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Genetic improvement: a major component of increased dairy farm profitability

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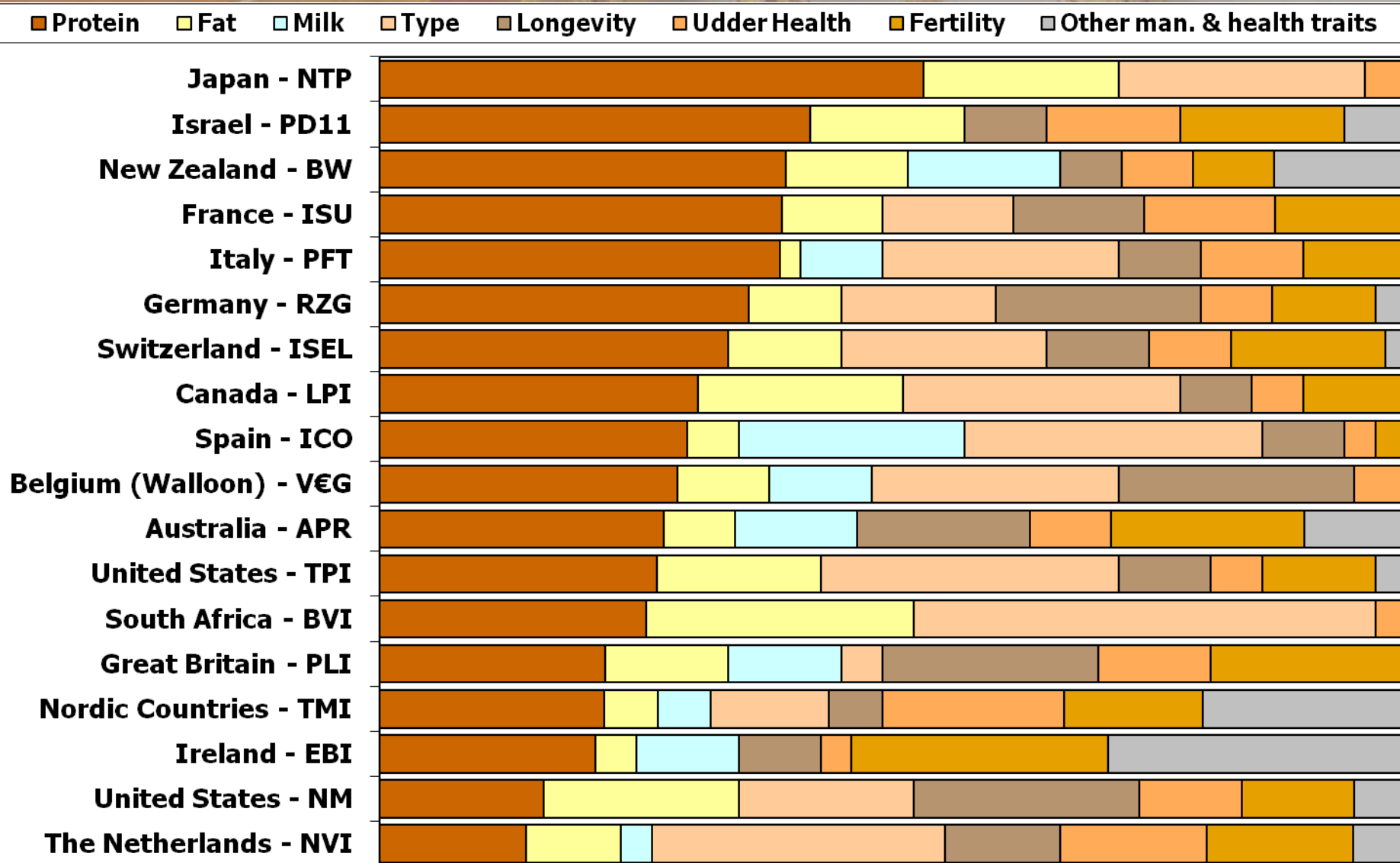
Introduction

- ❑ Genetic improvement has been a major force, if not the major one, for making advances in dairy cattle profitability during the last few decades
- ❑ Improvement has first been for production and conformation traits
 - except in some Scandinavian countries where an early focus was also placed on fertility and disease resistance
- ❑ In the last decade, however, selection objectives in many countries have been adjusted to give more emphasis to health, fertility and longevity
- ❑ This was made possible by an increased effort in the collection of data for the corresponding traits in on-farm recording programs

Objectives

- ❑ **To review selection objectives in use in Holsteins among Interbull member countries**
- ❑ **To report and compare genetic trends achieved for key economic traits over the last 10 years**
- ❑ **Finally, Canada was used as a case study:**
 - **to examine the impact of genetic improvement at the level of the cow population**
 - **to measure its economic significance for the dairy industry**

Selection indices worldwide

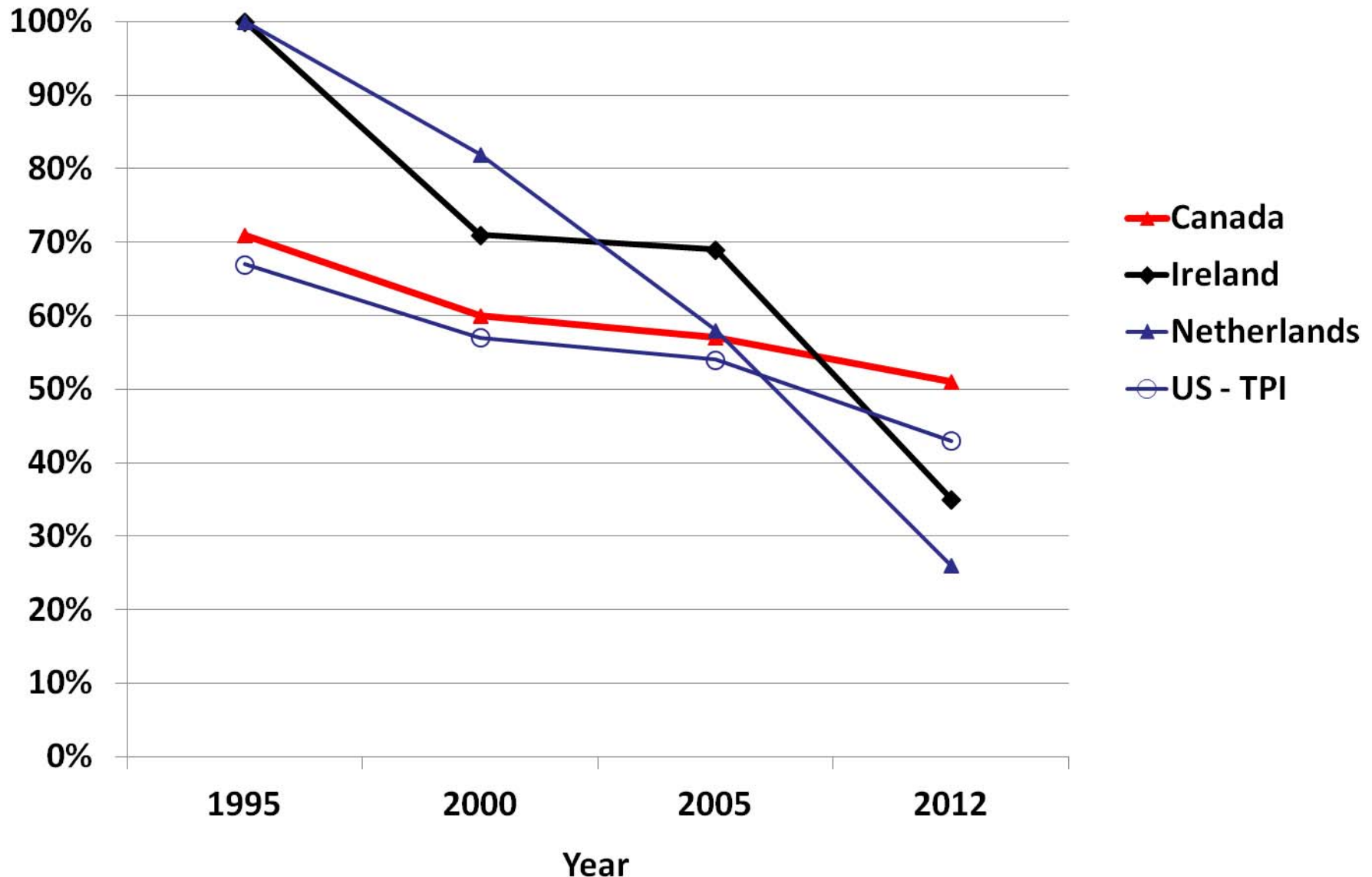


Selection indices worldwide - discussion

- ❑ **Large range among countries for relative emphasis on protein kg and overall production**
 - Protein kg: 14% (The Netherlands) to 52% (Japan)
 - Production: 26% (The Netherlands) to 72% (Japan)
- ❑ **Average index has following relative emphasis:**
 - 48% production (31% protein, 12% fat & 5% milk)
 - 17% type
 - 11% longevity
 - 8% udder health
 - 11% fertility
 - 5% other disease or management traits

