Bias in Proofs of Non-Random Used Sires

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Abstract

Selling sperm of genomic elite bulls for high prices, is something that can be seen more and more in the industry. Because of the high prices, these genomic bulls are mated with the best of the available heifers and cows, mostly in the form of embryo transfer (ET). Furthermore, offspring of these young genomic bulls possibly don't receive the same treatment as livestock with less potential would receive. The consequence of using these bulls non-randomly, can be an overestimation of the (first) breeding value(s) of the bull. In this study no obvious effects were found of the percentage of daughters born from embryo transfer on the breeding values of the bull. The results even suggest a very mild underestimation of the breeding values which have the highest percentage of daughters born from embryo transfer, not an overestimation.

Keywords: Elite bulls, Bias, Breeding value, Embryo transfer

1. Introduction

An increasing trend in the market is selling sperm of elite young genomic bulls for very high prices. These bulls are mated with the best female animals, mostly through embryo transfer. It is also possible that the valuable offspring of these elite animals receive a preferential treatment. Thus, the non-random usage of bulls could lead to an overestimation of the first breeding value of a bull.

Since April 2014 a correction is applied to the breeding values for milk production and conformation in the Canadian breeding value estimation. The correction is applied when more than 30 percent of the bull's daughters in the evaluation have been born from embryo transfer. (Beavers, 2014) The same issue has been looked at in the USA, but no effect of overestimation was found there.

2. Material and Methods

The breeding value estimations of April 2010 up until December 2015 were used in the analysis. For every estimation in this range, the percentage of daughters born from ET was determined. The %ET was determined by looking at the number of ET daughters contributing to the breeding value for milk production in relation to the total number of daughters. For each bull the breeding value estimation run with the highest %ET of the daughters is used in the analysis. De breeding values for kg milk, kg fat, kg protein corresponding with the highest %ET run are compared to the breeding values in December 2015. The general selection criteria for the analysis are:

- The number of daughters in the breeding value estimation of December 2015 must be higher than the number of daughters in the breeding value estimation with the highest percentage of daughters born from ET.
- The percentage of daughters born from ET must be higher in the breeding value estimation with the highest percentage of daughters born from ET than the breeding value estimation of December 2015.

2.1 Basic analysis

For an accurate analysis, the breeding value corresponding with the maximum %ET daughters must be compared with the breeding value that has a small %ET daughters (smaller than 5%). Only then can be stated that the progeny born from ET can't influence the breeding value anymore. This group of bulls is analyzed in the *basic analysis*. Figure 1 shows an overview of the maximum %ET daughters, set out to the %ET daughters in the breeding value estimation of December 2015.

2.2 Extensive analysis

Over the last years, the number of expensive elite genomic bulls which are being used for breeding, has grown more and more. Thus, the number of bulls that have a percentage of ET daughters over 30% in their milk production breeding value increases. The %ET has not yet decreased back to below 5% for most of these bulls. But this group of bulls do hold important information, that is why an *extensive analysis* was conducted, in which these animals were also taken into consideration. In this analysis, the decrease of the %ET was taken into account. In a second variant of the extensive analysis, only the group of bulls which had a maximum %ET of over 30% were taken into account. For all the bulls, figure 2 shows an overview of the maximum %ET, set out to the %ET in the breeding value estimation of December 2015.

The data is analyzed using a univariate analysis in ASREML. (Gilmour, 2006)

Basic model:
BV_153 = b1 * ET% + BV_max_ET + base

Extensive model:
BV_153 = b2 * diff_ET% + BV_max_ET + base

BV_153	: breeding value December 2015 for kg milk, kg fat, kg protein
b1 * ET%	: highest percentage of animals born from ET, as covariable.
b2 * diff_ET%	: difference in percentage animals born from ET between run with highest percentage and December 2015, as covariable
BV_max_ET	: breeding value for kg milk, kg fat, kg protein corresponding to run with highest percentage of animals born from ET
Base	: base on which the breeding values corresponding to the run with highest percentage of animals born from ET are presented.

