# Livestock Genetics Investment Priorities - Industry Discussion Paper 5
# October 2015

## WHO BENEFITS FROM GENETIC EVALUATION AND IMPROVEMENT?

### Purpose of this discussion paper

This is one of five discussion papers on key issues prepared to stimulate discussion of, and feedback on, the consultation draft of beef genetics research, development and extension (RD&E) investment priorities for the next 5 years.

This paper describes who benefits from genetic evaluation and improvement in the Australian beef industry. It lists a number of challenges for genetic improvement that arise from how benefits are generated and distributed. These need to be considered in developing a strategy and implementation plan for industry investment in genetics.

The Genetics RD&E Steering Group is seeking feedback on its current perception and assessment of these key issues and on the RD&E priorities in the industry consultation draft. Feedback can be emailed to livestockgenetics@mla.com.au by 31 January 2016.


### Summary

1. Genetic improvement in the beef industry is currently generated almost wholly by seedstock breeders, and is heavily dependent on the volume and quality of performance records they collect, and in the quality and use of the analysis.
2. In economic terms, the whole of the supply chain benefits from the activity of the seedstock sector, but breeders on average only receive 5-10% of the value generated by genetic evaluation and improvement. Consumers are the largest beneficiary (50-55%).
3. Collection of performance records is ultimately funded by benefits flowing back to the breeder through increased bull prices, but these benefits are quickly dissipated to other sectors of the supply chain due to competition, and any price signals are not necessarily indicative of what traits are valued.


### Where is value generated from genetic evaluation and improvement?

The overall enterprise of genetic evaluation and improvement can be broken into three steps:

a) **Data collection.** This is typically done by bull breeders acting individually, with more recently some collective investment from some breed societies on behalf of their members into reference herds, and also some collection of data from a range of points or links in the beef value chain (such as the collection of structured feedlot and carcase data).

b) **Transforming data into information**. This depends on knowledge of how records of animal performance (phenotypes) relate to genotype (which means knowing genetic parameters), being able to make valid comparisons, and having software that can handle extremely heterogeneous data. The end result is estimates of relative genetic merit (ie EBVs), all in the form of comparative values (ie compared to some base).

c) **Harvesting this information to generate wealth**. Estimates of genetic merit are turned into wealth by choosing where to buy bull(s), including which breed and which stud, choosing which bull(s) to buy, and which bulls and cows to mate.

Each section or step can be defined in terms of what maximises value at that point, which can then form the basis of quality control.

Three different forms of value, or types of benefit, are generated:

a) **The ability to make informed choice.** This reduces the risk of a negative outcome which can include paying too much for a bull with a particular genetic merit, or getting the wrong genetics for a particular job. This ability to make better choices increases as the number of animals sold with genetic information and the accuracy of that information increases. This is reflected in the variation in $Index within breed within year which has been rising (see chart in Appendix 1), and the value generated has been estimated to be in the order of $32.5m per year[1].
b) **The ability to generate genetic improvement over time.** This enables enterprises throughout the value chain to combat the cost-price squeeze. The value over a period of time is simply the sum of the annual increment in genetic merit as measured through economic value. As a simple example, if the current genetic trend is valued at $3 per cow joined, and c. 6 million cows are being joined to bulls with BREEDPLAN EBVs each year, then the annual increment of industry wealth from genetic improvement is 6m x $3 = $18m per year[2]. This is wealth that the industry would not have if there was no genetic improvement.
c) **The ability to make better management decisions** assuming the genetic merit of animals is known. The size of this benefit has not been estimated, but it could be generated in many ways. For example, the gross margin per cow across the chain might improve by c. 5% if animals that will underperform in feedlots could be removed earlier. Using Holmes-Sackett[3] estimates of gross margin per cow of c. $200, and conservatively assuming this benefit is only applied to 10% of cows, the benefit would be 5% x $200 x 1m cows = $10m pa. However, this benefit is not cumulative as it is a management decision– it does not grow over time in the way that genetic improvement does.