Reduced emphasis on production over time

Relative emphasis in national selection indices



International comparison of dairy bulls

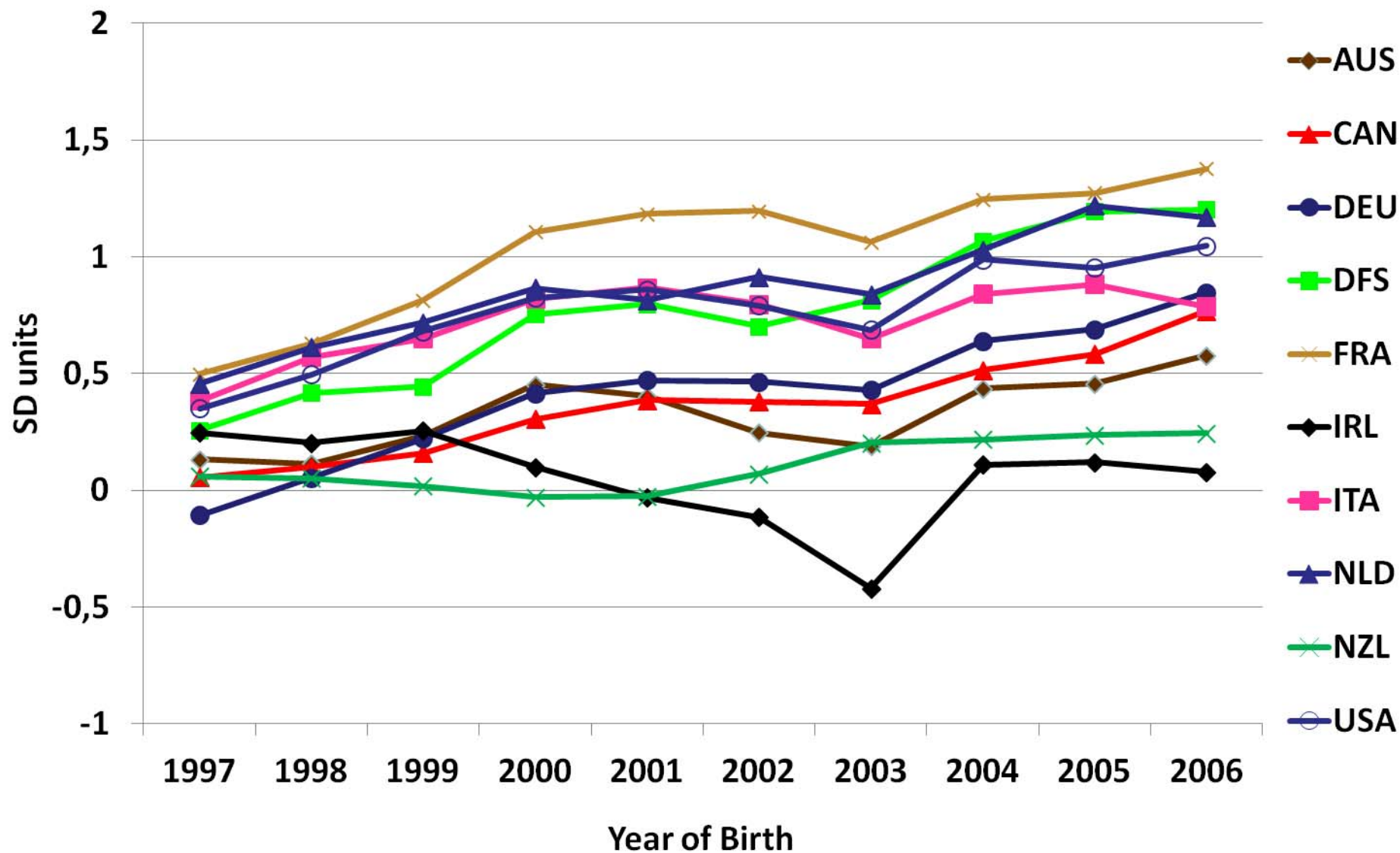
- ☐ MACE EBVs from Interbull April 2012 run were used
- ☐ Five major traits were considered
 - Protein kg (indicator of production)
 - Overall Udder (indicator of conformation)
 - Longevity
 - SCS (indicator of udder health)
 - Calving to First Service (indicator of fertility)
- ☐ MACE EBVs on the Canadian scale were standardized to SD units
- ☐ Only bulls born from 1997 to 2006 were kept
- ☐ No effect of genomic selection yet

International comparison of dairy bulls

- ❑ The country of origin of each bull assumed to be the country where the bull had the largest number of daughters
- ❑ Major dairy countries were defined as those with at least 200 bulls tested per year
 - Ireland, which tests 25-65 bulls per year, was added
- ❑ Genetic trends for bulls born in 1997-06 were plotted for the five traits
- ❑ The average EBV of bulls born in 2005-06 was plotted for each trait and country

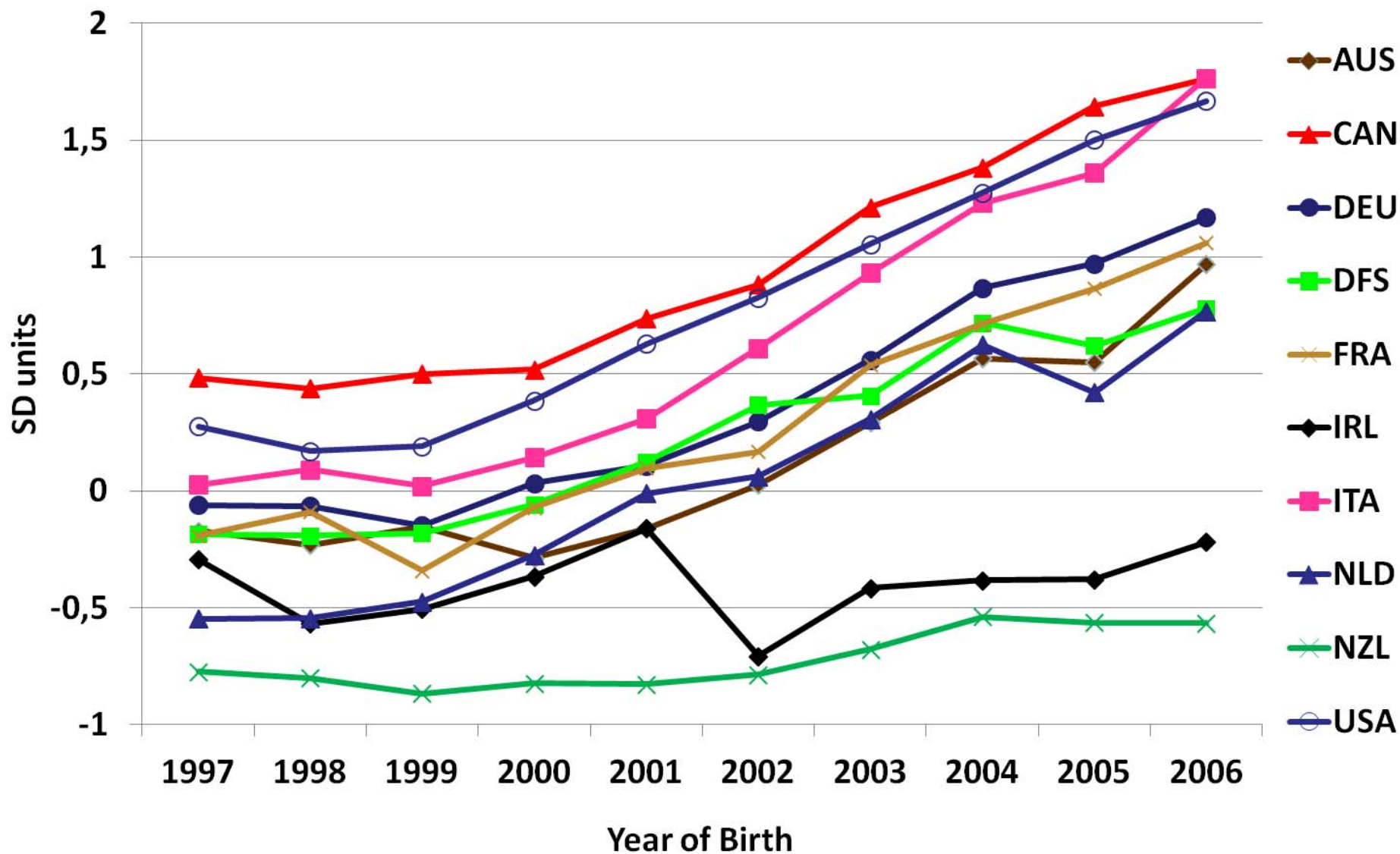
Average EBV by year of birth and country