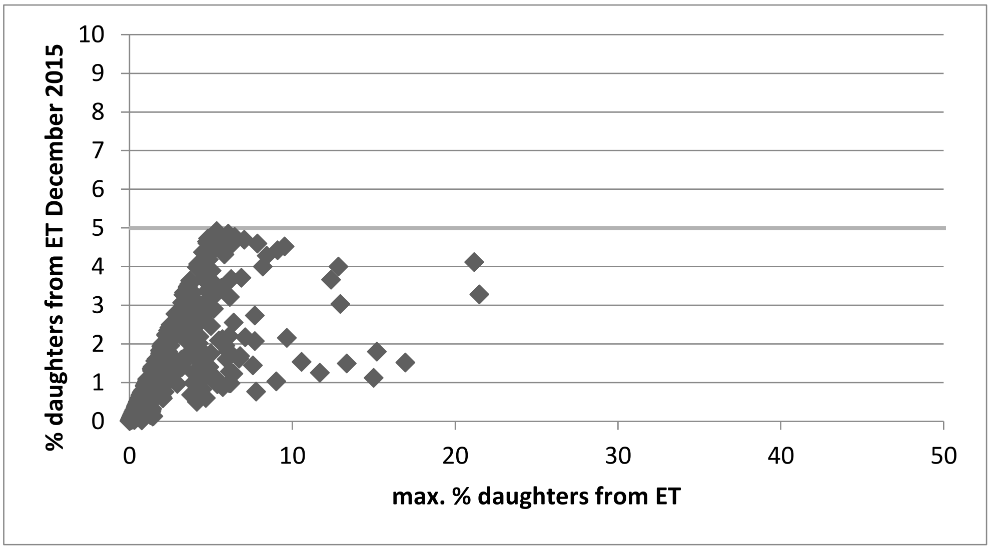

Figure 1. *Basic analysis: maximum percentage daughters in the breeding value estimation born from ET, set out to the percentage daughters born from ET in the breeding value estimation of December 2015.*

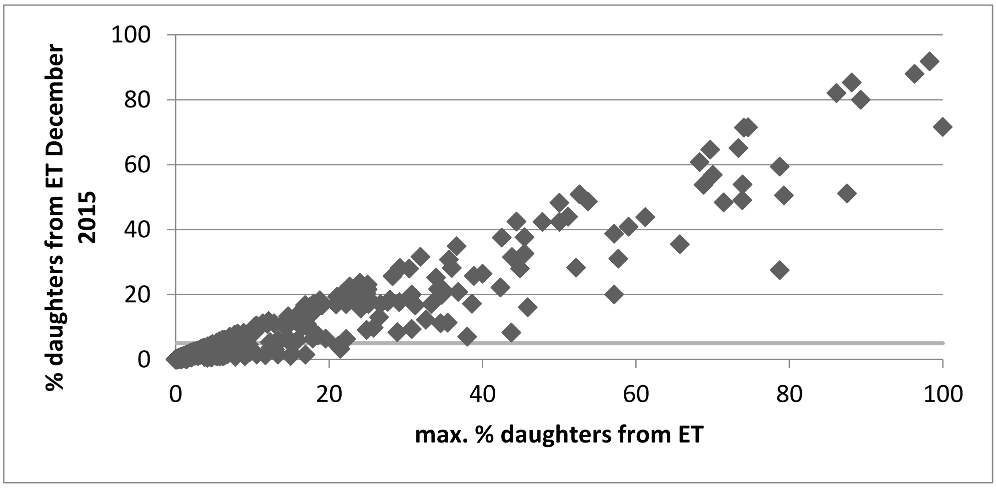

Figure 2. *Extensive analysis: maximum percentage daughters in the breeding value estimation born from ET, set out to the percentage daughters born from ET in the breeding value estimation of December 2015.*

Table 1. *The distribution of the bulls for the maximum percentage of daughters born from ET, the percentage of daughters born from ET in the December 2015 evaluation and the decrease in percentage daughters born from ET, for the breeding value kg milk.*

Basic analysis					
% ET	*# bulls maxET*	*# bulls BV_153*	*BV milk maxET*	*BV milk 153*	
0-9	474	485	386	391	
10-19	9		351	374	
20-29	2		817	842	
Extensive analysis					
% ET	*# bulls maxET*	*# bulls BV_153*	*Decrease %ET*	*BV milk maxET*	*BV milk 153*
0-9	505	538	0.7	390	388
10-19	46	47	5.4	551	538
20-29	29	21	7.9	866	843
30-39	22	10	13.9	704	669
40-49	12	10	13.1	944	917
50-59	8	7	17.3	654	736
60-69	6	3	14.7	803	804
70-79	9	4	20.1	961	989
80-89	4	3	13.2	1222	1213
90-100	3	1	15.8	544	355

maxET = the breeding value with the highest percentage daughters born from ET
BV_153 = the breeding value of December 2015, corrected for base

Table 2. *Regression coefficients with corresponding standard error (SE) for some production and conformation traits, displayed for multiple analyses.*

