National Index Correlations and Expected vs. Actual Use of Foreign Sires

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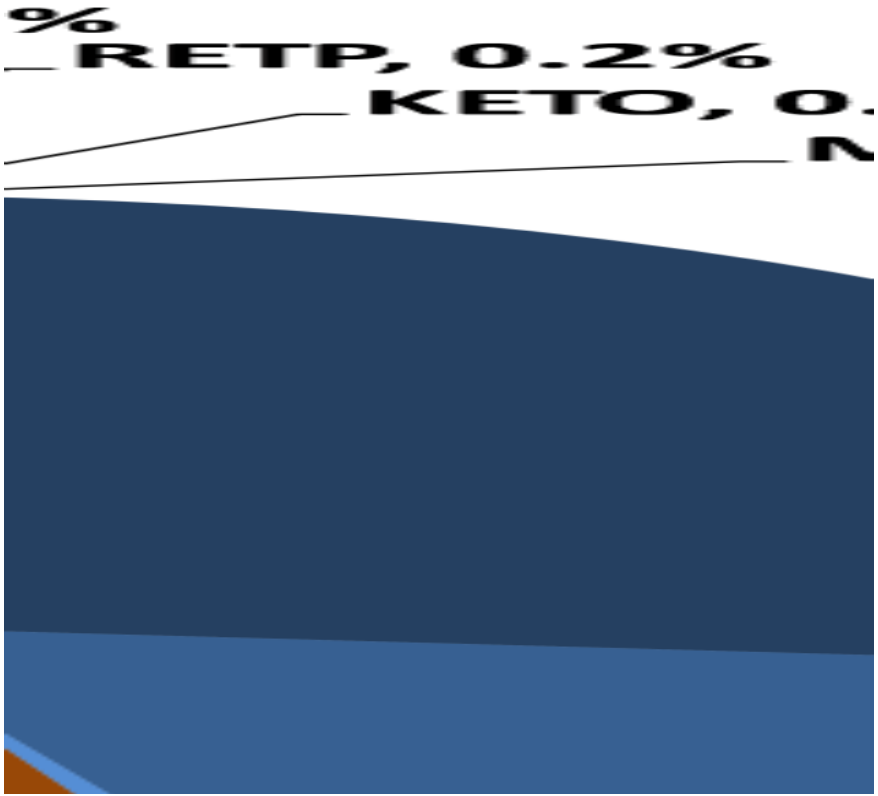


Backgrounds

- **Interbull uses a MACE method for genetic evaluation**
  - Measure genetic merit of dairy bulls for individual traits
  - Does not use selection index for ranking bulls

- **Reranking of the same bulls across countries**
  - Use of different relative emphasis in national selection indexes
  - Genetic correlations < 1.0 between estimated EBV traits
  - The incidence of missing traits in the selection index

Relative emphasis in 2018 USA index (NM$)



UC	Udder composite
BWC	Body weight composite
FLC	Feet-legs composite
DPR	Daughter pregnancy rate
CCR	Cow conception rate
HCR	Heifer conception rate
CA$	Calving ability (calving ease & stillbirth rate)
PL	Productive life
LIV	Livability
SCS	Somatic cell score
MAST	Mastitis
METR	Metritis
DA	Displaced abomasum
RETP	Retained placenta
KETO	Ketosis
MFEV	Milk fever

Objectives

- **Is reranking caused by low index correlations or genetic correlations?**
  - Tested different indexes applied to the EBVs on USA scale
  - Tested the USA index applied to the EBVs on different country's scale

- **Is the actual and expected use of top foreign bulls similar across countries?**
  - Actual use can retrieve from documented bulls across countries
  - Expected use can derive from using the index of each country on its EBV scale

Relative emphasis in national indices

		Trait emphasis (%)											
		Production			Health and Reproduction				Functionality and Durability				
Country (Index)	Year	Milk	Fat	Protein	Fertility	SCS	MAST	CA	Longevity	Feet/Legs Composite	Udder Composite	Type	BWC	Others
Australia (BPI)	2019	-8	25	22	13	-10	—	—	—	—	—	12	-3	7
Canada (LPI)	2019	—	16	24	13.4	-3.3	3.3	—	8	11.2	14.8	—	6	—
France (GDM)	2014	-9	4	27	20	-12	3	—	—	12.5	—	10	—	2.5
Germany (RZG)	2019	—	14.8	30.2	10	-7	—	3	20	4.5	6	4.5	—	—
Ireland (EBI)	2018	-8.9	7	17.9	23	-2	1	5	11	—	—	—	-6	13
Israel (PD11)	2011	—	15	41	16	-13	—	3	8	—	—	—	—	4
Italy (PFT)	2013	-2.5	9	37.5	10	-10	—	—	8	6	13	4	—	—
Japan (NTP)	2010	—	19.4	52.6	—	-4	—	—	—	3.6	20.4	—	—	—
Netherlands (NVI)	2018	—	10	19	16	-12	—	5	12	16	5	—	-5	—
New Zealand (BW)	2019	-13	20	18	13	-7	—	—	11	—	—	—	-11	—
Scandinavia (NTM)	2018	-7.8	17.2	21.9	12.8	—	14.5	6.9	4.7	3.2	3.8	—	—	4.7
Spain (ICO)	2013	22	5	30	3	-3	—	—	19	9	9	—	—	—
Switzerland (ISEL)	2013	-5.6	9.4	29.9	15	-8	—	—	10	5	5	7.5	-2.5	2