Protein kg



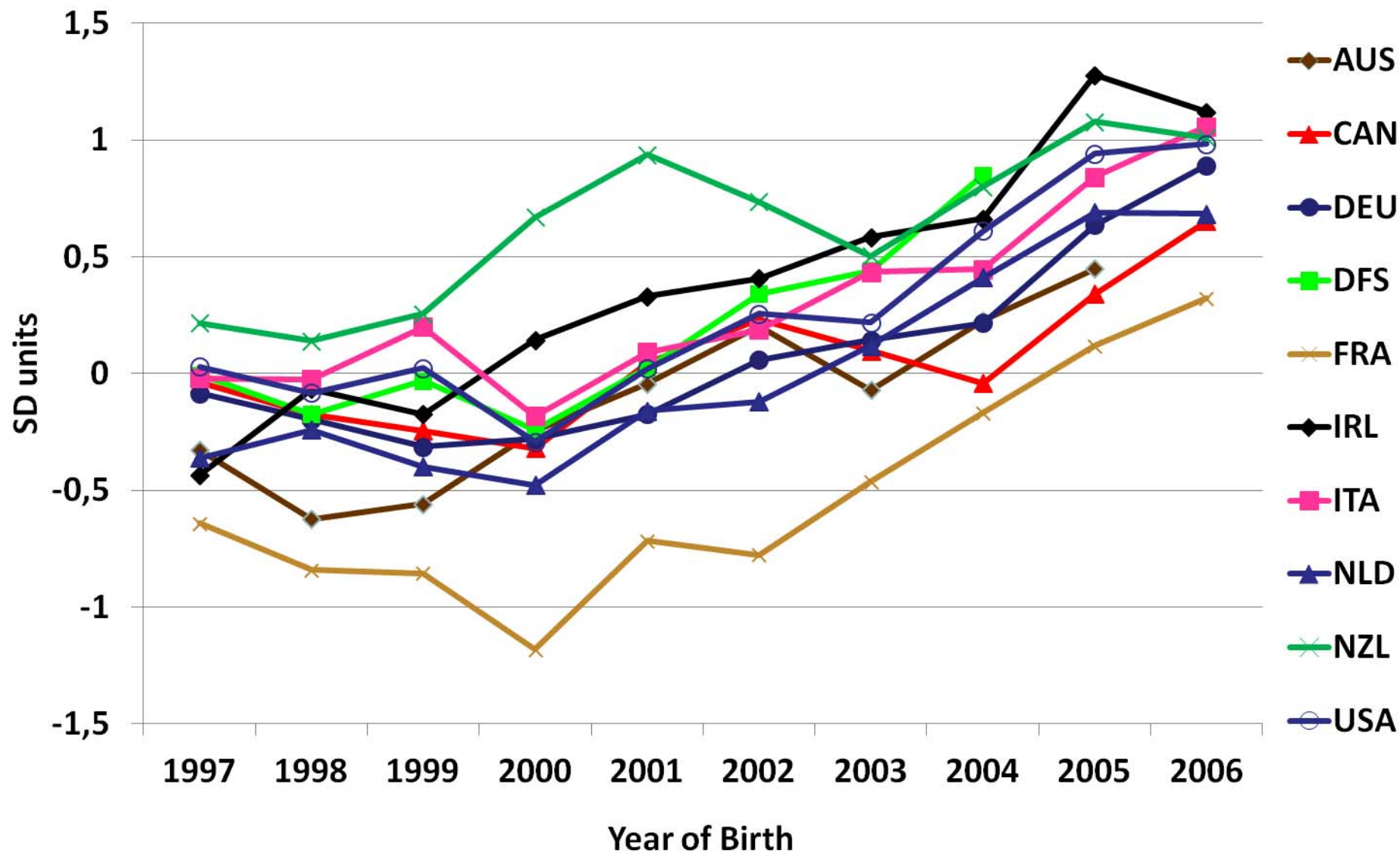
Average EBV by year of birth and country

Overall Udder



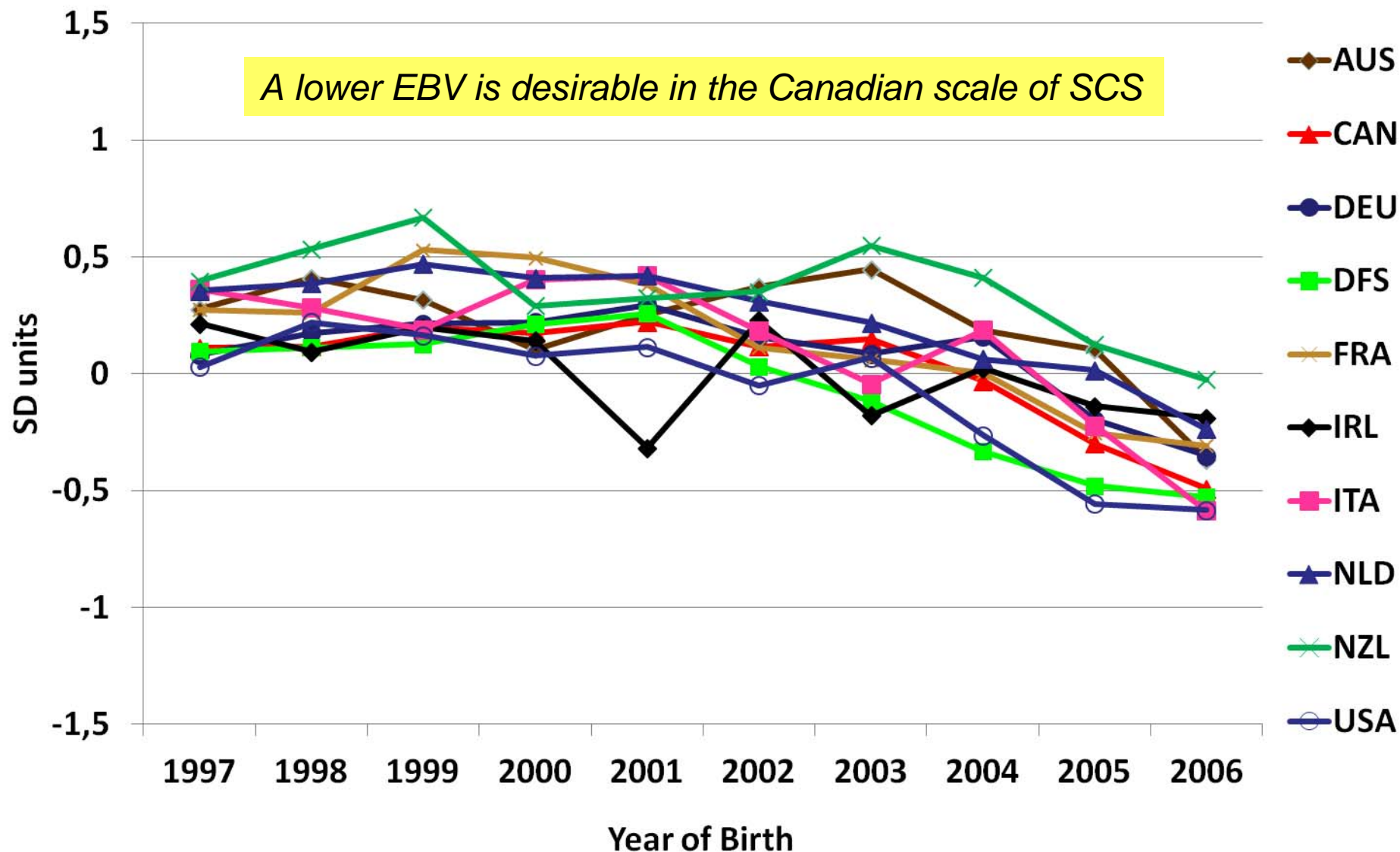
Average EBV by year of birth and country