## Who benefits from this value?

### a) Across the supply chain:

Detailed modelling studies have estimated the distribution of benefits from either increasing farm-level production or domestic market demand (ie from investment in marketing and promotion) summarised in Table 1.

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[1] Banks, R.G., "Who Benefits from Genetic Improvement?" Proc. WCGALP 10 (2014)

[2] Estimating benefits from genetic improvement is only possible if the genetic trend data is on an agreed set of economic weights, and these reflect all costs and returns through the chain. Extending this point, many breeds have weightings in their indexes for some traits that reflect non-financial weights (or at least not formally costed). An example is the Docility EBVs included in selection for at least one breed – for breed-specific reasons. This impacts their selection for other traits, but will not be captured in estimates of the economic value of returns from genetic improvement.

[3] MLA Report B.COM.0351A " Southern beef situation analysis." (2014)

When prices are determined by world markets, which is at least partly the case for beef in Australia, some authors argue that a higher proportion of the total benefit accrues to producers, typically ending up in the value of land (Amer, pers. comm.)

**TABLE 1: DISTRIBUTION OF RETURNS (%) BY SECTOR R&D INVESTMENT INTO IMPROVED PRODUCTION OR IMPROVED DEMAND**[4]

| Sector | Beef Research | | Sheep Research | |
|---|---|---|---|---|
| | Production | Promotion | Production | Promotion |
| **Producers** | 24-34% | 20-30% | 24% | 20-26% |
| **Feedlots** | 0.1-0.2% | 0.3% | - | - |
| **Processors** | 1% | 1% | 8% | 9-12% |
| **Retailers** | 4% | 4-7% | 5.5% | 3-10% |
| **Domestic Consumers** | 50-55% | 50-65% | 31% | 20-48% |
| **Overseas Consumers** | 8-9% | 5-12% | 31% | 15-38% |

### b) Within the on-farm sector:

The next question is how much of the benefit that is captured by producers, typically about 25-30% of the total, is shared back with bull breeders? This is harder to estimate precisely in any country, but some evidence is available, including:

- **Market share for a breed**: Angus and Hereford have swapped market share in southern Australia over the last 20 years (from approximately 20:50 of total *Bos taurus* breed sales to c. 60:20 or even higher), reflecting a combination of initial advantage in merit for marbling, coupled with higher genetic trend over much of the period.
- **Bull prices over time**: AbacusBio found that average bull prices more closely track nominal and real prices for slaughter steers over time than Index trends, as seen in the graph below[5]
- **Average bull prices per herd**: analysis of data from the Angus breed, for one year of sales, shows that there is a statistically significant relationship between average herd merit (based on $Index) and average bull price. Herd merit, in one year's data, explains about 10% of the variation in price, and for each $1 increase in herd average merit for $index, the average bull price per herd rises by $17 (R Banks analysis, data supplied by Angus Australia).
- **Within herd analysis**: within four "high-end" studs, each with long-term commitment to education and communication with their clients, the index value was found to explain around 15-20% of variation in bull price, with the price changing by around $30-70 per index point, depending on the index used[6].

Taken together, this very limited data suggests that the market does deliver some reward for superior genetic merit at the breed, herd and bull level. Over all breeds and herds, this reward is probably

