

# Multivariate Genetic Evaluation for Calving Ease and Stillbirth in Austria and Germany

*Christian Fuerst and Christa Egger-Danner*

*ZuchtData EDV-Dienstleistungen GmbH, Universumstraße 33/8, A-1200 Vienna, Austria*

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## Abstract

Breeding values for calving ease and stillbirth have been estimated jointly for Austria and Germany since November 2002. Calving ease and stillbirth are evaluated using a multivariate approach based on a BLUP animal model. About 13 million Simmental and 3 million Brown Swiss records from Germany and Austria are included in the evaluation. Breeding value estimation is performed with the computer program MiX99 for all breeds except Holstein. The fixed effects region\*year\*month, herd\*year, number of calving\*calving age and sex of calf and the random effects permanent environment, calf and cow are included. The joint evaluation increases accuracy through additional information and makes estimated breeding values of Germany and Austria completely comparable.

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## 1. Introduction

Minimizing dystocia and stillbirth is of great economic importance for dairy farmers and a matter of animal welfare. Stillbirth rates of 10% and more are reported in other populations and countries.

A crucial point in trying to improve the calving performance genetically, is the difficulty of correctly recording the data. Calving ease scores are usually collected by milk recording people as recorded by the farmers. The sometimes poor quality of the data is one reason for the low heritability of calving traits reducing the possibilities of genetic improvement.

In Germany breeding values for calving ease and stillbirth have been routinely estimated since 1994. In Austria the calving ease and stillbirth evaluation were introduced in 1995 and 1998, respectively. The joint genetic evaluation in Austria and Germany was implemented in November 2002 for all traits and all breeds (e.g. Emmerling *et al.*, 2002; Fuerst and Egger-Danner, 2002a,b; Schild *et al.*, 2003). The complete Holstein evaluation is done by VIT Verden. For all other breeds the genetic evaluation for calving ease and stillbirth is performed by ZuchtData in Vienna.

The objective of this paper is to present the joint routine genetic evaluation for calving

ease and stillbirth for Simmental and Brown Swiss in Austria and Germany.

## 2. Material and Methods

The new joint evaluation is based on the program MiX99 (Lidauer *et al.*, 2000) where breeding values for calving ease and stillbirth are estimated using a multivariate approach. The previous genetic evaluations for calving ease and stillbirth were based on programs by Gierdziewicz *et al.* (1994) in Austria and Germany. Only minor differences existed between the two evaluation systems.

### 2.1 Data

All calving scores and stillbirths recorded since 1990 from dual-purpose Simmental (Fleckvieh) and Brown Swiss (Braunvieh) cattle are used in the joint genetic evaluation. Twin calvings and aborted calves are excluded. Records of calving difficulty and calf mortality are scored by the farmer and collected in connection with the milk recording system. Calving performance ranges from calving without assistance to surgery (mainly caesarian) scored in 3 to 5 scores depending on year and region. Currently 4 scores are used in Germany (A-no assistance or assistance by 1 person, B-mechanical assistance or 2 or more persons, C-veterinarian assistance, D-surgery)

and 5 scores in Austria (A-no assistance, B-assistance by 1 person, C-mechanical assistance or 2 or more persons, D-caesarian, E-embryotomy).

Stillbirth is defined as calf born dead or deceased within 48 hours. Data from the official animal identification data base are used to improve the quality of stillbirth recording in Austria.

Data characteristics are shown in Table 1. German data are approximately 4 times more than Austrian data. Compared to most other countries the incidence of stillbirth is very low. Only 2 to 5% of all calves are born dead or died within 2 days. Meyer *et al.* (2001) reported up to 13% of stillborn calves in primiparous US Holstein. The genetic links between the two countries are sufficient (Fuerst and Egger-Danner, 2002a; Schild *et al.*, 2003).

**Table 1.** Data characteristics.

	Simmental	Brown Swiss
No. of calvings	13,426,031	2,941,809
No. of calvings from Germany	10,857,135	2,319,798
No. of calvings from Austria	2,568,896	622,011
Rate of stillbirth (%) <sup>1</sup>	3.2	3.6
- 1 <sup>st</sup> calvings	5.0	4.9
- 2 <sup>nd</sup> and later calvings	2.6	3.1

<sup>1</sup> due to regionally different data recording breed comparisons are not possible

## 2.2 Model

Theoretically linear models are not appropriate for categorical traits (Gianola and Foulley, 1983). Misztal *et al.* (1989) pointed out that a threshold model requests three to five time more CPU-time in comparison to a linear model. On the other hand Hoeschele (1988) carried out simulation studies for all-or-none traits, which resulted in a minor superiority of the threshold approach for high heritabilities. As a consequence a linear approach was chosen for calving ease and stillbirth. Calving scores were transformed due to their frequencies on a standardized normal distribution within region and month. This way it was possible to combine the different scales in Austria and Germany and also over time.