Longevity



Average EBV by year of birth and country

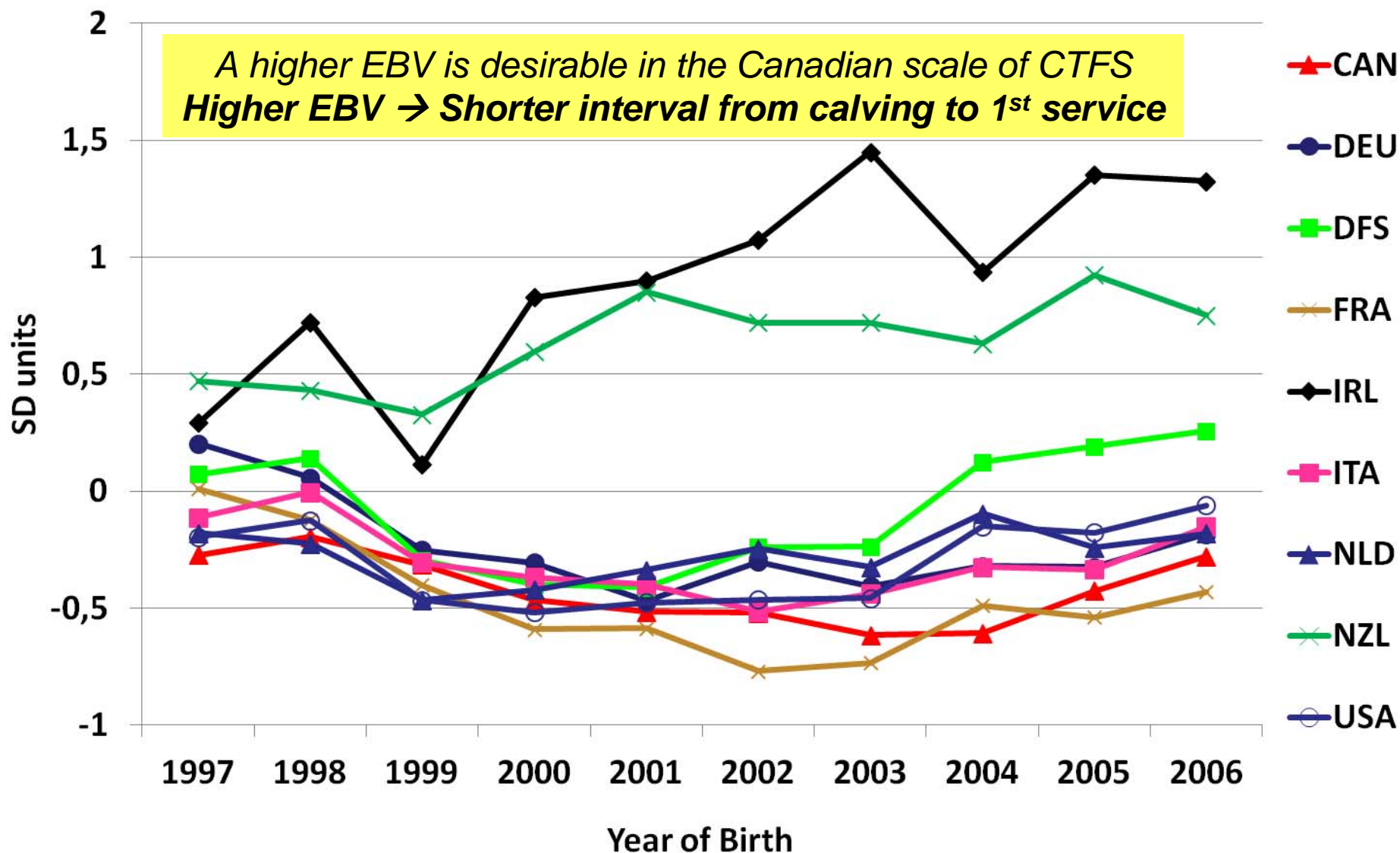
Somatic Cell Score



Average EBV by year of birth and country

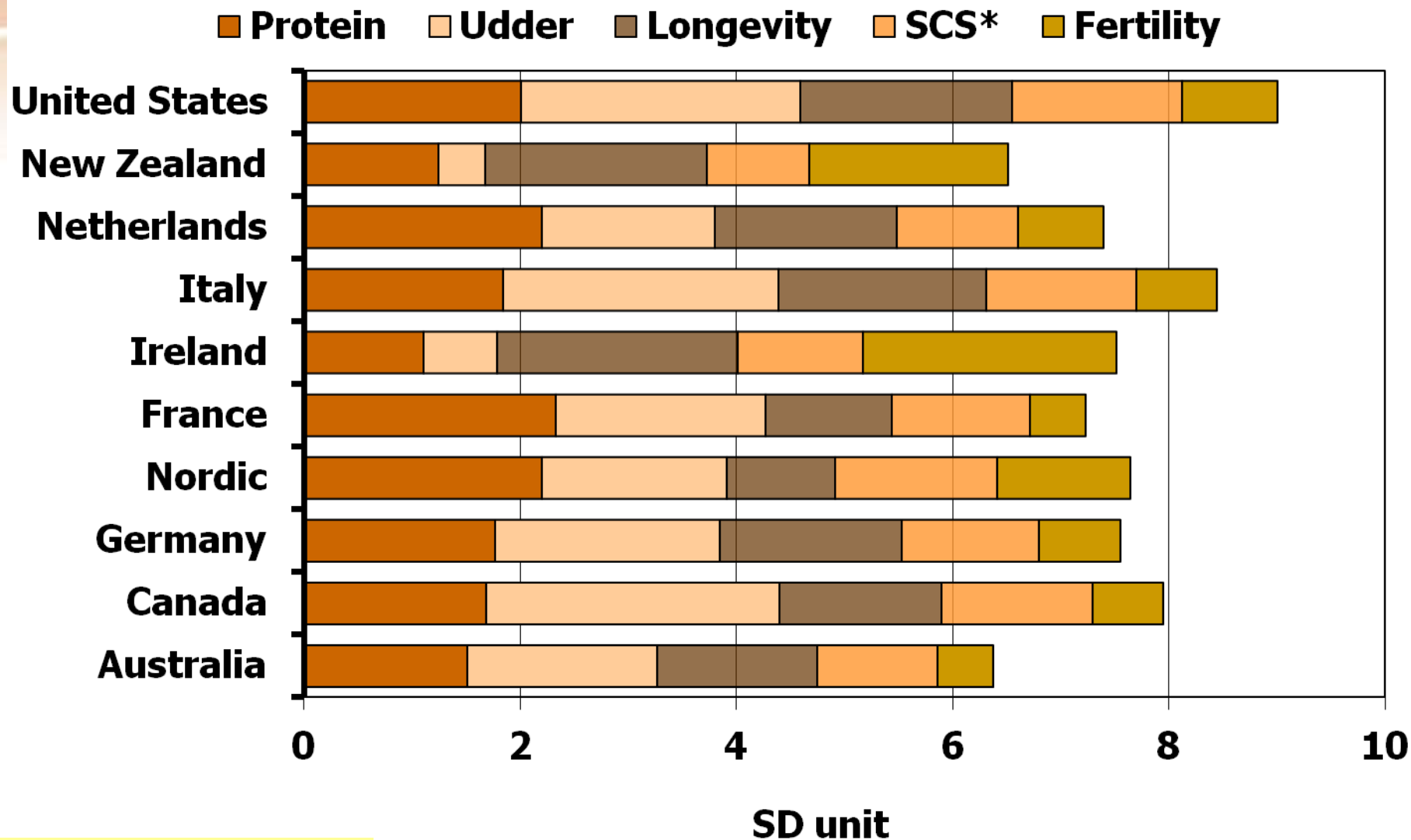
Calving to First Service

*A higher EBV is desirable in the Canadian scale of CTFS
Higher EBV → Shorter interval from calving to 1st service*