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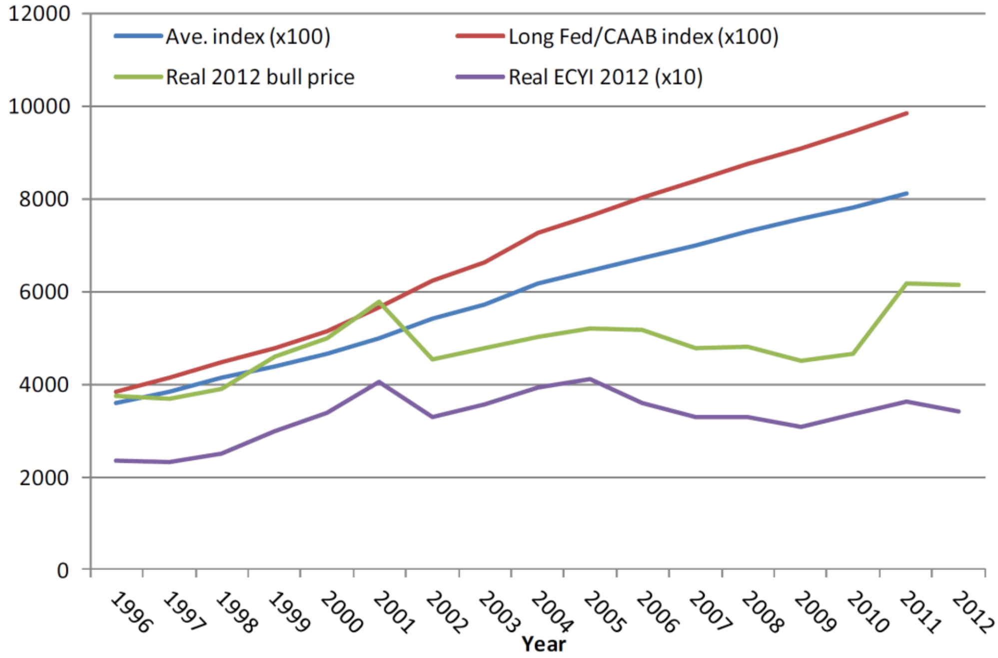
[4] Zhao Zhao, X., Mullen, J.D., Griffith, G.R., Griffiths, W.E. and Piggott, R.R. "An Equilibrium Displacement Model of the Australian Beef Industry" Economic Research Report No. 4, NSW Agriculture, Orange. Australian Agribusiness Review 16. Paper 1 (2000)

[5] Amer, P. MLA Research Report B.SGN.0137 "Development of models for incentivisation of recording in the beef and sheep breeding sectors" (2014)

[6] Van Eenennaam "How might DNA-based information generate value in the beef cattle sector?" ICAR Conference (2012)

around 5-10% of the total value created. There is definitely considerable variation around this estimate, both between and within breeds.




This is important because breeders must ultimately cover their additional costs for herd recording from sales of breeding stock. Whatever share of the total benefit generated ends up with breeders ultimately caps the amount they can afford to spend on recording, which is why the level of phenotype recording varies between breeds and between traits.

## Challenges:

1. The limited flow of benefits back to the breeding sector, and the very large variation in how much flows between breeds and herds, means that total funds available for recording are limited, uncertain and variable, and that investing in anything other than basic recording is a risky investment for many breeds and herds.
2. Improving this flow of benefits is a long-term project, one that has depended on both public/industry extension and also significant effort by some breeds and studs. The public good benefit from improving this flow is very large.
3. Industry recognises and responds to the market failure through co-investment by MLA in RD&E using levies, but not with any specified allocation to genetics. There is also essentially no pre-defined investment to assist with recording, except opportunistically via MLA Donor Company funds for reference herds (ie BINs). How benefits flow back to breeders also has a very strong influence on the direction of selection, with estimates that the whole chain opportunity cost generated by imperfect signals could be as much as $75 per cow joined from one round of selection[7].

[7] Banks, R.G. "Realising genetic improvement for the Extensive Livestock Industries as a Whole" Proc. AAABG (2013)

4. Relying on bull price signals to determine level of recording and selection is flawed and risky, particularly as prices received vary with beef prices.
5. There is an element of chicken and egg involved: if the rate of genetic progress is high enough, then even 5% of the total benefit flowing back to breeders is enough to fund adequate performance recording. However, breeders' forward investment tends to reflect the signals they have received so far, not what they hope to receive in the future. Accordingly, investment in recording will tend to lag, or act as a brake on, genetic progress.
6. An additional benefit not discussed above is that generated by having more breeders adopting recording and genetic evaluation. Through the genetic linkage that exists between studs, having more studs recording and participating in genetic evaluation "lifts all boats", both because all EBV accuracies will be higher, but also because the opportunity for selection is increased – breeders can select across more herds. Most of this effect probably ends up in potentially higher rates of gain, but it is noted here because it is effectively an industry good but only a limited good for the individual breeder, essentially because it makes the market they are operating in more competitive.
7. Benefits grow cumulatively but costs grow arithmetically meaning that substantial increases in total investment can generate much larger profits over time.
8. The beef industry relies almost totally on the exchange between the producer (bull-buyer) and the breeder to incentivise and guide the breeding activity – at present the imperfections in this market represent an opportunity cost likely to be in the order of $50m per year, or $2-3bn over 10 years. This can be estimated by multiplying the difference between the average rate of genetic progress (c. $2 per cow joined per year) and that achieved by top studs in all breeds (c. $7 per cow joined per year) by the number of cows mated each year (c.10m) ie c. $50m per year, or a cumulative value of around $2.5b over ten years.

