Effect of Standardisation of Within Country-Year Sire Variance of De-Regressed Proofs on International Evaluations

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Introduction

In recent years, the exchange of genetic resources among countries has stimulated research on more accurate methods for international comparison of dairy bulls. Joint evaluation of bulls from various countries has been carried out by Interbull, using the MACE procedure developed by Schaeffer (1994).

The goal of MACE is to provide the fairest comparison of international bulls. MACE allows for different heritabilities, correlations lower than unity among countries, and all relationships among animals are included. However, MACE has been shown to be sensitive to genetic parameters (Schaeffer et al., 1994). Differences in genetic parameters across countries may be due to differences in breeding schemes strategies adopted over time within country and to the correctness of national genetic evaluations.

Heterogeneity of sire standard deviation over time within country has been shown (Cassandro et al., 1996). A remaining question is the potential impact on MACE evaluations of this variance heterogeneity.

Within-country genetic standard deviation is influenced by selection, importation of different breeds or strains, heterogeneity of variance adjustments, improvements in herd management practices, and other factors (Weigel et al., 1996). Recently, two approaches were proposed to apply MACE procedure for estimating EBV of bulls corrected for heterogeneous variance within country (Cassandro, 1996). The first approach works on the genetic heterogeneous variance identifying sub traits per country covering different time periods, depending on the trend on sire standard deviation. It allows to use all available data, but requires a complex genetic and residual covariance matrix. The second approach works on the phenotypic heterogeneous variance standardizing de-regressed proofs within country.

The objective of this study is to evaluate the effect of standardization of sire de-regressed proofs (DPF) variance, within country, on international comparisons for protein yield.

Materials and methods

Data consisted of estimated breeding values of four countries: Italy (ITA, December, ›96), United States (USA, January, =97), The Netherlands (NLD, January, ›97) and Germany (DEU, January, ›97). Following the current routine international genetic evaluation, the editing procedures were applied as presented by Interbull centre on february 1997. Only protein yield was analyzed. Statistical descriptions of data are reported in Table 1.

Number of proven bulls per year and number of daughters per proven bulls are shown in Table 2. The large reduction of number of bulls shown in each country for the last year (1992), except for NLD, is mainly due to the time needed to prove young bulls. Differences in bulls group size per year and in average progeny group size are due to differences on efficiency among national breeding schemes. Over the last 10 years, an expected reduction on average progeny group size was observed in each country. This reduction is mainly due to the effect between the first and second crop which is almost the same in each country. However, on the last few years clear differences among countries on average progeny group size shows different strategies on breeding schemes among countries. Moreover, in Table 3 are shown the trends of proofs and DPF within country-year.

After the de-regression procedure, the following standardization was applied to each proof:

$$DPFs_{ijk} = [(DPF_{ijk} - \mu\ DPF_{jk}) / \sigma\ DPF_{jk}] * \sigma\ DPF1990_k + \mu\ DPF_{jk}$$

where

$DPFs_{ijk}$ = standardized de-regressed proof (DPF) of the i^{mo} bull of the j^{mo} year of birth in the k^{mo} country.

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$\mu\ DPF_{jk}$ = average de-regressed proof of the j^{mo} year of birth in the k^{mo} country.

$\sigma\ DPF_{jk}$ = standard deviation of de-regressed proof of the j^{mo} year of birth in the k^{mo} country.

$\sigma\ DPF1990_k$ = standard deviation of de-regressed proof of the 1990 year of birth in the k^{mo} country, used as reference base.

Two runs of MACE were performed. The first run (NORM) was used as control with the DPF not standardized. The second run (STD) used the DPF standardized as above. Results from the two MACE runs were compared to investigate the impact of standardization within country-year sire variance of DPF on MACE evaluations.

Results and discussion

Within country-year sire standard deviation of proofs and DPF are reported in Table 4. Descriptive statistics of the two sets of MACE runs are shown in Table 5. The rank correlations between NORM and STD for each country were very high, ranging from .989 to .992. However, the top 100 list of bulls showed an evident re-ranking (Table 6). For instance, with standardization, the Italian scale shows DEU and USA having decreased by 2 and 17 bulls, respectively, while ITA and NLD increased by 13 and 6 bulls , respectively. A similar pattern can be seen on scales from the other three countries, thus suggesting that heterogeneity of variance has a strong impact on international evaluations.

Figures 1 and 2 show estimated breeding values averaged by year of birth, for both NORM and STD on the Italian scale. The comparison between the two figures show a change of trend among countries after standardization.

Lastly, standardization produced evident changes on conversion factors (Table 7).

