQUA).

### Conversion equations

To estimate the parameters of the regression and in order to limit the bias due to selection of foreign bulls on the basis of their French proof, the proofs calculated in Ireland were deregressed according to the method proposed by Goddard (1985):

$$PD'_{IRL} = \frac{PD_{IRL} - u_{IRL}}{rel_{IRL}} + u_{IRL}$$

Where  $PD'_{IRL}$  is the deregressed form of the proof  $PD_{IRL}$  calculated in Ireland,  $rel_{IRL}$  the reliability computed in Ireland and  $u_{IRL}$  is the average of the genetic group or the population of bulls.

Stepwise regression using PROC REG (SAS, 2007) was used to develop the most parsimonious multiple-regression model. Multicollinearity between independent variables was quantified using the condition index and was avoided.

In order to detect possible outliers and leverage points and provide resistant (stable) results in the presence of outliers, regression coefficients for the generated model were also estimated using robust regression with PROC ROBUSTREG (SAS, 2007). The procedure computes some robust distances to detect outliers and leverage points (Colin, printed 2006, Weigel et al, 1999).

In order to maximise the number of animals included in the estimation of the parameters of the model as well as obtain confidence in the estimated parameters, the regression coefficients were estimated using sires with a reliability in Ireland of >10%, >20%, >30%...>90%. The chosen dataset is described in Table 2. The choice of the final population of bulls is guided by the analysis of the residuals, the observed correlations and the number of bulls in the sample of population.

Genetic correlations between traits across countries were estimated when applicable from the correlations between Irish estimated predicted differences and French breeding values and their reliabilities (Calo et al, 1973).

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<sup>1</sup> Calf quality = PD based, using marts data, on the animal weight and price per kilo predictors.

### Comparison of ranking

This method is a mean and standard deviation approach to integrate foreign proofs in the national evaluation where conversion equations could not be developed due to poor correlation and/or insufficient number of sires. It is solely designed for breeds who wish to have foreign proofs used in the national evaluation but whose population size does not facilitate the generation of conversion formulae. This approach applies only to convert similar traits in the foreign country to proofs in Ireland. The principle is to apply the standard deviation from the mean of the trait from the foreign country to the Irish scale of the trait to obtain an 'equivalent' ranking. This non genetic approach will be phased out as soon as conversion equations for each trait can be developed.

### Blending the new proofs in the national evaluation

This method for blending the converted proofs into the Irish national proofs was described by Olori et al. (2002). When a foreign bull has a proof in Ireland based on its progeny, the Irish proof is official if its reliability is at least 50%; otherwise, the converted foreign and the Irish proofs are blended according to the following equation:

$$PD_b = \frac{\frac{1}{1 - rel_{IRL}} \times PD_{IRL} + \frac{1}{1 - rel_{CONV}} \times PD_{CONV}}{\frac{1}{1 - rel_{IRL}} + \frac{1}{1 - rel_{CONV}}}$$

and the reliability of the blended proof is:

$$rel_b = 1 - \frac{1}{\left( \frac{1}{1 - rel_{IRL}} + \frac{1}{1 - rel_{CONV}} \right) - 1}$$

*where*  $PD_b$  = blended proof

$PD_{IRL}$  = Irish proof

$PD_{CONV}$  = converted proof

$rel_{IRL}$  = Reliability of the Irish proof

$rel_{CONV}$  = reliability of the converted proof

$rel_b$  = reliability of the blended proof

### Results

Only the French proofs using birth to weaning on-farm performances have been used; the carcass proofs extracted from the beef progeny programs could not be used because of insufficient number of beef progeny in Ireland ( $n < 8$ ,  $n < 12$  for Charolais and Limousine, respectively). Thus, the on-farm based French proofs could not be converted for carcass fat in either breed.