Average EBV of bulls born in 2005-'06

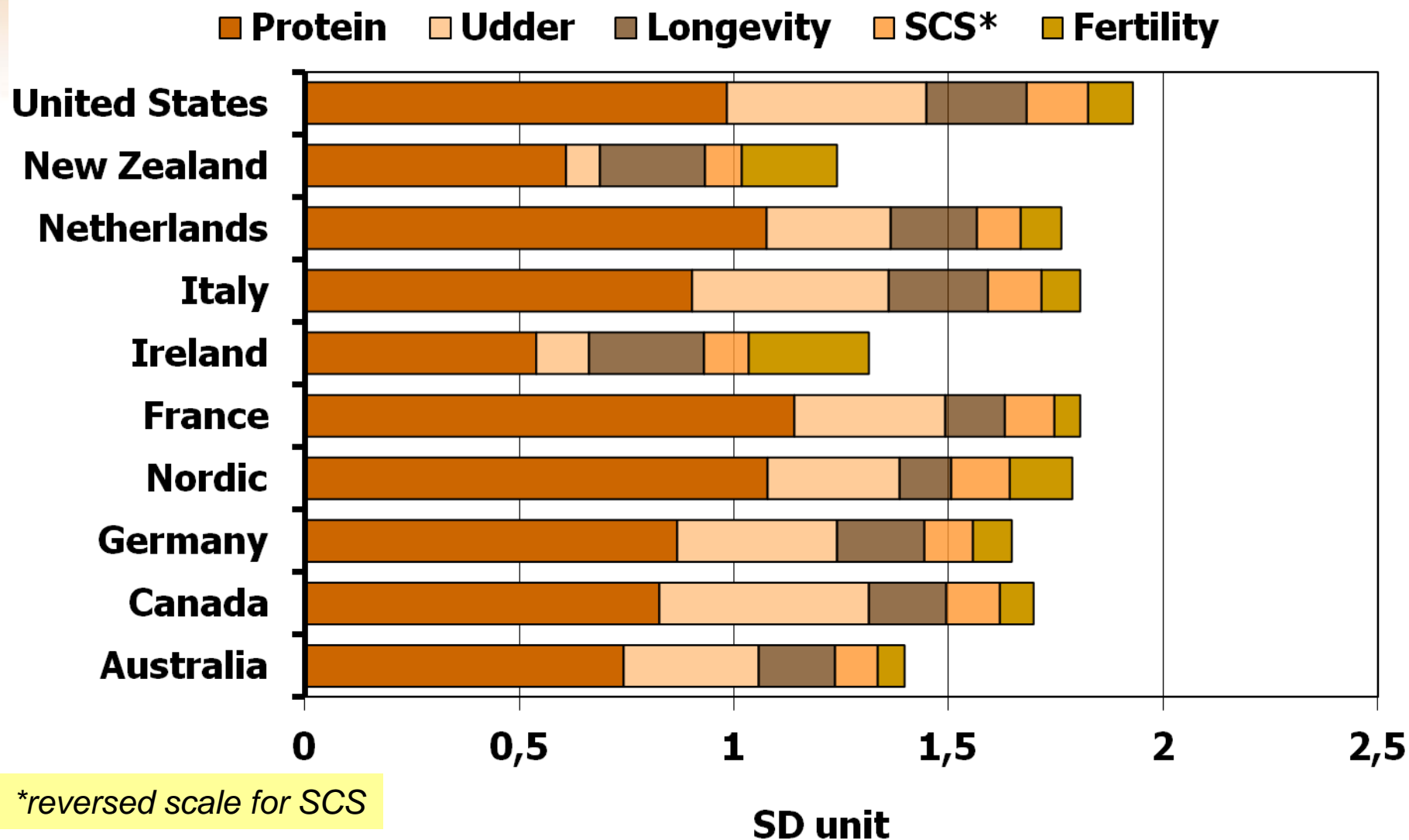
Each trait was given an equal weight



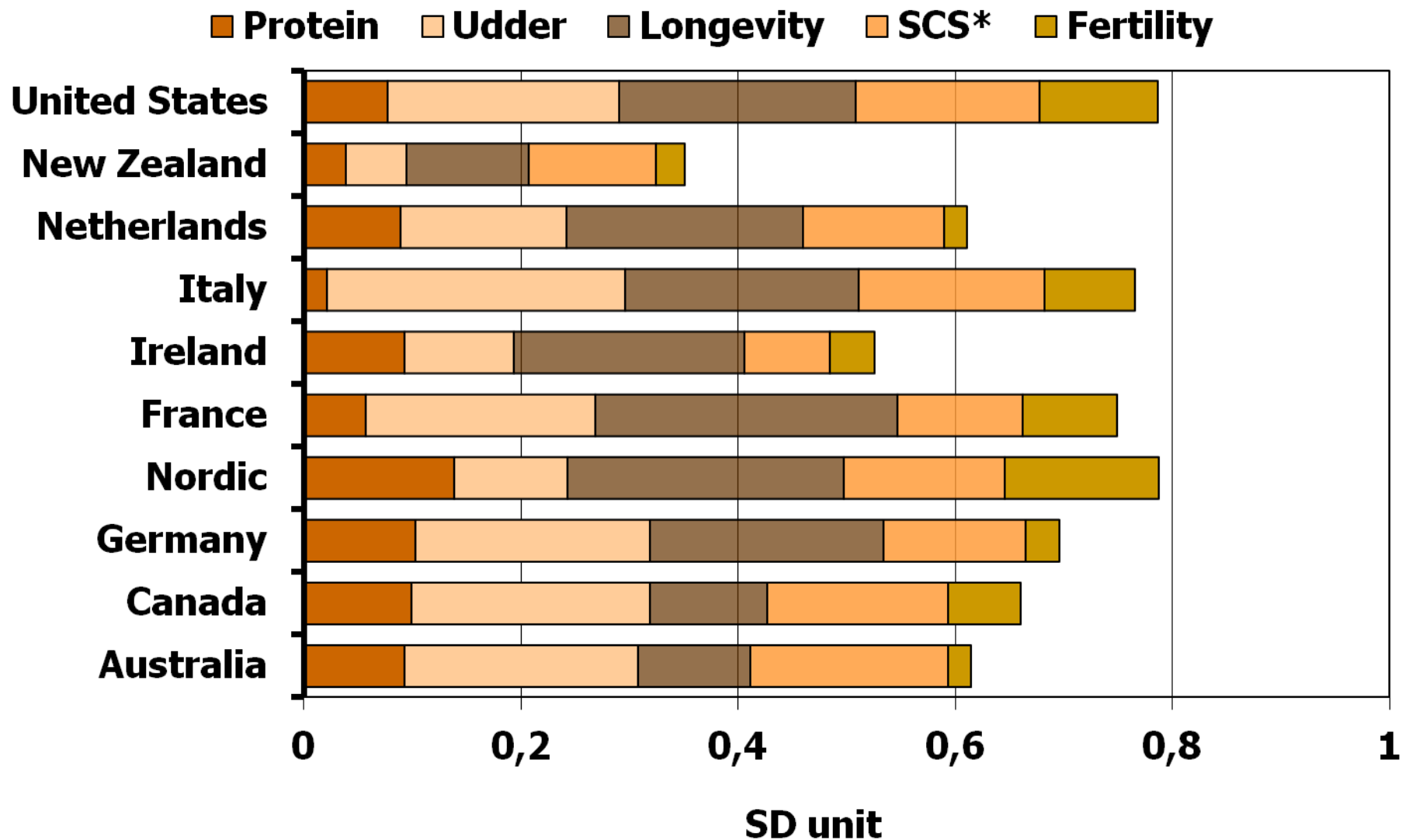
*reversed scale for SCS

Average EBV of bulls born in 2005-'06 for average index* (P 49%, U 18%, L 12%, S 9%, F 12%)

**Average of 18 national selection indices*



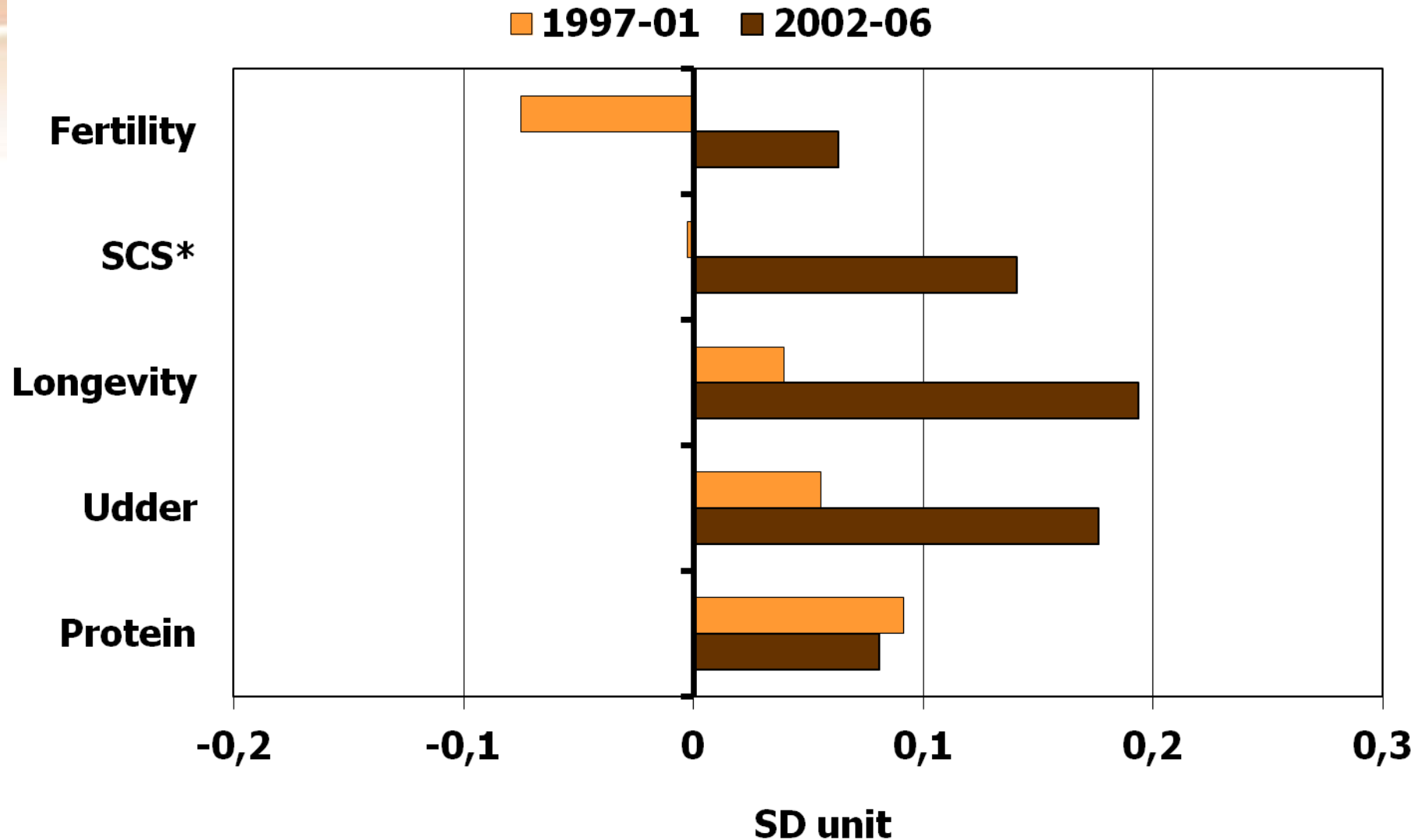
Yearly genetic progress by country and trait (last 5 years: bulls born in 2002-'06)



*reversed scale for SCS

Average genetic progress by trait across countries

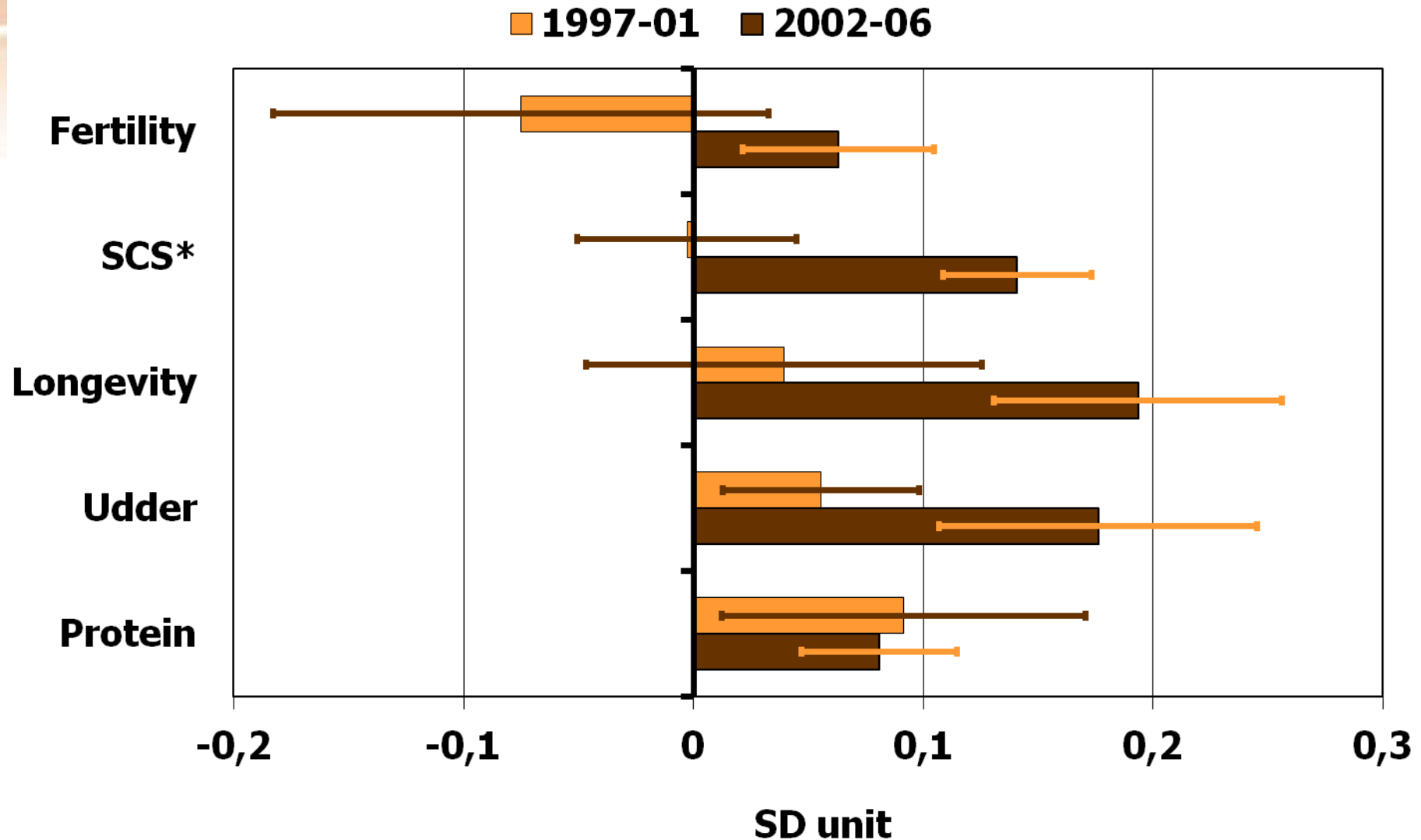
Last 5 years vs. previous 5 years (± 1 SD)



