ECONOMIC VALUES FOR A CALVING EASE ESTIMATED BREEDING VALUE (EBV) FOR AUSTRALIAN HOLSTEIN FRIESIAN BULLS

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SUMMARY
This paper attempts to estimate the total cost of calving difficulty, for both sire and maternal grandsire. Dystocia (calving difficulty) can be regarded as both a trait of the cow (expressed several times, each time a cow calves) and of the calf (expressed only once, when the calf is born). Dystocia, as a trait of the cow or of the calf, is not explicitly included in the Australian Profit Ranking (APR) of dairy bulls. Some of the indirect effects of dystocia on the cow are included in the APR, such as fertility, survival and milk yield ABVs (Australian Breeding Value). The analysis in this paper removes some of the economic effects on cows that have already been accounted for in the APR. A combined calf and partial maternal cost for dystocia could be considered for inclusion in the APR.
Keywords Holstein-Friesian, dystocia, cost, economic

INTRODUCTION
Dystocia (or calving difficulty) is a lowly heritable trait, as found by Bar-Anan (1976), Philipsson (1976), Pollak & Freeman (1976) and Politiek, (1979). Dystocia is a problem of both the cow and for the calf. It can be measured as a trait of the cow (her ease of calving): for example the cow may have a smaller pelvic area, resulting in her having difficulty extruding a calf. Part of this trait will be contributed by the genes of the maternal grandsire. It can also be a trait of the calf (its ease of being born): for example calves with relatively wide pectoral girdles may have increased difficulty being born. The genes responsible for a calf's calving ease are contributed partly by the dam, and partly by the sire of the calf. Thus, separate estimates may be needed for dystocia resulting from both the calf sire and the maternal grandsire. In addition, dystocia is expressed a different number of times as a trait of the sire compared to a trait of the maternal grandsire. A sire influences the ease with which his calves are born only once (at the time of his calf's birth) whereas the maternal grandsire influences his daughter's ability to give birth every time she has a calf. From one successful calving, the influence of the maternal grandsire is approximately the proportion of female calves (0.5) times the likelihood of the female calf being reared as a replacement (0.8) times the average numbers of lactations/calvings for cows in Australian herds (5) (as shown in Table 1). Hence the influence of the maternal grand sire on dystocia is expressed about twice as often as the influence of the sire.

Table 1 Relative numbers of gene expressions of sires and maternal grandsires.

	maternal grand sire	sire
successful pregnancy	1	1
proportion of calves that are female	0.5	
proportion of daughters that survive and are selected for herd	0.8	
average number of calvings per daughter	5	
number of gene expressions/pregnancy	2	1

These two components of dystocia (the cow's ability to give birth, and the calf's ability to be born), which are different traits, need to be accounted for separately and given suitable relative weightings when compared, because of the different numbers of times they are expressed.

The economic effect of the bull, as sire of the calf, is rarely taken into account in bull selection, except for some primiparous cows. This is even though the farmer will, on average, incur losses estimated to be US$10.00 for multiparous cows and US$28.53 for primiparous cows (Dematawewa & Berger, 1997). However, farmers may be reluctant to use 'easy-calving bulls' because they believe that the female calves themselves may have difficulty calving, though this is not proven (Thompson et al., 1981).

The deleterious effects of dystocia on the cow, such as reduced milk yield, fertility or survival, are reflected in the sire of the cow's proof for these traits: this has been included in normal bull proofs based on daughter performance for some years.

The Australian Profit Ranking (APR) is an index that ranks bulls according to their profitability to the dairy farmer. The current index includes weightings for milk fat, fertility, milk volume, milk protein, somatic cell count, survival and temperament, weighted according to economic value (A$ per cow per year). Dystocia is not included directly in the APR, though some of its effects, such as effects on cow survival, fertility or milk yield are included. Dystocia is a major cost and cause of stress for farmers, and may reasonably be considered to be a candidate for inclusion in the APR based on its real and social costs. Dystocia as a trait of the calf is not yet included in the APR, either directly or indirectly.
Currently, cow costs for dystocia are indirectly incorporated into the present APR, as a component of cow fertility and milk yield. The relatively high cost of cows that are terminated shortly after parturition may not be fully accounted for. Calf mortality, costs of labour, veterinary and medication costs associated with dystocia are not included in any component of the APR.

AIM
To find economic values of maternal grandsires dystocia with and without adjusting for factors already in the APR, and compare it with dystocia costs due to the calf sire

METHOD AND MATERIALS
Dystocia was scored by the Australian Dairy Herd Improvement Scheme (ADHIS) using a seven point calving ease scoring system, (as shown in Table 2), which is not linear. Score 1 is more serious than score 2, score 5 is more serious than score 4, and may or may not be more serious than score 7. Most of the

herds used in this study made use of both unobserved and observed categories of this scoring system, though most herds tended not to use all of the categories available.

Costs of individual categories of calvings for primiparous and multiparous cows were calculated using frequencies from calving records, cow and calf survival data from ADHIS and *InCalf*. The full costings included the following categories: labour, medication, veterinary assistance (these three were estimated from farmer surveys), calf and cow mortality, fertility and reduced milk yield (estimates obtained from mixed model analysis). Cow loss was divided into two groups: (1) early non-survivors and (2) late non-survivors. Cows that did not survive the early post-parturient period (to 21 days) had a greater tendency to die on farm, producing no salvage value. Cows that were culled later in the post-parturient period were more likely to be sold (usually for slaughter) and had some salvage value. Reduced costs included only the first four categories (labour, medication, veterinary assistance and calf mortality).

