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R. Mark Enns
Colorado State University, Mark.Enns@Colostate.edu

Dorian J. Garrick
Colorado State University

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THE ECONOMIC BENEFITS AND POTENTIAL WHEN USING CURRENT AND FUTURE EPD – ECONOMICALLY RELEVANT TRAITS

R. Mark Enns and Dorian J. Garrick
Department of Animal Sciences
Colorado State University

INTRODUCTION

Expected Progeny Differences (EPD) have been widely adopted by the US Beef Industry over the last several decades. During this time and especially over the last 8 years, the number of EPD published by breed associations has increased dramatically from 5 in some cases to over 15. The assumption has been that by adding additional EPD producers could better characterize the genetic potential of prospective replacements (Bourdon, 1998) and therefore, to make more appropriate selection decisions that would improve or at least maintain profitability. No matter the number of available EPD, making the jump from genetic change through use of EPD to economic improvement is not a trivial task. There are several ways to tie genetic change to economic improvement and in the near future several new advances will be released that will make this association easier to establish.

An assumption throughout the remainder of this paper is that the goal for the beef producer is profitability with an acceptable level of risk; thereby ensuring the long term sustainability of that operation. It follows, then, that the purpose of genetic improvement is to help the producer meet the goal of profitability and that there are traits that directly influence your ability to be profitable. Finally, what is required are methods for taking EPD for multiple traits and combining those with economic information to determine the effect a particular selection decision will have on profitability.

HISTORICAL PERSPECTIVE

For genetic change to result in economic improvement, it must apply to traits that influence income or costs with any unfavorable changes in individual traits being offset by favorable changes in other traits. This can be formally achieved by identifying the economic value of the specific traits that influence our goal of profitability. The idea of combining genetic evaluation with the costs and revenues of beef production as a basis for selection was originally developed by Hazel (1943). This method is known as the selection index where each trait is weighted by its affect on profitability. These weighted trait values are then summed into one number which represents the overall genetic value, in dollars, of a particular animal, otherwise known as “net merit”. Selection is made on these dollar values. This system, for which an example follows, has been successfully used to ensure genetic change results in economic improvement, especially by integrated ranching organizations and research facilities.

In 1976, Landcorp Farming, Ltd, a New Zealand ranching operation with 65,000 beef cows, implemented a selection index that resulted in net merit values for animals in the company's beef breeding program (Nicoll, et al. 1979). In brief, the organization identified the traits that influenced their overall income. These included slaughter weight of progeny, fertility of the replacement females, weight of cull cows, and feed costs on the range and in the feedlot. As is true today, they were unable to measure feed intake on a large scale, so rather than select directly on this trait, the index allocated a cost for increased intake that resulted from selecting larger animals. Income resulting from larger animals was "penalized" 11% and 32% for slaughter and replacement animals, respectively.

This selection index resulted in considerable genetic improvement in both production traits (Figure 1) and overall genetic value (Figure 2).

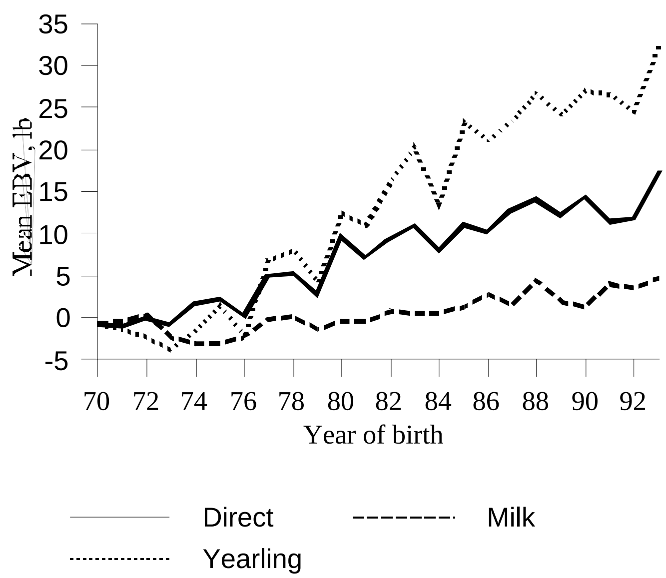

Figure 1. Genetic improvement in weaning weight direct (direct), milk, and yearling weight resulting from index selection at Landcorp.