Calving ease and stillbirth are evaluated using a multivariate approach considering first and later calvings as different but correlated traits. This results in four traits with two genetic components each (direct and maternal).

The model for the multivariate evaluation is:

$$y = X_r r + X_h h + X_s s + X_n n + Z_p p + Z_m m + Z_d d + e$$

where

- y** = vector of transformed calving ease/stillbirth;
- X<sub>r</sub>, X<sub>h</sub>, X<sub>s</sub>, X<sub>n</sub> and Z<sub>p</sub>, Z<sub>m</sub>, Z<sub>d</sub>** = known matrices relating calving ease/stillbirth to fixed and random effects, respectively;
- r** = vector of region by year by month of calving fixed effects;
- h** = vector of herd by year of calving fixed effects;
- s** = vector of sex of calf fixed effect;
- n** = vector of fixed effects of number of calving (8 groups, 1<sup>st</sup> to 8<sup>th</sup> and later calvings) by calving age (for 1<sup>st</sup> and 2<sup>nd</sup> calvings only);
- p** = vector of permanent environment of the cow random effects;
- m** = vector of maternal genetic effects;
- d** = vector of additive genetic calf effects (direct genetic effect) and
- e** = vector of residuals.

The multivariate genetic evaluation is based on a BLUP-animal model.

The genetic parameters used in the routine evaluation were derived by Druet (2002) mainly using Austrian Simmental data (Table 2). As the resulting (co)variance matrix was

not positive definite the Bending procedure (Essl, 1991) was used resulting in slightly changed parameters.

### 2.3 Publication of estimated breeding values

The genetic evaluation for calving ease and stillbirth is carried out simultaneously with all other traits, i.e. four times per year. The official EBVs are calculated by weighting EBVs for 1<sup>st</sup> and later calvings equally.

Breeding values for direct and maternal calving ease and stillbirth are published as relative EBVs with a mean of 100 and 12 points for one genetic standard deviation. The base population for the relative breeding values is rolling. Currently it consists of sires born between 1993 and 1995. The EBVs of the cows are only included in the total merit index and not published separately. The reliability is calculated approximately using the effective daughter contributions approach.

**Table 2.** Genetic parameters (heritabilities on diagonal, genetic correlations above diagonal).

	CE1dir	CE1mat	CE2dir	CE2mat	SB1dir	SB1mat	SB2dir	SB2mat
CE1dir	.09	-.26	+.80	-.35	+.70	.00	+.63	.00
CE1mat		.04	-.35	+.80	.00	+.60	.00	+.54
CE2dir			.03	-.52	+.63	.00	+.70	.00
CE2mat				.02	.00	+.54	.00	+.60
SB1dir					.02	-.04	+.80	-.06
SB1mat						.02	-.06	+.80
SB2dir							.01	-.10
SB2mat								.01

CE1dir, CE1mat = direct and maternal calving ease for 1<sup>st</sup> calvings, CE2dir, CE2mat = direct and maternal calving ease for 2<sup>nd</sup> and later calvings, SB1dir, SB1mat = direct and maternal stillbirth for 1<sup>st</sup> calvings, SB2dir, SB2mat = direct and maternal stillbirth for 2<sup>nd</sup> and later calvings.

## 3. Results and Discussion

### 3.1 Fixed effects

The effect of the number of calving on calving ease and stillbirth is one of the most important (Figure 1). First calvings need a lot more assistance and lead to higher calf mortality. These marked differences justify the decision to distinguish between 1<sup>st</sup> and later calvings.

The results for age at calving indicate more difficult calvings with a very low and a very high age at calving. Young heifers have smaller pelvic sizes which causes birth difficulties, whereas older heifers might be too fat which leads to difficulties as well (Gierdziewicz *et al.*, 1994).

The effects of month on calving ease show slightly easier calvings in late summer and autumn particularly for heifers. A reason might be the pasturing during summer and autumn in several regions resulting in a better condition of the heifers/cows.

As expected the most important influence is found for the sex of the calf, indicating more difficult calvings with a male calf (Figure 2).

Due to different recording systems between and within countries, the region effect shows a large effect on calving ease and stillbirth.

The effects for stillbirth are in general similar to the effects for calving ease.