Table2 gives the details about the connection between Ireland and France used in the conversion equations. The estimated genetic correlation was low in the Limousine breed for maternal weaning weight ( $r_g = 0.39$ ) and averaged approximately 0.60 for the direct calving difficulty and carcass weight in both breeds. Strong genetic correlations ( $> 0.70$ ) were observed for direct weaning weight, the muscle and linear composites, carcass conformation and calf quality.

**Table2** Number of bulls (N), average reliability of the trait in Ireland ( $rel_{IRL}$ ) and estimated genetic correlation ( $r_g$ ) between Ireland and France for the Charolais and Limousine

|                             |      | Charolais |             |       | Limousine |             |       |
|-----------------------------|------|-----------|-------------|-------|-----------|-------------|-------|
|                             |      | N         | $rel_{IRL}$ | $r_g$ | N         | $rel_{IRL}$ | $r_g$ |
| Irish Predicted Differences | DCAL | 25        | 60          | 0.59  | 24        | 80          | 0.59  |
|                             | MCAL | 18        | 50          | 0.78  | 10        | 70          | 0.55  |
|                             | DWW  | 58        | 60          | 0.80  | 54        | 70          | 0.83  |
|                             | MMW  | 12        | 60          | 0.61  | 22        | 30          | 0.39  |
|                             | MUSC | 54        | 70          | 0.77  | 64        | 70          | 0.83  |
|                             | SKEL | 53        | 70          | 0.81  | 64        | 70          | 0.77  |
|                             | CCON | 47        | 60          | 0.92  | 65        | 50          | 0.82  |
|                             | CWEI | 26        | 60          | 0.55  | 53        | 50          | 0.51  |
|                             | CQUA | 37        | 50          | 0.70  | 58        | 40          | 0.82  |

In May 2007 and according to the rule of blending, the proofs of 6,904 Charolais and 5802 Limousine animals originated in France and present in the Irish genetic database were converted to the Irish scale. Because of insufficient data and/or low correlation, the maternal weaning weight proofs for Charolais and Limousine and maternal calving difficulty for Limousine were converted using the comparison of ranking approach instead of conversion formulae.

Table3 and Table4 give the parameters of the conversions for each of the trait for the Charolais and Limousine breeds, respectively.

### Discussion

The beef farmers and industry in Ireland have seen the benefit and are very keen to use the converted/blended proofs. It has been introduced successfully in May 2007 in the national genetic evaluation process for the Charolais and Limousine breeds as a first step towards international genetic evaluation. The use of conversion equations will stop when AMACI for each trait becomes part of routine evaluations.

Other breeds have shown great interest in making use of foreign breeding values: Hereford, Simmental, Angus, Blonde d'Aquitaine, Belgian Blue, Salers, Aubrac, Parthenaise and Piemontese. Depending on the size of their population in Ireland and on the degree of connection between Ireland and the foreign country(ies), conversion equations or comparison of ranking will be used. The Hereford breed is already participating in the international Hereford evaluation conducted by the University of Armidale in Australia.

This study has also clearly shown the importance of the animal identification and of the management of identification database.

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**Table1:** Number of purebred (diagonal) and crossbred calves born in 2006 by breed of sire and breed of dam as recorded through CMMS and published by the Irish Department of Agriculture.

