Proc. Assoc. Advmt. Anim. Breed. Genet: 26: 483-486

GENETIC TRENDS IN AUSTRALIAN BEEF CATTLE AND SHEEP POPULATIONS, AND THEIR IMPACT

R.G. Banks, D.J. Brown, K.L. Moore, B.J Walmsley and A.A. Swan

Animal Genetics and Breeding Unit[1*], Armidale, NSW, 2351 Australia

SUMMARY

Since 2000, genetic improvement in the Australian beef and sheep industries has exhibited increasing rates of genetic progress expressed in economic index terms, increasing adoption of genetic technologies, and consequently, substantial and increasing economic impact. Economic benefits flow to both private and public beneficiaries, and imply substantial return on public and private investments. Monitoring and communication of ongoing progress will be important in maintaining investment, particularly as phenotyping increases in importance.

INTRODUCTION

Genetic evaluation at an industry level provides a basis for genetic improvement and for an informed market for genetic products (animals, semen, oocytes, embryos) and services (e.g. mating and breeding program design). These support public and private benefits, and attract both public (including both taxpayer and industry contributions) and private investment. Documenting and understanding the scale of these benefits is important for attracting and maintaining investment.

Genetic evaluation for the Australian beef and sheep industries is available through BREEDPLAN (Gudex *et al.* 2025) and Sheep Genetics (Brown *et al.* 2007), noting that some breeders access other systems. BREEDPLAN and Sheep Genetics have been available since the mid- and late 1980s respectively, and provide information on animals' genetic merit, which bull- and ram- breeders, and commercial cattle and sheep producers, can use to assist in selection.

These genetic evaluation systems routinely track information including numbers of animals entering the evaluation and average genetic merit for individual traits and economic indexes. This paper reports on genetic trends in BREEDPLAN and Sheep Genetics data, and using these derives estimates of economic impact.

MATERIALS AND METHODS

Data on genetic trends in BREEDPLAN and Sheep Genetics were provided by ABRI and AGBU, respectively. For beef cattle the indexes were developed using BreedObject v.6 (Barwick *et al*. 2018). Individual breed index trends were combined into aggregates for southern and northern breeds respectively by first averaging across the current indexes produced for each individual breed, and then combining into a weighted aggregate index using the numbers registered with each breed within birth year (Millen*, pers. comm.*; Gudex *et al.* 2025). The breed groups aggregated were:

- Southern: Angus, Charolais, Hereford, Limousin, Murray Grey, Red Angus, Shorthorn, Simmental, South Devon, Speckle Park and Wagyu.
- Northern: Belmont Red, Brahman, Brangus, Droughtmaster and Santa Gertrudis.

In sheep, trends were averaged across the main currently used indexes for each breed group; terminal sire breeds, maternal breeds and Merinos (https://www.sheepgenetics.org.au/getting-started/asbvs-and-indexes).

---

[*] A joint venture of NSW Department of Primary Industries and Regional Development and the University of New England

Estimates of annual economic impact were calculated as the product of:

- the difference between the index mean for each year and the mean for the 2000 drop)
- estimated number of sires entering industry annually as 0.55 of the number of animals enrolled in each year as male (Skinner and Brown *pers. comm.*), and 0.75 of those being used as sires
- estimated lifetime females joined as 100 times the estimated number of bulls entering industry and 125 times the number of rams
- number of animals enrolled in that year

Because the relevant indexes are all essentially a Net Present Value per female joined, the overall impact is therefore an estimate of Net Present Value added due to animals born in that year, compared to a 2000-drop base.

RESULTS AND DISCUSSION

Genetic trends for the breed groups, summarised by 5-year regressions for each period, are shown in Table 1. In all groups, the average rate of genetic progress in 5-year periods has increased through time. While unlikely to be the sole contributing factor, single step genomic evaluation was introduced to some extent in all 5 groups in 2016-2018, and may have contributed to the increases in genetic trend observed since 2015. Increase in genetic trend with the introduction of genomic prediction has been observed in other industries, most notably but not limited to dairy cattle (Guinan *et al.* 2022; Shaffer, *pers. comm*., Knol *et al*. 2016).

Table 1. Breed group aggregated average genetic trends ($NPV per female joined per year)

Period	Southern Beef	Northern Beef	Merino	Terminal Sire	Maternal
2000-2005	$4.58	$0.75	$1.12	$1.22	$0.72
2005-2010	$4.86	$0.69	$1.13	$1.13	$2.56
2010-2015	$7.45	$0.67	$1.24	$1.00	$1.89
2015-2020	$8.73	$0.67	$1.53	$1.38	$2.14
2019-2023	$9.46	$0.83	$2.52	$1.99	$3.43

NB: the values here are the slope of the average genetic trend in that group for that period

Regardless of the extent to which these results reflect adoption of genomic prediction, they imply utilisation of genetic improvement technologies. Not shown here, 3 other trends contribute to this last observation:

- average index accuracy is rising steadily in all three sheep breed groups (data not available for beef at the time of writing), implying more and/or better recording practices. Sheep Genetics has provided metrics of data quality throughout the period of these results, and these coupled with general extension, would seem to be encouraging improved recording. The product of average index accuracy and number of animals evaluated, a measure of the informaton available to the market, has grown at about 7% per year in the 3 sheep groups (year data not shown).
- a steady genetic trend for improved fertility (expressed via the Days to Calving EBV) in Brahmans, with some suggestion of acceleration in the most recent years. Fertility is a major component of breeding objectives for northern breeds, so this trend is encouraging.
- and numbers of animals entering genetic evaluation are rising steadily through the period, most notably in sheep.

The estimates of economic impact across the whole industry are shown in Table 2.