### 3.2 Genetic effects

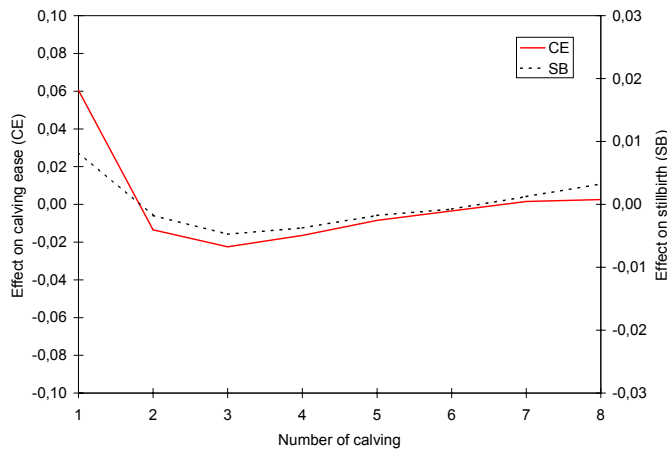
The estimated genetic trends for calving ease and stillbirth for the joint Austrian-German Simmental population are shown in Figures 3 and 4. The average breeding values per year are fluctuating slightly, showing no marked positive or negative trend over time. This is also true for Brown Swiss.

#### 4. Conclusions

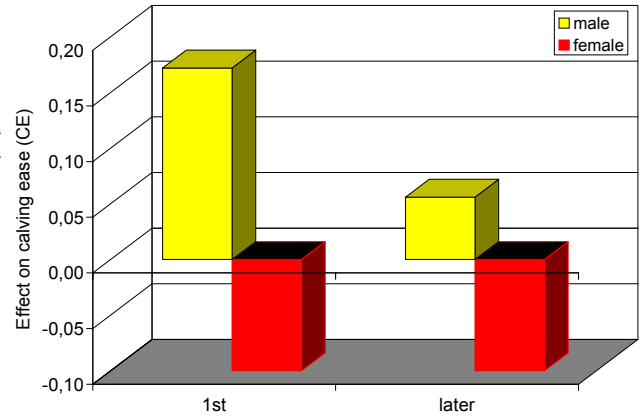
Austria and Germany have introduced a joint genetic evaluation based on raw data for all traits and all breeds in November 2002. The multivariate evaluation for calving ease and stillbirth and first and later calvings requires much computational effort but increases the accuracy by taking all genetic relations into

account. In the joint economic total merit index in Austria and Germany, calving ease and stillbirth have an economic weight of approximately 7% for Simmental and 6% for Brown Swiss in total.

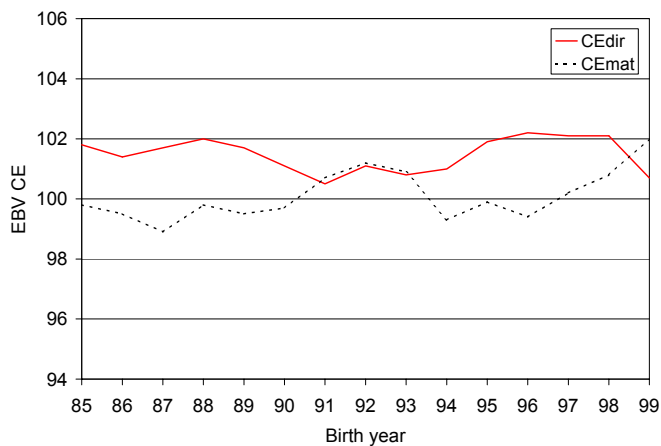
The joint evaluation increases accuracy and makes estimated breeding values of Germany and Austria completely comparable.



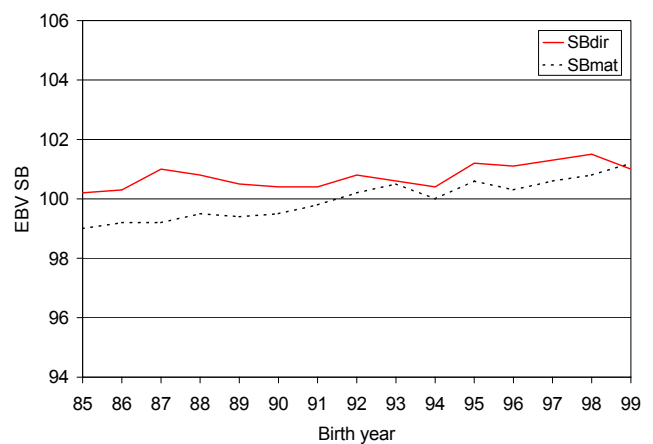
**Fig. 1.** Effect of number of calving on calving ease (CE) and stillbirth (SB) for Simmental.



**Fig. 2.** Effect of sex of calf on calving ease for Simmental.



**Fig. 3.** Genetic trend for direct (CEdir) and maternal calving ease (CEmat) for Simmental bulls.



**Fig. 4.** Genetic trend for direct (SBdir) and maternal stillbirth (SBmat) for Simmental bulls.

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