Conclusions

Sire standard deviations and DPF standard deviation are heterogeneous within country over time. This study has attempted to demonstrate the impact of heterogeneity of variance of DPF within country over time on MACE evaluations. Re-ranking of top bulls was evident, together with changes of conversion factors and differences of average EBV. These results are at this stage observations and suggest the need for further studies including simulations to identify the appropriate use of data under such conditions.

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Table 1: Statistical descriptions of data analyzed using bull born since 1980.

	ITA	USA	NLD	DEU
Date of evaluation	Dec. '96	Jan.'97	Jan. '97	Jan. '97
- Bull (N.)	2698	14214	4405	6263
- Birth year	86 ± 3	86 ± 4	86 ± 4	86 ± 4
Minimum	80	80	80	80
Maximum	92	92	92	92
- Daughters/Bull (N.)	305 ± 1014	265 ± 1449	394 ± 3548	323 ± 1299
Minimum	10	10	15	10
Maximum	20955	59757	138322	39111
- Herds/Bull (N.)	140 ± 335	118 ± 444	194 ± 801	176 ± 470
Minimum	10	10	10	10
Maximum	5487	9842	17986	8839
- ETA for Protein (kg)*	8.4 ± 10.2	10.2 ± 23.5	-0.2 ± 10.6	-5.1 ± 7.5
Minimum	-33.0	-96.0	-35.5	-19.1
Maximum	33.5	88.0	30.5	35.2

* lbs for USA data

Table 2: Trend of the number of proven bulls used, within country[1].

Birth year of bull	ITA		USA		NLD		DEU	
	No. Bulls	No. Daugs	No. Bulls	No. Daugs	No. Bulls	No. Daugs	No. Bulls	No. Daugs
80	122	640	887	562	348	758	489	438
81	111	805	888	618	370	458	484	492
82	134	848	944	571	403	674	458	474
83	139	452	948	443	324	546	473	592
84	150	544	929	400	338	258	406	394
85	129	508	1024	379	328	662	400	490
86	256	372	1200	317	301	491	451	447
87	264	142	1200	149	270	383	398	220
88	258	90	1272	80	320	248	454	183
89	296	79	1360	61	353	116	566	135
90	330	75	1358	61	330	126	640	118
91	270	61	1316	55	333	137	595	87
92	48	27	715	30	266	86	160	38
Total	2507	305	14041	265	4284	394	5974	323

[1] Daugs = daughters per proven bull

Table 3: Trend of average for ETA and DPF for protein yield within country [1,2].

Birth year of Bull	Average of protein yield							
	ITA		USA		NLD		DEU	
	ETA	DPF	ETA	DPF	ETA	DPF	ETA	DPF
80	-3.83	-4.30	-15.08	-15.97	-12.61	-12.83	.38	.34
81	-1.34	-1.68	-10.75	-12.01	-9.71	-9.87	1.14	1.12
82	.55	.14	-7.58	-8.86	-8.39	-8.64	1.30	1.30
83	1.65	1.30	-5.25	-6.04	-5.65	-5.73	1.67	1.56
84	1.66	1.67	-3.54	-4.63	-4.69	-4.80	1.92	1.83
85	3.67	3.28	1.37	.77	-2.29	-2.32	3.02	3.03
86	7.21	6.90	8.58	7.72	.72	.56	4.67	4.71
87	8.97	8.91	11.88	11.17	3.53	3.49	5.33	5.30
88	12.10	12.12	16.21	15.88	5.64	5.57	6.32	6.36
89	13.19	13.18	21.23	21.20	6.74	6.76	7.55	7.74
90	13.52	13.51	27.00	26.88	7.45	7.49	9.00	9.19
91	16.68	16.79	32.96	32.98	10.18	10.23	11.01	11.10
92	17.41	17.49	40.53	40.95	12.53	12.73	13.65	14.95
Average	8.56	8.43	10.41	9.86	-0.23	-0.30	5.02	5.08

[1]DPF = de-regressed proofs; [2] ETA and DPF are lbs for USA data

Table 4: Trend of the standard deviation for ETA and DPF for protein yield [1,2].