Table 2. Breed group and industry total estimates of economic impact ($m)

Period	Southern Beef	Northern Beef	Merino	Terminal Sire	Maternal
2000-2005	$538.69	$18.06	$35.10	$42.10	$3.18
2005-2010	$1,220.91	$46.18	$113.89	$161.23	$55.70
2010-2015	$2,433.08	$73.56	$327.65	$313.45	$148.31
2015-2020	$3,679.22	$102.68	$721.87	$569.83	$322.59
2021-2023	$3,440.14	$86.81	$649.75	$517.35	$356.05
Total	**$11,312.95**	**$327.30**	**$1,848.27**	**$1,603.96**	**$885.83**

NB: economic impact for the last period is years 2021-2023. The last period for the genetic trend results is 2019-2023 (Table 1) – simply to have a 5-year trend rather than 3-year.

The estimated impacts in Table 2 are rising - in both species reflecting both increasing rates of genetic progress and increased numbers entering evaluation. Note that while the estimation method assumed constant proportion of rams entering the sheep industry to total animals evaluated, and constant lifetime joinings per ram, these parameters appear to be rising (Brown*, pers. comm.)*

The totals for the two species - $11.6bn and $4.3bn respectively – are approximately the current gross value of production of the beef and lamb and sheepmeats industries (Meat and Livestock Austalia 2025), meaning that gross margins have been growing at approximately 4% of gross value of production annually (which if gross margin averages 20% of gross value of production, equates to annual growth in real gross margin of 20%). These estimates suggest very substantial contribution of genetic improvement to industry economic outcomes, and steady and substantial increase in that contribution through the period 2000-2023.

Are there any caveats to these observations?

i) Average index change within a breed is not what every individual producer obtains by sourcing sires from a herd or flock making genetic progress, but the average trend describes progress in the population as a whole.
ii) Using the current indexes to define genetic trend does not mean that selection emphasis has been constant, as indexes have changed their trait coverage and weightings.
iii) The economic impact estimates depend on the scale of expression of genetic trend, which is here calculated using estimates of numbers of sires entering industry from herds or flocks per animal evaluated and their lifetime joinings. The values used here (41 and 52 for bulls and rams respectively) are similar to those derived by Fennessy *et al* (2014), but as noted above, appear to be rising, at least in sheep.
iv) The impact estimates are expressed in approximately current dollars – reflecting when the indexes were updated (through the period 2020-2024). Because nominal prices have risen during the period 2000-2025 in both species, the comparison with industry value should be done using current price and income levels (as was done here).

Other factors to consider include:

- counterfactual, including importation: importation has contributed to genetic improvement in the beef industry, but this fact does not lessen the value of that improvement, or the return on investment. Without local investment in genetic evaluation, importation would likely be less directed to local breeding objectives, and hence of lower value for the Australian industry, and also would be impossible to evaluate.
- the impact includes public, industry, and private benefits. The evaluation systems provide a platform that enhances each of them.
- the impact does not account for multiplication of these genetics such as sires bred from evaluated sires, which is a significant pathway especially in Northern Beef and Merino sheep.

- maintaining industry evaluation systems has to date depended on models of funding that were established in the 1980s, with understandably no appreciation of the ongoing challenge of attracting sufficient funds to collect phenotypes. Addressing this issue – funding phenotyping at sufficient scale and trait coverage – is urgent now.

CONCLUSIONS

The overall messages are clear:

- In both species, there have been significant increases in the rate and value of genetic change since 2000, with clear signs of acceleration in more recent years, which likely have made major contributions to maintain or improve profitability in value chains in both species.
- These trends reflect increases in adoption as well as improved recording resulting in increased accuracy, and implied increasing selection differential (as approximated by the ratio delta G/accuracy – not shown here).
- The economic impacts of the genetic change are substantial in both species.
- And while not estimated here, the return on investment ratios in both species, with investment including RDE and recording and selection costs, are approximately 33:1.

Genetic improvement in the Australian beef and sheep industries has generated susbtantial economic benefits, and there is good evidence that the scale of those benefits is increasing. Monitoring outcomes for these public-industry-private partnerships is essential, ideally tracking longer terms, and should include regular and open updating of economic indexes to ensure both their relevance to value chain businesses and to overal evaluation.

ACKNOWLEDGEMENTS

ABRI and Sheep Genetics are acknowledged for the provision of genetic trend data. Particular thanks to Catriona Millen (ABRI) and Peta Bradley (Sheep Genetics). This paper was initiated with inputs from Andrew Swan, and pays tribute to his contribution to beef and sheep genetic improvement in Australia.

REFERENCES

Barwick S.A., Henzell A.L., Walmsley B.J., Johnston D.J. and Banks, R.G. (2018) *J. Anim. Sci.* **96**: 1600.

Brown D.J., Huisman A.E., Swan A.A., Graser H.U., Woolaston R.R., Ball A.J., Atkins K.D. and Banks R.G. (2007) *Proc.Assoc.Advmt. Anim. Breed. Genet*. **17**: 187.

Fennessy P., Byrne T., Amer P. and Martin, G. (2014) Meat and Livestock Australia, Final Report B.EVA.001 and B. EVA.002 Meat & Livestock Australia, North Sydney.

Gudex B.W., Millen C.A., Johnston D.J. and Turner, N. (2025) *Proc. Assoc. Advmt. Anim. Breed. Genet.* **26**: *These proceedings.*

Guinan F.L., Wiggans G.R., Norman H.D., Dürr J.W., Cole J.B., Van Tassell C.P., Misztal I. and Lourenco D. (2023) *J. Dairy Sci*. **106**: 9911.

Knol E.F., Nielsen B. and Knap P.W. (2016) *Anim. Front.* **6***:* 15.

Meat and Livestock Australia (2025) https://www.mla.com.au/about-mla/the-red-meat-industry/