Trait	*Analysis*	*Regression coefficient*	*SE*
Kg milk	basic	4.003	2.212
	extensive	0.302	1.046
	extensive >30%	2.858	2.923
Kg fat	basic	-0.024	0.094
	extensive	-0.017	0.041
	extensive >30%	0.032	0.085
Kg protein	basic	0.063	0.073
	extensive	0.018	0.033
	extensive >30%	0.062	0.079
INET	basic	1.359	0.770
	extensive	-1.214	0.351
	extensive >30%	-0.715	0.626
Frame	basic	-0.033	0.062
	extensive	0.013	0.027
	extensive >30%	-0.048	0.054
Dairy strength	basic	0.182	0.083
	extensive	-0.058	0.033
	extensive >30%	0.123	0.090
Udder	basic	0.069	0.033
	extensive	-0.034	0.015
	extensive >30%	0.000	0.025
Feet & Legs	basic	-0.027	0.034
	extensive	0.044	0.017
	extensive >30%	0.020	0.027

3. Results

Table 1 shows the distribution of the number of bulls per percent class and the corresponding averages for the basic analysis as well as the extensive analysis. The biggest part of the bulls with daughters born from ET have a maximum %ET lower than 10 percent. For the extensive analysis the column with the difference in %ET was added. This column shows the average difference between the maximum %ET daughters and the %ET daughters in December 2015. The decrease in %ET is minor, even for bulls with high percentages ET daughters.

The breeding value for maxET is the breeding value at the moment the percentage of daughters born from ET was the highest. The difference between the breeding values gives an impression of the over- or underestimation of the breeding value with the highest ET%. This is also shown in the graph in figure 3.

Figure 4 shows the difference in breeding values for milk production between the two breeding value runs used, set out to the decrease in the percentage of animals born from ET between the runs. Bulls with a difference higher than zero, have a breeding value that is higher in the breeding value estimation with the highest %ET than in the breeding value estimation of December 2015. Bulls with a difference lower than zero, have a breeding value that is lower in the breeding value estimation with the highest %ET than in the breeding value estimation of December 2015. Based on figure 3 and 4 it can be stated that the breeding value for milk production is overestimated as often as it is underestimated.

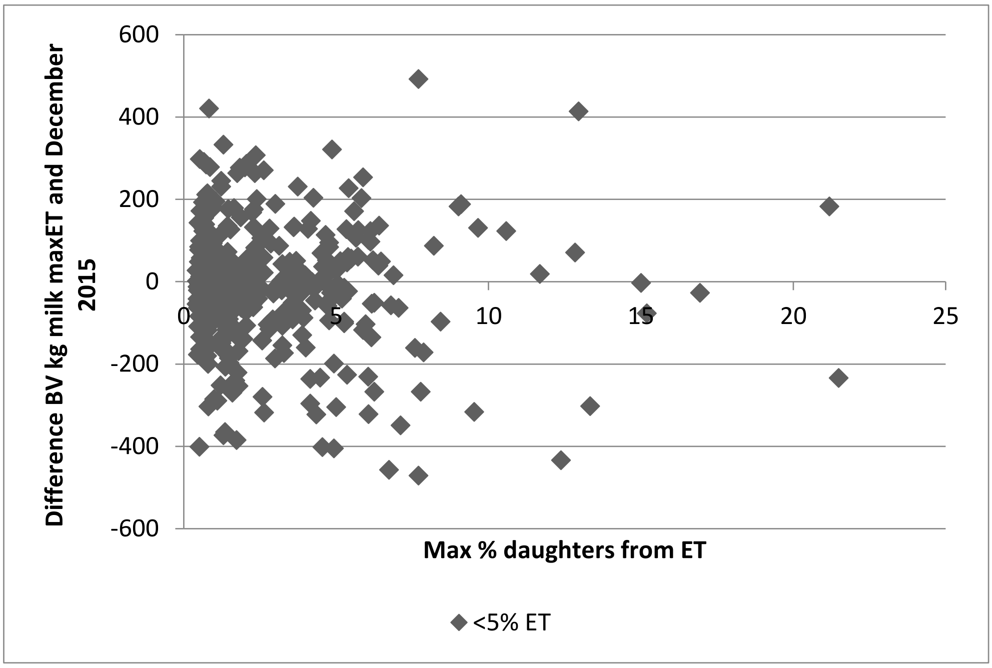

Figure 3. *Basic analysis: maximum percentage daughters born from ET set out to the difference between breeding value for milk at maxET and the breeding value for milk in December 2015, corrected for base adjustment, for the bulls with percentage ET <5% in December 2015.*