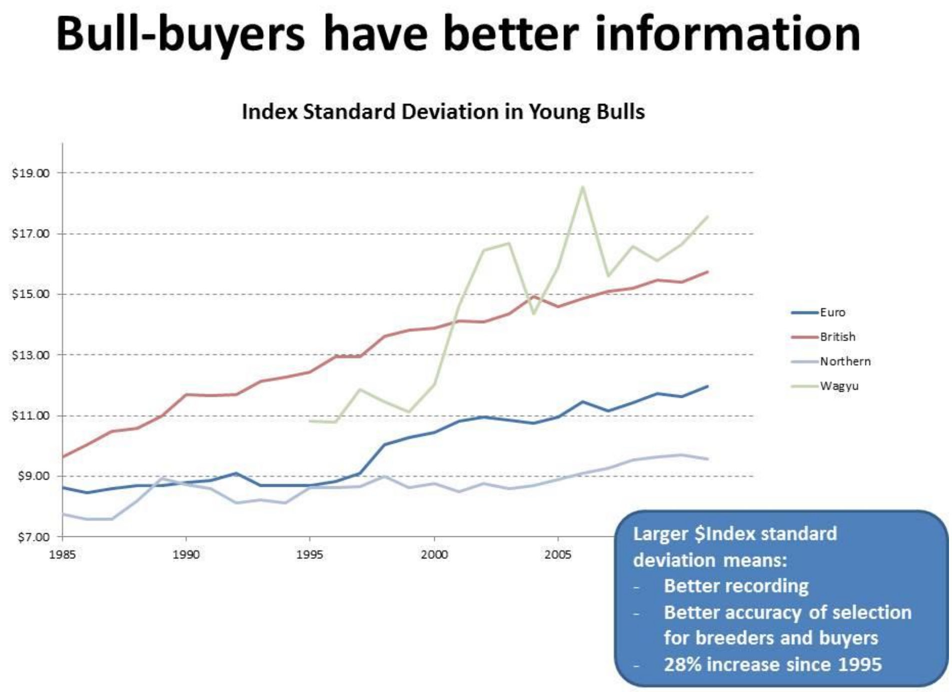
***Discussion points***

1. *Given that on average bull breeders making genetic gain retain only around 5% of the value of the genetic gain they create, and the quantum of value creation varies greatly between breeders, what is a fair and equitable system for rewarding investment in genetic gain?*
2. *In particular, what incentives could be provided to encourage measure of hard-to-measure traits?*
3. *The End Point Royalty system used in cereal breeding in Australia collects a small levy at point of sale of harvested grain and returns that directly to the company that bred that variety to fund their breeding program. It is separate to the R&D levy, and has stimulated significant private investment in their breeding sector. The more tonnes of a particular variety harvested, the greater the return to the breeder, over the commercial life of that variety. How could a similar mechanism be established to reward beef breeders?*

## Acknowledgements:

This paper has been primarily prepared by Robert Banks (AGBU) with input from Steering Group members. The use of data from the Angus Australia is gratefully acknowledged.

## Appendix 1: Trend in Variation in $Index in Australian beef breeds (variation in $Index is a measure of the value of information to bull-buyers)




The chart shows that the variation in $Index among young bulls within a year has risen steadily in the main breeds over the last 30 years.

This means that bull buyers have better information about the genetic merit of animals on offer – the accuracy of $Index has risen.