**reversed scale for SCS*

Average genetic progress by trait across countries

Last 5 years vs. previous 5 years (± 1 SD)



**reversed scale for SCS*

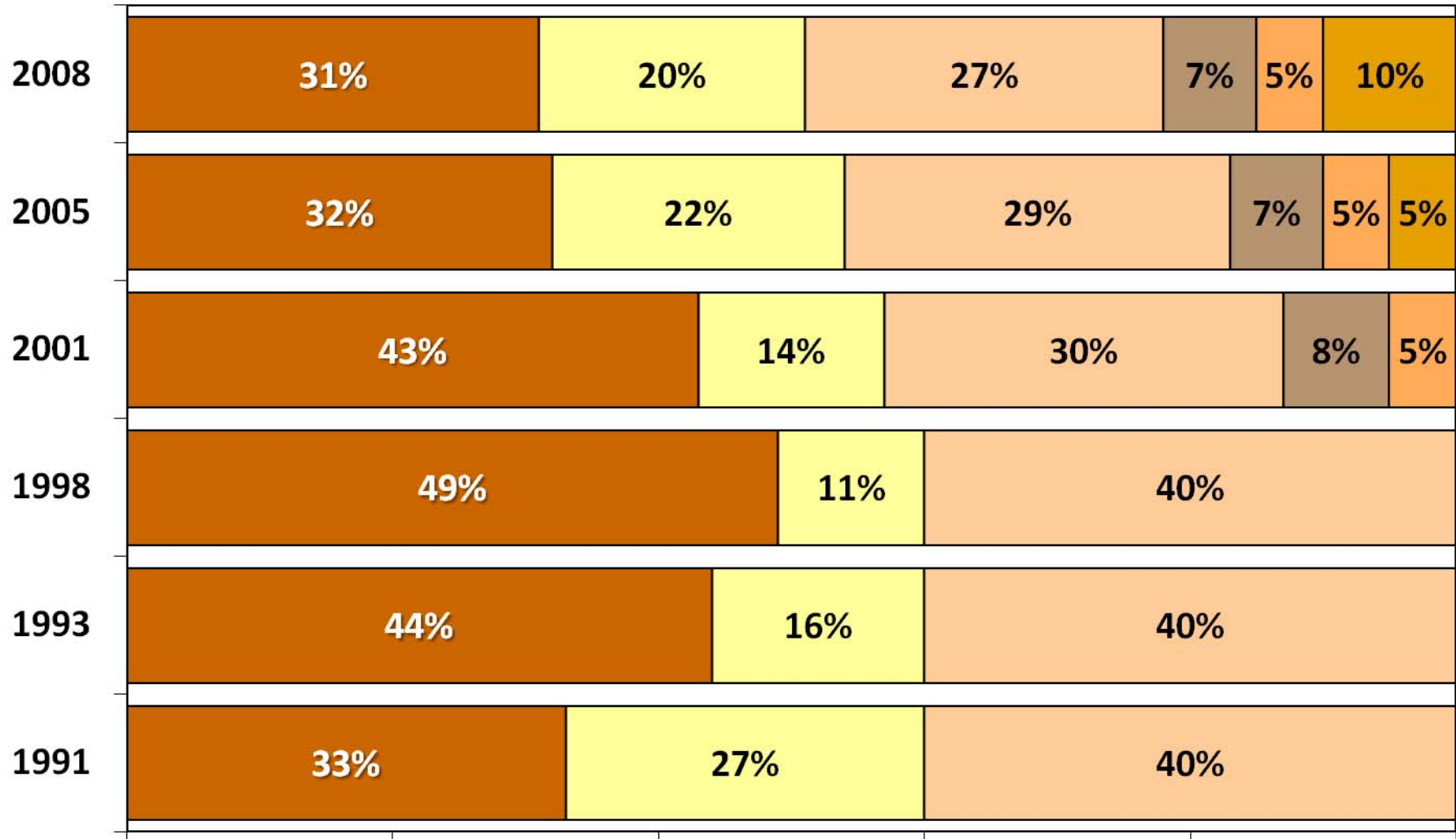
A case study: Canada

- ❑ **Changes in LPI over time**
- ❑ **Cow EBV from April 2012 CDN evaluations**
 - **Fat and protein kg, mammary system, SCS, Direct Herd Life, Calving to First Service and First Service Conception**
 - **Genetic trends for cows born in 1981-2011**
 - **Cow genetic progress from last 5 complete years of birth (2007-11) and 5 previous years (2002-06)**
- ❑ **Economic impact of genetic improvement**