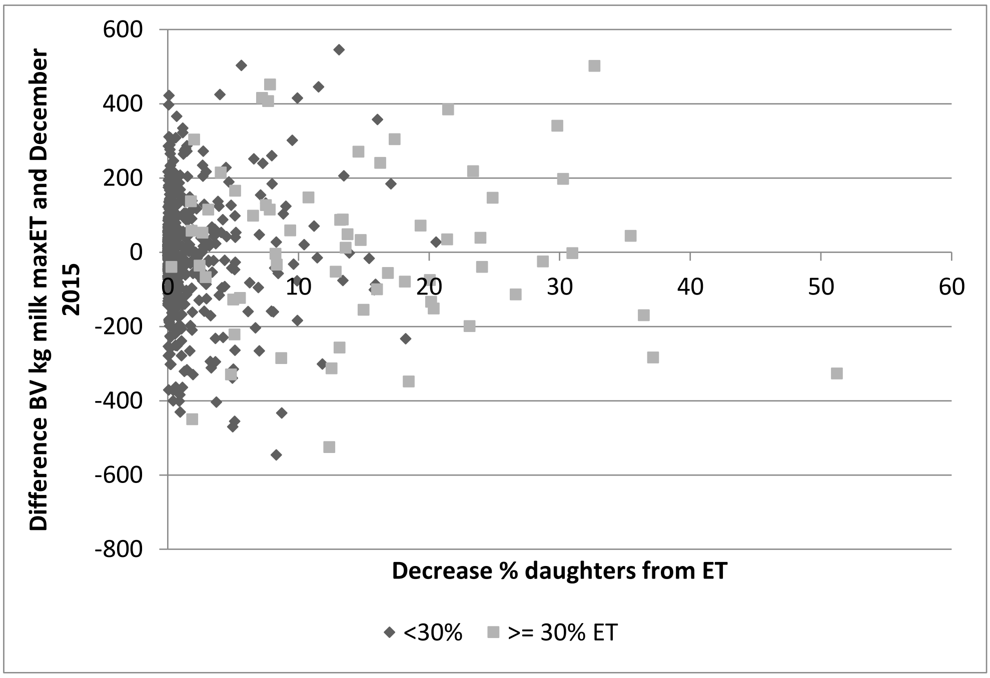

Figure 4*. Extensive analysis: decrease in %ET daughters set out to the difference between breeding value for kg milk at maxET and the breeding value for milk in December 2015*

The regression coefficients for the basic analysis is 4.0, meaning that, apart from the correction for the base change, 4 kg milk should be added to the breeding value kg milk of the maxET% breeding value estimation run per percent ET, to get to the breeding value of December 2015. So in this analysis, where the percentage of maximum daughters born from ET is relatively low, there is a slight underestimation of the breeding value for milk production.

The regression coefficients for the extensive analysis is 0.3, meaning that, apart from the correction for the base change, 0.3 kg milk should be added to the breeding value kg milk at maxET% per percent ET to get to the breeding value of December 2015. So in this analysis the underestimation is even smaller. Repeating the extensive analysis while only taking into account the bulls that had a maxET% higher than 30% results in a regression coefficient of

2.9, which again points to a slight underestimation of the breeding value.

The regression coefficients for the production traits kg milk, kg fat, kg protein, and INET, as well as the conformation traits frame, dairy strength, udder and feet & legs are displayed in table 2. The results vary between the traits and between the different analyses. For kg milk the results tend to a slight underestimation, the same goes for kg protein. Important to notice are the large standard errors (SE) on the regression coefficients, which indicates the precision of the estimation is smaller. Kg fat and INET show very varying results between the different analyses. The conformation traits frame, udder and feet & legs show small effects, and also large standard errors and varying results between the different analyses. For dairy strength the effects are larger for the basic analysis and the extensive analysis using only bulls with a maxET% of over 30%, which both show an underestimation of the breeding values. The extensive analysis with all bulls however, shows a small underestimation. So here it is again clear, that the results vary.

4. Discussion & Conclusion

Based on the performed analyses, no clear effects were found of the percentage of daughters born from ET on the breeding values of a bull. De results tend a little bit more to an underestimation of the breeding value at maxET% than an overestimation. The results also show to be very dependent on which animals are included in the analyses. It would be wise to repeat the analyses again when more information is available, when more bulls with maxET% higher than 30% have decreased their current %ET to less than 5 percent.

5. References

Beavers, L. & Van Doormaal, B. 2014, 'Steps to Reduce Bias in Genetic and Genomic Evaluations'. *CDN Article.*

Gilmour, A.R., Gogel, B.J., Cullis, B.R., Welham, S.J. & Thompson, R. 2006. *ASReml User Guide Release 2.0* VSN International Ltd, Hemel Hempstead, HP1 1ES, UK.