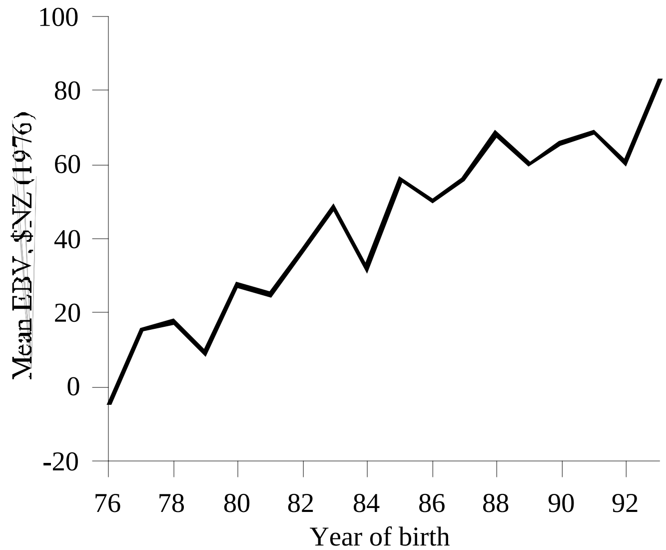

Figure 2. Genetic improvement in animal net merit ($) resulting from selection on an economic selection index. (Units are in 1976 New Zealand dollars).

Another example of success using selection indexes was recently report by MacNeil (2003). Selection was based on a suggestion by Dickerson et al. (1974) where index value (I) was

I = yearling weight – (3.2*birth weight)

As outlined by MacNeil, this index, while not directly related to profitability, was anticipated to reduce increases in mature cow weight and birth weight normally associated with selection for increased yearling weight. Correspondingly feed requirements as a result of larger size and incidence of dystocia associated with increases in birth weight should be less than would occur with yearling weight selection alone. MacNeil reported that selection of animals based on index value resulted in progress in both the index (13.2 lb/generation) and production traits such as weaning weight direct (7.5 lb per generation) and yearling weight (17.1 lb per generation); and a relatively small change in birth weight of 1 lb per generation (Figure 3). The authors concluded that on a national scale, seedstock breeders have even more opportunity for genetic improvement than does a limited-size research herd.

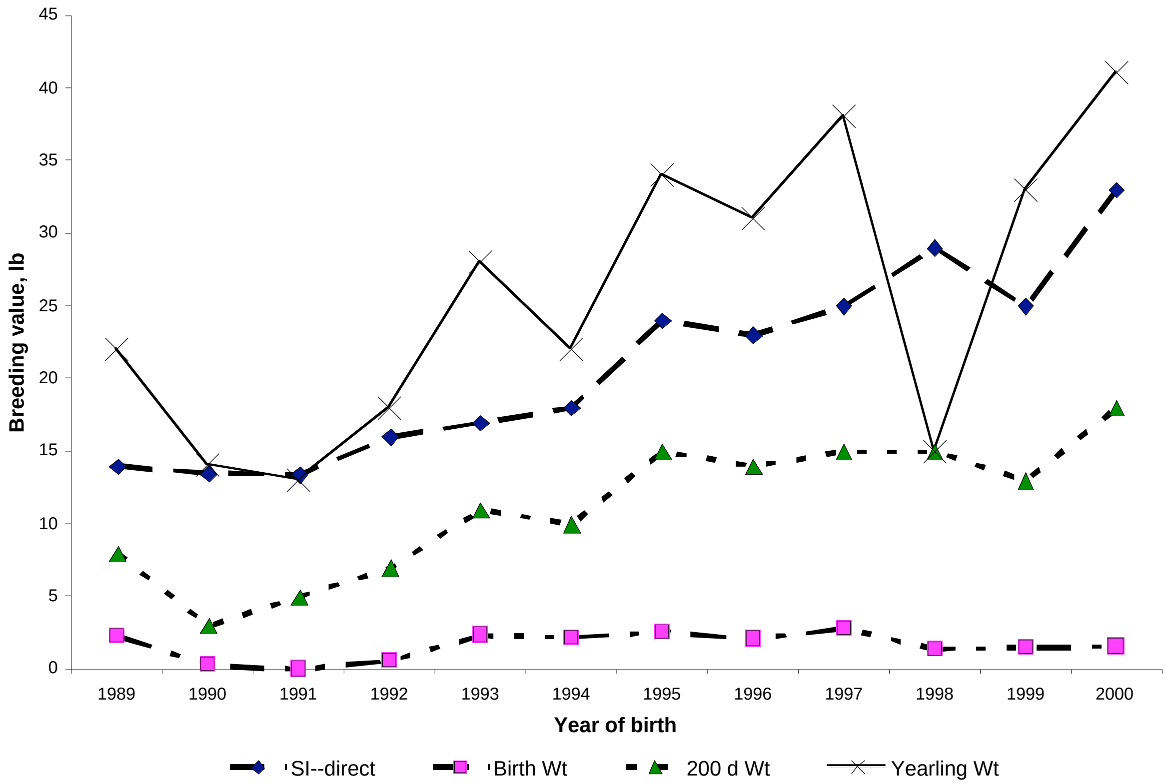

Figure 3. Genetic improvement resulting from selection on the index, I = yearling weight – (3.2 * birth weight) (MacNeil, 2003).