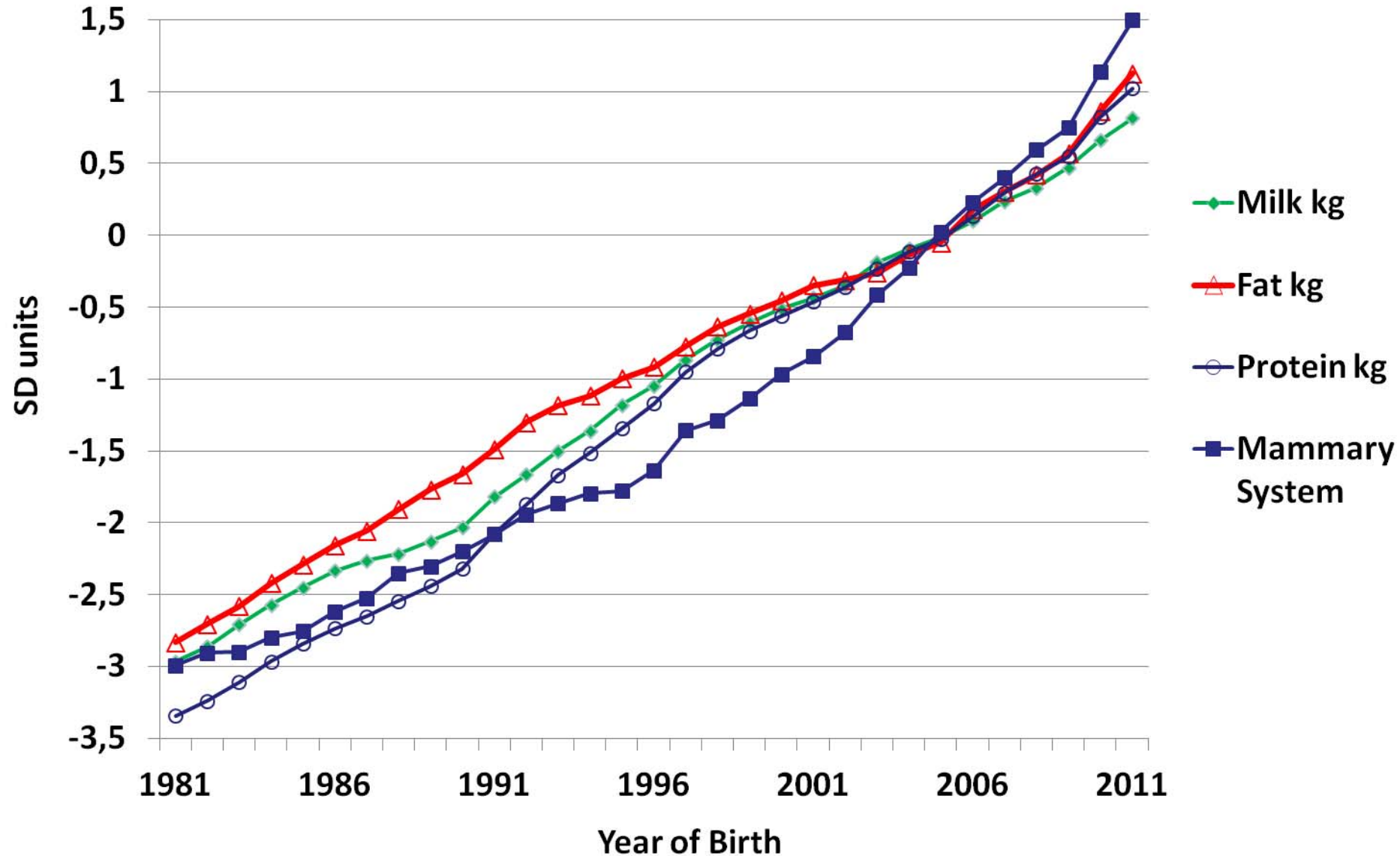
Canadian LPI history

■ Protein ■ Fat ■ Type ■ Herd Life ■ Udder Health ■ Fertility



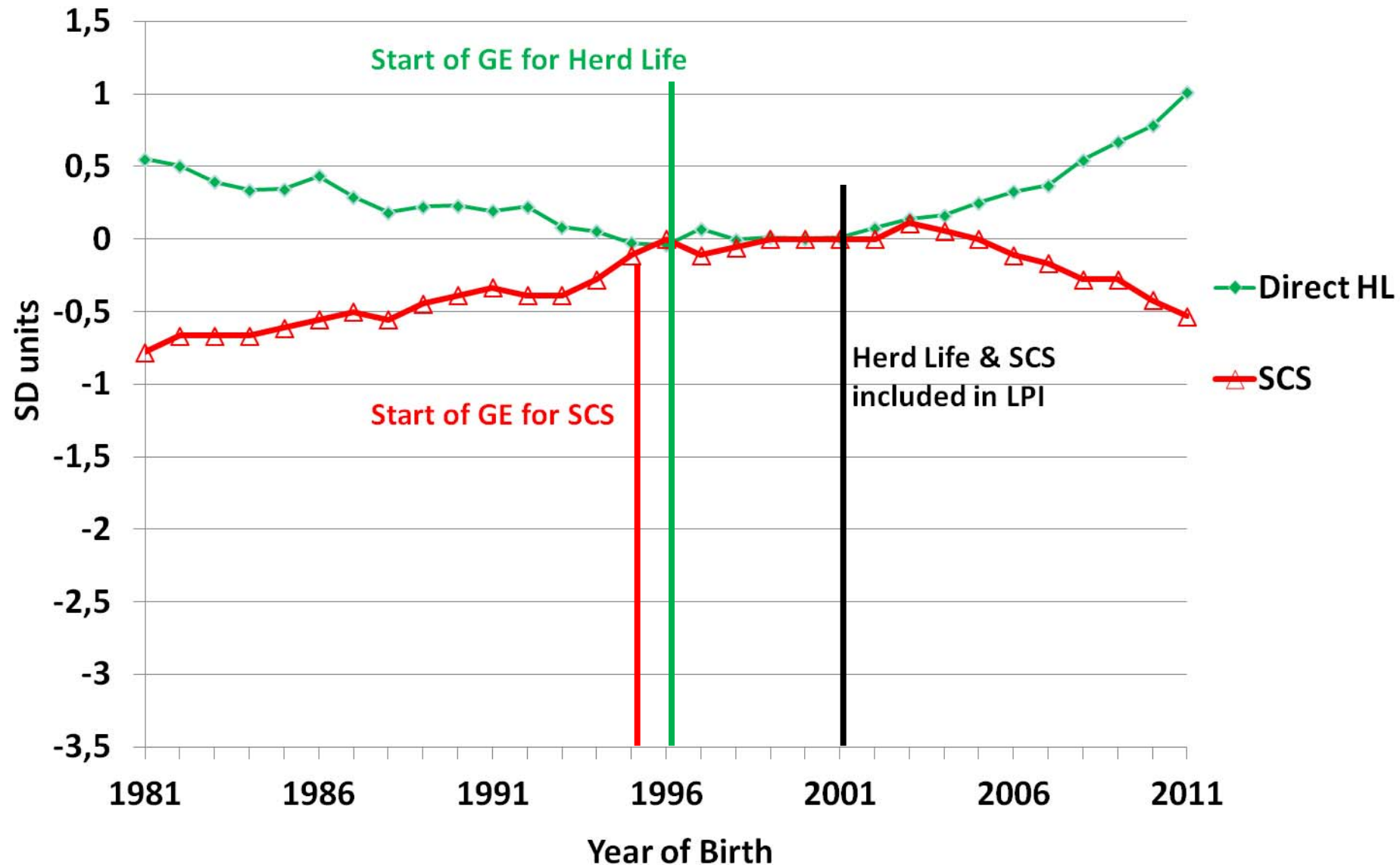
Traditional selected traits

Cow genetic trends



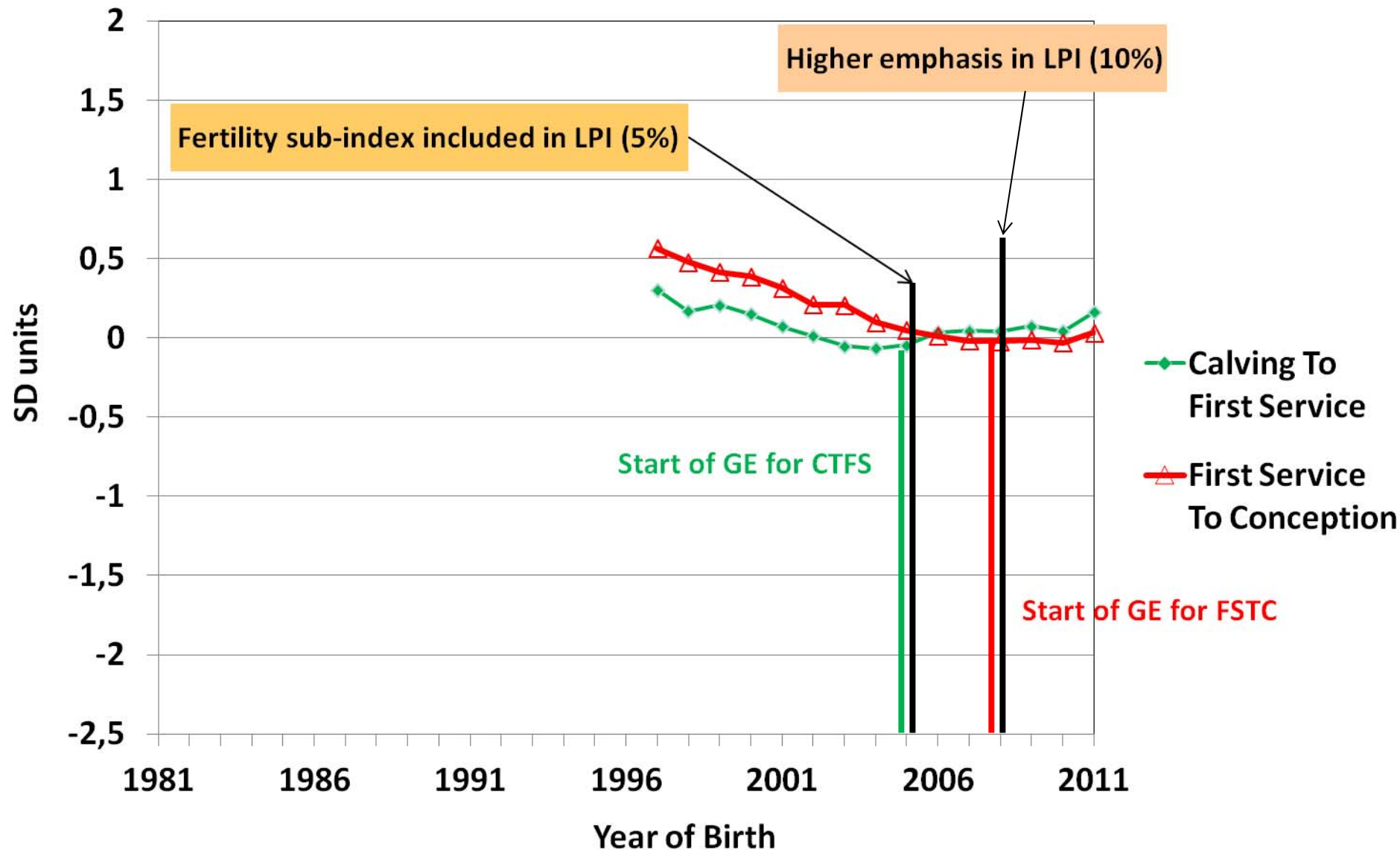
Traits under more recent selection

Cow genetic trends



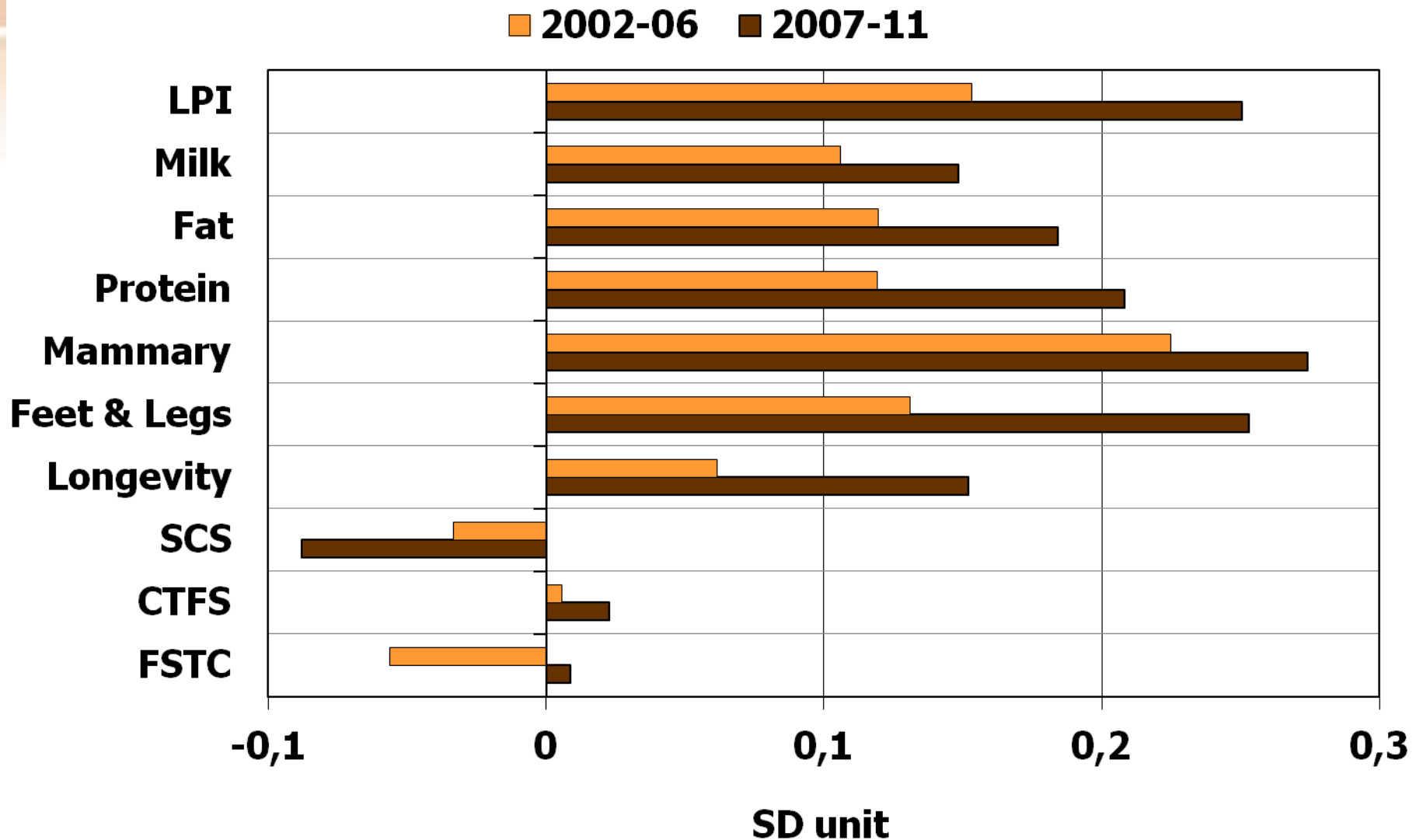
Fertility traits under recent selection

Cow genetic trends (higher value is desirable)