| DAM<br>SIRE  | CH            | LM            | HE            | AA            | SI            | BB           | SH           | BA          | SA          | HO FR         | MO           | RB          | MY          | JE          | Other       | Total          |
|--------------|---------------|---------------|---------------|---------------|---------------|--------------|--------------|-------------|-------------|---------------|--------------|-------------|-------------|-------------|-------------|----------------|
| CH           | 167454        | 90984         | 53022         | 47749         | 60376         | 20067        | 12114        | 1614        | 2615        | 35395         | 2176         | 192         | 350         | 127         | 815         | 495050         |
| LM           | 55255         | 129415        | 36936         | 31132         | 40889         | 17868        | 8342         | 1736        | 1322        | 98115         | 3457         | 434         | 616         | 166         | 1013        | 426696         |
| HE           | 4508          | 5253          | 26189         | 5135          | 4781          | 1745         | 1525         | 156         | 123         | 137625        | 2589         | 663         | 441         | 276         | 476         | 191485         |
| AA           | 10814         | 13646         | 10715         | 32114         | 8624          | 4299         | 2966         | 275         | 321         | 167894        | 4001         | 1371        | 552         | 714         | 1419        | 259725         |
| SI           | 11225         | 12154         | 10615         | 6305          | 32364         | 2958         | 1885         | 244         | 295         | 35977         | 1272         | 163         | 192         | 39          | 255         | 115943         |
| BB           | 7216          | 12832         | 4750          | 5273          | 6325          | 7240         | 1183         | 595         | 247         | 37891         | 1491         | 126         | 204         | 137         | 276         | 85786          |
| SH           | 1239          | 1674          | 1295          | 1540          | 1004          | 545          | 7617         | 30          | 83          | 3066          | 185          | 23          | 79          | 37          | 140         | 18557          |
| BA           | 1400          | 2140          | 983           | 803           | 1297          | 825          | 191          | 1801        | 41          | 2099          | 143          | 36          | 6           | 1           | 40          | 11806          |
| SA           | 1467          | 1605          | 698           | 959           | 879           | 425          | 485          | 143         | 2414        | 2181          | 120          | 44          | 26          | 4           | 73          | 11523          |
| HO FR        | 560           | 994           | 1440          | 1295          | 1246          | 740          | 537          | 27          | 15          | 452589        | 4163         | 1779        | 871         | 1801        | 1169        | 469226         |
| MO           | 73            | 124           | 113           | 124           | 282           | 69           | 48           | 7           | 0           | 11095         | 6460         | 130         | 264         | 70          | 133         | 18992          |
| RB           | 16            | 23            | 15            | 17            | 36            | 34           | 18           | 3           | 1           | 3569          | 226          | 1829        | 173         | 12          | 71          | 6043           |
| MY           | 13            | 45            | 22            | 19            | 24            | 9            | 17           | 0           | 1           | 730           | 58           | 17          | 988         | 3           | 6           | 1952           |
| JE           | 1             | 5             | 7             | 9             | 6             | 7            | 4            | 0           | 1           | 3561          | 94           | 75          | 5           | 1282        | 95          | 5152           |
| Other        | 866           | 1129          | 502           | 565           | 634           | 367          | 217          | 118         | 103         | 4870          | 272          | 110         | 100         | 94          | 3379        | 13326          |
| <b>Total</b> | <b>262107</b> | <b>272023</b> | <b>147302</b> | <b>133039</b> | <b>158767</b> | <b>57198</b> | <b>37149</b> | <b>6749</b> | <b>7582</b> | <b>996657</b> | <b>26707</b> | <b>6992</b> | <b>4867</b> | <b>4763</b> | <b>9360</b> | <b>2131262</b> |

CH Charolais

LM Limousin

HE Hereford

AA Angus

SI Simmental

BB Belgian Blue

SH Shorthorn

BA Blonde d'Aquitaine

SA Salers

FR Holstein Friesian

MO Montbeliarde

RB Rotbunt

MY Meuse Rhine Yssel

JE Jersey

**Table3** The parameters of the conversion equations calculated for the Charolais breed between the French IBOVAL 2007 and the Irish national genetic evaluation from May 2007.