So why have selection indexes not been more widely adopted by U.S. industry? The main reason may be the lack of relatively precise cost and income information for each production enterprise (e.g. heifer development, cow/calf, etc). Unfortunately, feed costs are difficult to value due to fluctuations that might be caused by drought, oversupply, etc. and many producers do not have a plan for future marketing of animals over the long term. Does the producer plan to market weaned calves, calves after backgrounding, or retain ownership and sell live or perhaps on some grid marketing system? What will that system look like in 5 to 10 years time? Some producers have an aversion to associating one number with each potential replacement and making selections decisions based on that ranking—they feel this takes some of the "fun" or "art" out of making breeding decisions.

The Australians have begun to overcome these difficulties in implementation with the development and release of BREEDOBJECT. Producers use this via paid consultants or online. When detailed economic information is not known for a particular operation an "average" production situation is used to determine economic values and corresponding animal ranking. Using the same system, some breed associations in that country have chosen to produce generalized indexes for their breeders. The problem with this approach for US beef producers is the wide disparity in the costs and incomes of production and especially localized costs of feeds. These different costs of production and different marketing strategies can lead to widely different economic values. Melton (1995) showed that with different levels of integration in a production firm (i.e. selling at weaning vs retained ownership) the relative importance of reproduction, production, and consumer traits and therefore their economic values change considerably.

The question remains as to how best implement methods to ensure profitability increases as a result of genetic change in the U.S. production system.

POTENTIAL CURRENT AND FUTURE APPROACHES

The increase in the number of EPD reported by the breed associations--in many cases over 15 traits—has helped the producer to better characterize the animals they produce but has not eased the difficulty in associating costs and incomes of production with selection decisions. The increase in number of EPD, actually may have made this association more difficult. So with the ability to characterize genetic potential like never before, there are several options, some better than others, that can help make sense of this wealth of information and turn it into increased profits. These options are to:

1. Stay with the status quo
2. Develop an index
3. Focus selection on the economically relevant traits.

Option 1 is to continue to use available EPD and weight those by some "perceived" value and make selections based on that value. This is the typical selection method implemented when attending bull sales armed only with the sale catalog. You have an idea of what an increase in weaning weight EPD or Marbling EPD is worth but no solid evidence. This is likely the least accurate method for multiple trait selection and improved economic performance.

Option 2, the development of a formal index, requires a more detailed knowledge of costs and income but is certainly a viable option. To be specific to your production system, the final development may require the aid of a consultant or trained geneticist.

Option 3 provides the most flexibility for using EPD to make economic improvement. Options range from using only the EPD for the economically relevant traits (ERT) to developing some "perceived" value, to using your knowledge of the costs of production to develop an index of ERT.

Before continuing, we need to clarify the meaning of the terms "economically relevant traits" and "indicator traits". Economically relevant traits (ERT) are those traits that we are trying to improve. These are the traits that directly affect profitability—our goal—by being associated with a cost of production or an income stream. Indicator traits are traits we measure because they are related to the ERT, that is, they "indicate" the merit an animal has for another trait. A good illustration is birth weight. Birth weight is an indicator trait and of itself has no value—a producer receives no more income if the birth weight is 80 pounds than if the birth weight 78 pounds. Birth weight is measured because it is related to the ERT, probability of a dystocia or difficult birth. What really matters to the commercial producer is whether that potential replacement produces calves that are born unassisted. Increased incidence of dystocia may result in increased labor costs and increased calf mortality.

One alternative for using the ERT concept is to limit the number of EPD used to make selection decisions. Selection decisions should be based only on those traits that are economically relevant. For instance, when there is a calving ease EPD and a birth weight EPD, focus selection on the calving ease EPD. Calving ease is the ERT and the EPD for calving ease include birth weight information and account for other factors that may influence calving ease such as shape of the calf. This method is the easiest to implement and actually reduces the number of EPD that must be considered when making a selection decision.