Others: Milking speed, Temperament, Carcass weight, Carcass fat, Carcass conformation, Cull cow weight, Lactation persistency, Workability, health traits sub-index

Evaluations of proven HOL bulls

- **Data obtained from Dec 2019 routine MACE files**
  - Missing EBVs in some countries for different traits was imputed
    - Using the mean of available EBV grouped by birth year
  - The EBVs for each trait standardized by dividing by one SD
    - Afterwards, each national index calculated from multiplying standardized EBVs of each trait by the corresponding relative emphasis and then summed.

- **Correlations among national indices**
  - A subset of bulls (n=1847) born 2005-2010 at least 200 daughters with yield records on USA scale.

Different national indices applied to EBV on USA scale

Correlations among national indices

	AUS	CAN	CHE	DEU	DFS	ESP	FRA	GBR	IRL	ISR	ITA	JPN	NLD	NZL	USA
AUS	1.00	0.89	0.90	0.89	0.83	0.72	0.80	0.72	0.62	0.89	0.89	0.82	0.80	0.79	0.90
CAN	0.89	1.00	0.92	0.91	0.81	0.86	0.87	0.66	0.53	0.82	0.96	0.88	0.82	0.59	0.83
CHE	0.90	0.92	1.00	0.98	0.80	0.83	0.91	0.87	0.77	0.93	0.96	0.78	0.94	0.81	0.93
DEU	0.89	0.91	0.98	1.00	0.81	0.89	0.82	0.82	0.74	0.96	0.96	0.83	0.91	0.80	0.96
DFS	0.83	0.81	0.80	0.81	1.00	0.76	0.70	0.59	0.67	0.83	0.77	0.75	0.70	0.71	0.84
ESP	0.72	0.86	0.83	0.89	0.76	1.00	0.64	0.53	0.47	0.86	0.90	0.90	0.71	0.52	0.78
FRA	0.80	0.87	0.91	0.82	0.70	0.64	1.00	0.81	0.67	0.74	0.85	0.62	0.90	0.65	0.74
GBR	0.72	0.66	0.87	0.82	0.59	0.53	0.81	1.00	0.90	0.76	0.73	0.41	0.95	0.90	0.86
IRL	0.62	0.53	0.77	0.74	0.67	0.47	0.67	0.90	1.00	0.75	0.59	0.31	0.84	0.91	0.81
ISR	0.89	0.82	0.93	0.96	0.83	0.86	0.74	0.76	0.75	1.00	0.91	0.82	0.84	0.83	0.93
ITA	0.89	0.96	0.96	0.96	0.77	0.90	0.85	0.73	0.59	0.91	1.00	0.90	0.85	0.67	0.87
JPN	0.82	0.88	0.78	0.83	0.75	0.90	0.62	0.41	0.31	0.82	0.90	1.00	0.59	0.47	0.73

USA index applied to EBV on different national scales

Correlations among national indices

	AUS	CAN	CHE	DEU	DFS	ESP	FRA	GBR	IRL	ISR	ITA	JPN	NLD	NZL	USA
AUS	1.00	0.74	0.72	0.74	0.74	0.74	0.84	0.71	0.82	0.76	0.69	0.79	0.69	0.86	0.71
CAN	0.74	1.00	0.92	0.94	0.96	0.96	0.85	0.94	0.92	0.93	0.93	0.80	0.92	0.80	0.97
CHE	0.72	0.92	1.00	0.95	0.94	0.94	0.88	0.94	0.91	0.91	0.94	0.81	0.95	0.83	0.91
DEU	0.74	0.94	0.95	1.00	0.94	0.95	0.90	0.91	0.89	0.92	0.92	0.85	0.92	0.79	0.93
DFS	0.74	0.96	0.94	0.94	1.00	0.96	0.87	0.95	0.92	0.93	0.94	0.83	0.95	0.83	0.94
ESP	0.74	0.96	0.94	0.95	0.96	1.00	0.87	0.95	0.91	0.94	0.97	0.82	0.94	0.81	0.96
FRA	0.84	0.85	0.88	0.90	0.87	0.87	1.00	0.81	0.86	0.88	0.85	0.92	0.85	0.80	0.84
GBR	0.71	0.94	0.94	0.91	0.95	0.95	0.81	1.00	0.92	0.91	0.92	0.76	0.94	0.84	0.93
IRL	0.82	0.92	0.91	0.89	0.92	0.91	0.86	0.92	1.00	0.89	0.88	0.77	0.90	0.93	0.89
ISR	0.76	0.93	0.91	0.92	0.93	0.94	0.88	0.91	0.89	1.00	0.93	0.80	0.94	0.83	0.94
ITA	0.69	0.93	0.94	0.92	0.94	0.97	0.85	0.92	0.88	0.93	1.00	0.79	0.94	0.79	0.93
JPN	0.79	0.80	0.81	0.85	0.83	0.82	0.92	0.76	0.77	0.80	0.79	1.00	0.79	0.73	0.78