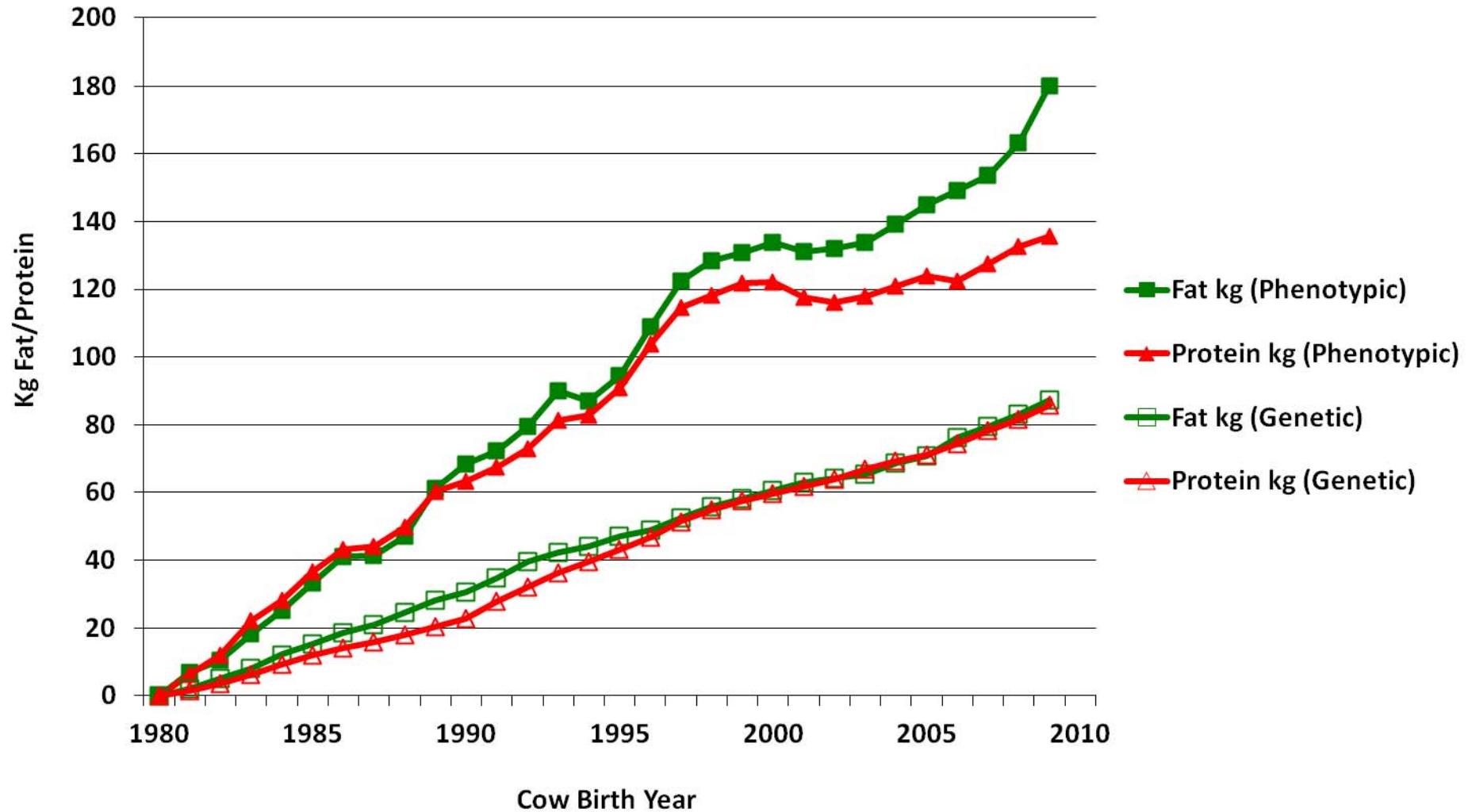


Average cow genetic progress by trait

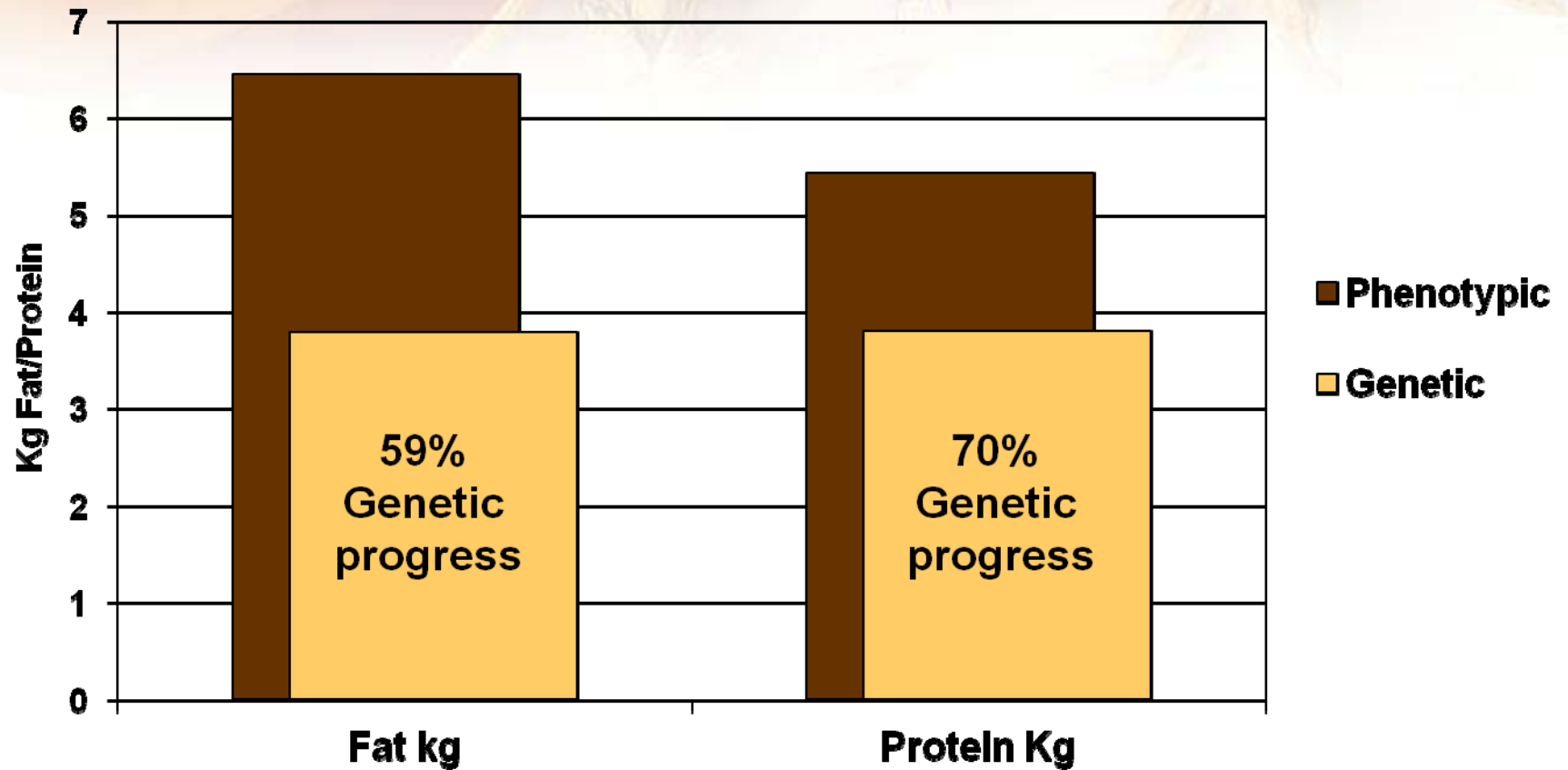
Last 5 years vs. previous 5 years



Genetic and phenotypic trends for Canadian Holstein cows from 1980 to 2009



Ratio of genetic and phenotypic progress



Effect of genetic improvement on farm profitability - Assumptions

- ☐ Value of 100 points of LPI: \$29 per cow per year (van Beek et al, 2009)
- ☐ Canadian milking cow population: 1M
- ☐ Discounting rate applied to benefits: 5%
- ☐ Increase in progress from genomics: 60%



Net annual economic value of genetic change for the Canadian dairy cow population

Rate of change and value of selection	Current rate (last 5 years)	Expected rate after genomics
Annual genetic change (points of LPI per year)	142	227
Annual value of this change for the Canadian dairy herd	209 M\$	334 M\$



Conclusions

- ❑ **Increased emphasis on functional traits in most countries has resulted in more genetic progress for these traits**
- ❑ **These advances were achieved**
 - **without a reduction in the rate of progress for key production and conformation traits**
 - **without the use of genomic selection, since that new tool was not yet available**
- ❑ **Genetic improvement programs work as expected and have a high Return On Investment**
- ❑ **Genomics should produce even better results but phenotypic recording remains essential**