Another alternative for using the ERT concept is more objective but requires in-depth knowledge of your particular production system. In the example that follows, we examine the actual value associated with increasing weaning weight through selection on weaning weight direct EPD (WW EPD). In this scenario, replacement heifers sired by the bulls are retained. Suppose selection can increase the WW EPD by 16 pounds. At first glance, this might seem easy to value. If calf prices are $1.05/lb then the 16 pound increase should result in $16.80 more profit ($1.05 * 16) per calf. To get the true effect on profitability however, we need knowledge of mature cow weight, average calf weaning weight from bulls with a particular WW EPD, the relationship between weaning weight and mature cow size (remember we're keeping replacements produced by these bulls), and an anticipated prices for weaned calves. The scenario is set up in Table 1 and assumes there are fixed resources on the ranch that are used to their fullest extent; that is, there are no excess feed resources in a normal year. In this situation, the producer has been using bulls with an average WW EPD of +16 and a mature cow size of 1200 pounds and wants to determine the economic impact of selecting bulls with WW EPD of +32 (designated as "Heavy" in the table). Since this producer keeps replacement heifers produced by these sires, it is likely that there will be some increase in mature cow size associated with the increase in weaning weight. The regression relationship of mature size on weaning weight is about 1.84 lb mature weight for every 1 lb increase in weaning weight direct. This means that the average cow size will increase by 30 pounds as a result of using "growthier" bulls (16 * 1.84). These heavier cows will consume more feed than the original cows (23.6 lbs dry matter per day vs 23.1 lbs) and in the absence of additional feed purchases, will reduce the number of cows, previously 400, that can be run on the ranch by 7 head. Using this knowledge and assuming calves on average will be worth $1.05/lb, we discover that the increase in WW EPD results in $2719.19 increased profit (if used on a herd wide basis for the 393 cows) or, put another way, each pound increase in WW EPD results in $6.80 increased profit after accounting for effects of increased feed requirements. This is considerably less than the $16.80 first anticipated. (Admittedly, this does not account for the time lag before the replacement heifers are actually in production).

With a little time commitment, valuing EPD is possible, however, this example looked at only one trait (WW) that was economically relevant to this specific production situation and on the consequences of selecting on only this trait. This example did not consider all of the other factors that would determine profitability in this type of operation, such as dystocia, longevity, and heifer fertility.

This scenario serves to identify the weaknesses in our current genetic evaluation system. In this instance, the whole process would have been made considerably easier if an EPD existed for feed requirements. With that information we could have bypassed much of the complexity and considerably simplified the calculations. As part of the National Beef Cattle Evaluation Consortium's efforts, we have prototyped an EPD for Maintenance Feed Requirements that will be released this spring by at least one breed association. Because it is a project supported by the NBCEC, this technology will be available to all US breed associations for implementation should they so desire.

The NBCEC is a cooperative effort between Colorado State University, Cornell University, and the University of Georgia, the 3 universities that perform genetic evaluation in the United States. The NBCEC's goal is to develop better methods of genetic evaluation that help producers become more profitable and sustainable. The consortium is partially funded by the US government and partially funded the universities and their breed association clients.

SUMMARY

We as academic animal breeders have done a good job providing EPD to help producers characterize the genetic potential of animals. We have not done a good job providing the tools to use those EPD to increase profitability but have made the commitment to focus on that weakness through the NBCEC.

Until the new methods for genetic evaluation are released there are several good methods for using EPD to improve profitability. The best options are to focus selection decisions on the economically relevant traits and/or to develop an objective method, such as the simple spreadsheet in this article, or an index to evaluate the effect of changes in EPD on profitability of your operation.

Weaning weight EPD			**Cow Weight**	**Metabolic Wt**	**DMI per day**	**Herd Size**	**WWT**	**Sale wt**	**Sale Value**
Average	16		1200	203.9	23.1	400	466	186400	$177,080.00
Heavy	32		1230	207.7	23.6	393	482	189262	$179,799.19
					(lb / day)				
Difference	16						Difference in total sale value		$ 2,719.19
Value at $1.05	$ 16.80						expressed	per "cow"	$ 6.80
							expressed per lb per cow		$ 0.42
		Genetic regression		Mature wt increase			expressed per lb per 40 mates		$ 16.99
		1.84 lb M/lb Wd		30			expressed per lb per 40 mates for 4 yr		$ 67.98

Note: The base operation is 400 cows consuming 23.1 lb/day of feed (dry matter basis) over 365 days. This is equivalent to 393 cows eating 23.6 lb/day over 365 days.

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