| <b>CHAROLAIS</b>                   |             | <b>French Breeding Values</b> |                      |                      |                      |                      |                      |         |
|------------------------------------|-------------|-------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------|
|                                    |             | <b>CNd</b>                    | <b>AVel</b>          | <b>CRsev</b>         | <b>ALait</b>         | <b>DMsev</b>         | <b>DSsev</b>         |         |
|                                    |             | <b>a</b>                      | <b>b<sub>1</sub></b> | <b>b<sub>2</sub></b> | <b>b<sub>3</sub></b> | <b>b<sub>4</sub></b> | <b>b<sub>5</sub></b> |         |
| <b>Irish predicted differences</b> | <b>DCAL</b> | 23.9078                       | -0.2139              |                      |                      |                      |                      |         |
|                                    | <b>MCAL</b> | 7.9506                        |                      | -0.0956              |                      |                      |                      |         |
|                                    | <b>DWW</b>  | -139.3825                     |                      |                      | 0.7221               |                      | 0.2543               |         |
|                                    | <b>MWW</b>  | -27.8724                      |                      |                      |                      | 0.1835               |                      |         |
|                                    | <b>MUSC</b> | -35.9924                      |                      |                      | 0.4139               |                      | 1.0157               |         |
|                                    | <b>SKEL</b> | -2.4359                       |                      |                      |                      |                      | -0.2407              | 1.2966  |
|                                    | <b>CCON</b> | 0.1361                        |                      |                      |                      |                      | 0.0332               | -0.0199 |
|                                    | <b>CWEI</b> | -64.0767                      |                      |                      | 0.5011               |                      | 0.4265               |         |
|                                    | <b>CQUA</b> | 20.1161                       |                      |                      |                      |                      | 0.3061               | -0.2966 |

Direct (CNd) and maternal (AVel) calving difficulties, direct (CRsev) and maternal (ALait) weaning weights, muscle (DMsev) and skeletal (DSsev) composites  
 Direct (DCAL) and maternal (MCAL) calving difficulties, direct (DWW) and maternal (MWW) weaning weights, muscle (MUSC) and skeletal (SKEL) composites, carcass weight (CWEI), carcass conformation (CCON), carcass fat (CFAT) and calf quality (CQUA)

**Table4** The parameters of the conversion equations calculated for the Limousine breed between the French IBOVAL 2007 and the Irish national genetic evaluation from May 2007.

| <b>LIMOUSINE</b>                   |             | <b>French Breeding Values</b> |                      |                      |                      |                      |                      |         |
|------------------------------------|-------------|-------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------|
|                                    |             | <b>CNd</b>                    | <b>AVel</b>          | <b>CRsev</b>         | <b>ALait</b>         | <b>DMsev</b>         | <b>DSsev</b>         |         |
|                                    |             | <b>a</b>                      | <b>b<sub>1</sub></b> | <b>b<sub>2</sub></b> | <b>b<sub>3</sub></b> | <b>b<sub>4</sub></b> | <b>b<sub>5</sub></b> |         |
| <b>Irish predicted differences</b> | <b>DCAL</b> | 14.8982                       | -0.1341              |                      |                      |                      |                      |         |
|                                    | <b>MCAL</b> | 3.1460                        |                      | -0.0555              |                      |                      |                      |         |
|                                    | <b>DWW</b>  | -81.2322                      |                      |                      | 0.6439               |                      | 0.1927               |         |
|                                    | <b>MWW</b>  | -25.8734                      |                      |                      |                      | 0.2035               |                      |         |
|                                    | <b>MUSC</b> | 14.9955                       |                      |                      |                      |                      | 0.8798               |         |
|                                    | <b>SKEL</b> | 31.7378                       |                      |                      |                      |                      |                      | 0.7075  |
|                                    | <b>CCON</b> | 1.1558                        |                      |                      |                      |                      | 0.0233               | -0.0182 |
|                                    | <b>CWEI</b> | -83.6654                      |                      |                      |                      |                      | 0.4868               | 0.5142  |
|                                    | <b>CQUA</b> | 33.3959                       |                      |                      |                      |                      | 0.2880               | -0.4038 |

Direct (CNd) and maternal (AVel) calving difficulties, direct (CRsev) and maternal (ALait) weaning weights, muscle (DMsev) and skeletal (DSsev) composites  
 Direct (DCAL) and maternal (MCAL) calving difficulties, direct (DWW) and maternal (MWW) weaning weights, muscle (MUSC) and skeletal (SKEL) composites, carcass weight (CWEI), carcass conformation (CCON), carcass fat (CFAT) and calf quality (CQUA)