National index applied to their own EBV scale

Correlations among national indices

Index and scale		AUS	CAN	CHE	DEU	DFS	ESP	FRA	GBR	IRL	ISR	ITA	JPN	NLD	NZL	USA
Index and scale	AUS	1.00	0.74	0.71	0.72	0.70	0.56	0.64	0.56	0.57	0.75	0.71	0.72	0.60	0.77	0.72
	CAN	0.74	1.00	0.87	0.87	0.80	0.82	0.80	0.63	0.57	0.79	0.90	0.86	0.76	0.60	0.80
	CHE	0.71	0.87	1.00	0.91	0.72	0.78	0.91	0.76	0.68	0.85	0.91	0.80	0.86	0.72	0.81
	DEU	0.72	0.87	0.91	1.00	0.75	0.88	0.78	0.73	0.66	0.92	0.90	0.85	0.85	0.70	0.90
	DFS	0.70	0.80	0.72	0.75	1.00	0.70	0.62	0.53	0.63	0.74	0.69	0.75	0.63	0.69	0.78
	ESP	0.56	0.82	0.78	0.88	0.70	1.00	0.64	0.50	0.46	0.83	0.83	0.86	0.69	0.47	0.78
	FRA	0.64	0.80	0.91	0.78	0.62	0.64	1.00	0.73	0.62	0.74	0.86	0.66	0.84	0.62	0.67
	GBR	0.56	0.63	0.76	0.73	0.53	0.50	0.73	1.00	0.88	0.71	0.73	0.44	0.90	0.81	0.76
	IRL	0.57	0.57	0.68	0.66	0.63	0.46	0.62	0.88	1.00	0.69	0.63	0.39	0.77	0.85	0.72
	ISR	0.75	0.79	0.85	0.92	0.74	0.83	0.74	0.71	0.69	1.00	0.87	0.80	0.82	0.73	0.88
	ITA	0.71	0.90	0.91	0.90	0.69	0.83	0.86	0.73	0.63	0.87	1.00	0.85	0.84	0.66	0.80
	JPN	0.72	0.86	0.80	0.85	0.75	0.86	0.66	0.44	0.39	0.80	0.85	1.00	0.61	0.54	0.72
	NLD	0.60	0.76	0.86	0.85	0.63	0.69	0.84	0.90	0.77	0.82	0.84	0.61	1.00	0.74	0.82

Expected distribution of top 100 ranking HOL bulls

Country selection index		HOL Bulls' origin country (2005-2013)													
		AUS	CAN	DEU	DFS	FRA	GBR	IRL	ISR	ITA	JPN	NLD	NZL	USA	Other
	AUS	4	9	4	2	4	2	0	0	0	0	9	5	60	1
	CAN	0	17	0	0	1	0	0	0	0	0	7	0	75	0
	CHE	0	12	8	2	1	0	0	0	1	0	6	0	70	0
	DEU	0	8	6	1	1	0	0	0	0	0	7	0	77	0
	DFS	0	6	5	10	1	0	0	0	0	0	14	1	63	0
	ESP	0	8	8	2	1	0	0	0	2	0	7	0	72	0
	FRA	0	13	2	1	2	0	0	0	0	0	4	0	78	0
	GBR	0	8	0	2	0	0	0	0	0	0	10	0	80	0
	IRL	0	4	0	1	0	0	19	0	0	0	9	27	40	0
	ISR	0	2	5	2	1	1	0	9	0	0	5	0	75	0
	ITA	0	12	2	0	2	0	0	0	0	0	3	0	81	0
	JPN	0	8	7	2	3	1	0	0	1	2	8	0	68	0

Actual and expected percentages of foreign sire use

Foreign%	AUS	CAN	CHE	DEU	DFS	ESP	FRA	GBR	IRL	ISR	ITA	JPN	NLD	NZL	USA
Actual (Since 2008)	60	56	38	51	15	73	13	73	15	5	52	39	18	2	8
Expected (2005-2013)	96	83	100	94	90	100	98	100	81	91	100	98	87	24	8

- **Recent stats on the actual use of foreign HOL sires across countries**

https://queries.uscdcb.com/eval/summary/top100.cfm?t100_tbl=fsuHOL

Conclusions

- Differing selection indexes, genetic correlations < 1.0, and missing traits each cause reranking of the same bulls in different countries
- Bull rankings seem to differ across countries more from different selection goals than from genotype by environment interaction or missing traits
- Many countries can improve genetic progress by using domestic bulls less and foreign bulls much more

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- International Bull Evaluation Service

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