Table 2 Estimated Costs of Differing Degrees of Dystocia.

		primiparous			multiparous		
dystocia category		probability of being in category	full cost ($)	reduced cost ($)	probability of being in category	full cost ($)	reduced cost ($)
unobserved not ok	1	0.025	885.89	203.34	0.016	818.80	187.31
unobserved - ok	2	0.410			0.618	-	-
observed - ok	3	0.257			0.243	-	2.41
easy pull	4	0.190	62.69	19.48	0.077	76.53	16.77
hard pull	5	0.097	229.36	125.50	0.032	195.53	113.07
surgical	6	0.004	770.21	505.63	0.001	712.70	521.00
malpresentation	7	0.017	264.40	117.04	0.013	178.65	98.07

ADHIS provided data (801,652 calving records) from which 134,141 records were extracted, which were the result of AI matings of known Holstein bulls with Holstein cows. Calving records that resulted in twins, which were from sire-daughter matings, or the result of abortions or inductions, were excluded. The calvings were from herds that reported at least one difficult and one normal calving in a season: Primiparous cows were defined as cows younger than 33 months at calving, and multiparous cows as older than 40 months at calving. After editing, 1647 sires and 1010 maternal grandsires remained of which 551 bulls were both sires and maternal grandsires. A pedigree file of 9609 animals was also used in the analysis.

The reduced cost of a calving was matched with dystocia scores for each calving record. The breeding values of calving cost for the maternal grandsires were calculated:

$$D_{ijklmp} = m + s_i + m_j + \sum_{n=1}^{5} a_n Z_{kn} + b_l + mgs_m + hys_p + e_{ijklmp}$$

where

D_{ijklmp} denotes the (reduced) dystocia cost in dollars per calving, for multiparous or primiparous cows

μ is the population mean for that trait

s_i denotes the fixed effect of the i^{th} sex of the $ijklmp^{th}$ calf

m_j denotes the fixed effect of the j^{th} month of birth of the ijklmpth calf
a_n denotes the fixed regression coefficient of the cow age at calving on calf fate
Z_{nq} denotes the n^{th} order orthogonal polynomial corresponding to the a^{th} month of age of the cow at calving
b_l denotes the random effect of the l^{th} bull, the sire of the ijklmpth calf
mgs_m denotes the random effect of the m^{th} bull, as the maternal grandsire of the ijklmpth calf
hys_p denotes the fixed effect of the n^{th} herd-year-season in which the ijklmpth calf was born
e_{jiklmn} denotes the random error associated with the calving of the ijklmpth calf.

Bull breeding values as sires and as maternal grandsires were calculated as double the bull solutions. Genetic standard deviations were calculated as the square root of four times the sire or maternal grandsire variance.

RESULTS
Bull breeding values for maternal grandsires that were calculated from the reduced cost dataset were about one third of the magnitude of the breeding values produced with the full costs of calving. Breeding values for sires had a range spanning about A$57, maternal grandsires about A$48 and reduced maternal grandsire EBVs had a range of about A$17.

Table 3 Breeding value ranges and genetic standard deviations for full and reduced costs.

	MGS (reduced)	MGS (full)	sire (full)
maximum EBV	$8.82	$25.94	$28.88
minimum EBV	-$7.78	-$21.76	-$27.70
genetic standard deviation	$4.28	$12.62	$14.69

DISCUSSION
The remaining genetic cost of the maternal grand sire dystocia was accounted for: the genetic standard deviation of the maternal grandsire cost of dystocia was A$12.62 for all costs, which was reduced to A$4.28 when only costs that were not included in the APR were used. This is quite small by comparison with existing traits in the APR, such as milking speed (A$7.09), temperament (A$9.05) or protein (A$46.2). The full cost of dystocia as a trait of the calf was A$14.69, but this is halved to A$7.35 as it is expressed half of the number of times of the maternal grandsire effect on dystocia.

Although the genetic standard deviation of the reduced cost of maternal grandsire dystocia was relatively small by comparison with some traits that are included in the APR, such as protein kg, it is of a similar size to other traits such as liveweight and survival. A combined estimate of a bull's breeding value for dystocia, as a trait both of the calf and of the cow, when suitably weighted, could be incorporated into the APR, and would reflect the true effect of dystocia on the profitability of that bull. This could allay some of the traditional concerns of farmers that "easy calving bulls beget daughters that have difficult calvings themselves."

CONCLUSION

About two thirds of the effect of the maternal grandsire is already accounted for by inclusion of other traits such as cow survival. However, further investigation is required to find out if the inclusion of early post-parturient loss in these calculations will have some effect on this conclusion.

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REFERENCES

Bar-Anan, R. (1976). Genetic and Environmental factors affecting the Incidence of Difficult Calving and perinatal calf mortality in Israeli-Friesian Herds. *Animal Production*, **22,** 299 - 310.

Dematawewa, C. & Berger, P. (1997). Effect of Dystocia on Yield, Fertility, and Cow Losses, and an Economic Evaluation of Dystocia Scores for Holsteins. *Journal of Dairy Science*, **80,** 754 - 761.

Philipsson, J. (1976). Studies on calving difficulty, stillbirth and associated factors in Swedish cattle breeds. III. Genetic parameters. *Acta Agriculturae Scandinavica*, **26,** 211 - 220.

Politiek, R. (1979). Calving problems and early viability of the calf. In *Calving problems and early viability of the calf*, B.Hoffman, J.M., J.Schmidt, Martinus Nifhoff (ed) pp. 206 - 219: The Hague.

Pollak, E. & Freeman, A. (1976). Parameter Estimation and Sire Evaluation for Dystocia and Calf Size in Holsteins. *Journal of Dairy Science*, **59,** 1817 - 1824.

Thompson, J., Freeman, A. & Berger, P. (1981). Age of Dam and Maternal Effects for Dystocia in Holsteins. *Journal of Dairy Science*, **64,** 1603 - 1609.