Birth year of Bull	Standard deviation of protein yield							
	ITA		USA		NLD		DEU	
	ETA	DPF	ETA	DPF	ETA	DPF	ETA	DPF
80	12.09	13.42	17.01	22.83	8.62	9.12	5.65	6.78
81	13.14	13.95	17.67	22.97	8.32	8.91	6.18	7.45
82	12.58	13.85	19.07	23.93	7.58	8.38	5.96	7.05
83	10.24	11.66	17.91	22.82	7.36	8.03	6.02	7.02
84	9.33	10.41	17.74	22.51	7.01	7.69	6.03	6.96
85	9.47	10.34	16.24	20.59	6.98	7.47	6.67	7.75
86	8.16	9.22	16.80	21.69	7.23	7.80	6.62	7.58
87	5.89	6.90	16.35	21.13	6.63	7.13	6.01	7.12
88	6.76	8.25	16.78	22.34	6.70	7.30	6.73	7.85
89	6.22	7.71	16.68	22.86	7.17	8.03	7.36	8.59
90*	5.76	**7.00**	16.10	**22.12**	6.60	**7.17**	6.58	**7.89**
91	5.29	7.11	16.26	22.84	6.69	7.36	6.69	8.01
92	5.06	7.99	16.38	27.14	5.63	6.60	6.40	10.29
Average	7.76	9.08	16.93	22.59	7.17	7.82	6.40	7.62

[1]DPF = de-regressed proofs; [2] ETA and DPF are lbs for USA data; *reference base

Table 5: Sire standard deviation, EBV statistics and rank correlation (28286 bulls).

	ITA	USA	NLD	DEU
Sire SD	8.44	21.32	7.70	7.39
NORM				
average	14.4	1.9	-0.2	14.9
SD	20.3	26.9	26.2	16.2
STD				
average	7.8	3.9	-0.8	16.2
SD	18.9	26.2	18.0	16.7
Rank correlation	.981	.992	.990	.989

Table 6: Effect on re-ranking on top 100 bulls.

	FROM			
TO	ITA	USA	NLD	DEU
ITA NORM	1	68	20	11
STD	14	51	26	9
USA NORM	1	71	22	6
STD	12	52	31	5
NLD NORM	1	56	32	10
STD	7	43	42	8
DEU NORM	1	63	24	12
STD	14	49	29	8

Table 7: Conversion factors for foreign bulls to ITA.

	Bulls	a	b
ITA <- USA	6534		
NORM		12.21	.746
STD		5.30	.696
ITA <- NLD	1926		
NORM		15.56	1.047
STD		8.22	1.004
ITA <- DEU	2799		
NORM		-1.14	1.090
STD		-7.19	1.017

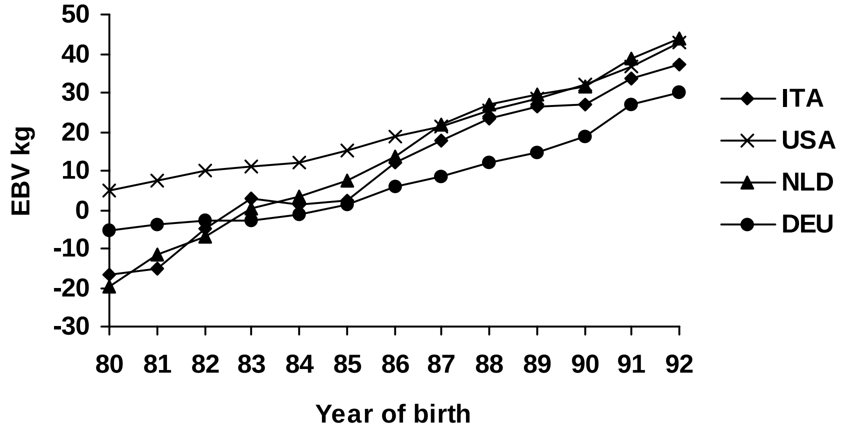

Figure 1. Average EBV for protein yield on the Italian scale (NORM run)

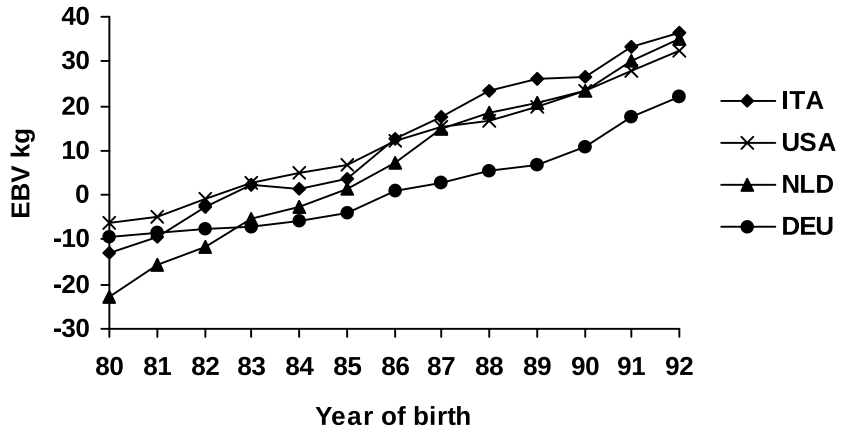

Figure 2. Average EBV for protein yield on the Italian scale (STD run)