Constructing ASA's Economic Indexes

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Though not a scientific poll, based on my interaction with breeders there seems to have been a substantial increase in the use of our economic indexes since their introduction. I get call after call from breeders who are using them—or at least are curious about their use. There have been several breeders of late who have asked for more specific details on the construction of our indexes. Given the interest, I thought it may be worthwhile to delve a little deeper into what makes them tick. Since several articles pertaining to ASA's All Purpose (API) and Terminal (TI) indexes have been published in *the Register* I will not take time for the basics (e.g., defining them); for those wishing for a quick reference on our indexes see page 46 in the March *SimTalk*, more thorough description can be found by clicking the library icon at www.simmental.org.

Some are of the impression that we use our intuition to construct our indexes, much like a chef would put together a gourmet meal—a dash of this and a pinch of that and voila! The truth is that it is not nearly that exciting. ASA's indexes are constructed very similarly to the way an accountant would calculate projections on how the purchase of a piece of equipment will impact a firm's bottom line. In doing so, the accountant has to estimate how the equipment will perform, i.e., how much output will be achieved and what level of input will be required to achieve it.

This is where EPDs come in. Because they are calculated by using all available information on the over 6,000,000 animals in our database, EPDs provide far and away the best prediction of the output and corresponding input expected in a sire's offspring. These output and input traits are those required to calculate profit—the type of information an accountant would need to make economic projections on a piece of equipment. In animal breeding lingo, these are called economically relevant traits. The traits relevant to our All Purpose Index (API) are listed below:

***Table 1.* Economically Relevant Traits in API**

- Salvage weight
- Female longevity
- Milk production
- Cowherd intake
- Feedlot intake
- Calf survival
- Weaning growth
- Post-weaning growth
- Carcass weight
- Yield grade
- Marbling

Beside the fact that the list is extensive due to API covering virtually all segments of a production system, in perusing it you probably noticed that we only publish EPDs for some of these traits. For example, though you have all seen our weaning growth and carcass EPDs you undoubtedly have never seen our cowherd or feedlot intake EPDs. I say that like we have them. We do! You may be wondering how that can be since we do not collect data on those traits. The answer is that we calculate EPDs for traits we don't collect data on by using traits we do collect data on. For example, research has shown that there is a very strong genetic relationship between feedlot intake and growth; i.e., animals with genes for rapid growth very likely eat more in the feedlot—hardly a surprise. Since we collect loads of data on growth, we can leverage what we know about a sire's growth genetics with the strong relationship between growth and intake to predict feedlot intake on the sire's calves.

We also know that the size of a sire's daughters and their milk production level provides insight about the energy they will need to maintain themselves and wean a calf, i.e., their intake requirements. Through this process of combining our knowledge of genetic relationships with the data you submit on calving ease, growth, carcass traits and stayability, we are able to predict the genetic level for each of the eleven traits used in the calculation of API. Because cowherd traits are not important in terminal sire selection, only the last seven traits are economically relevant to TI.

Predicting an animal's genetic merit in the economically relevant traits provides the biological components required to determine an animal's impact on profit. Now we need to tie economics to the biology. This is accomplished via a computer simulation program developed by USDA research geneticist, Dr. Mike MacNeil. Dr. MacNeil's simulator mimics beef cattle production on the computer—cows conceive, gestate, calve, lactate, rebreed, calves are weaned, open and old cows are culled, heifers are retained, and cull heifers and steers are placed on feed and eventually harvested. You do not get dirty raising computer cows—but you can sure answer a lot of questions!

The first step in tying biology to economics with the simulator is generating a "base" herd. The base simulation calculates the profitability of the average half Simmental, half Angus herd. Simmental x Angus was chosen for the base, as Angus is the predominant cow in the commercial industry by a country mile. It stands to reason, therefore, that the bulk of Simmental bulls will be used on Angus cows. The averages of the basic biological traits of this virtual base herd can be found below:

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Table 2. **Biological Trait Averages for Base Simulation**

Weaning weight: 550 lb
Feedlot gain; intake:
Phase 1 (80 d): 2.51 lb/d; 26.86 lb/d
Phase 2 (50 d): 2.92 lb/d; 21.90 lb/d
Phase 3 (100 d): 3.81 lb/d 26.67 lb/d
Cow size: 1250 lb
Milk production: 5283 lb/lactation
Pregnancy rate: 84%
Dystocia heifers (direct): 20%
Dystocia heifers (maternal): 20%
Calf survival: 96%
Harvest weight: 1277.8 lb
Dressing: 62.9%
Carcass weight: 803.7 lb
Marbling score: 5.14
Yield grade: 2.8

Of course, we also need estimates of future prices and costs to make economic projections for this herd. Yes. I said *future* prices and costs. Because we are selecting seed stock that will produce offspring in the future, future prices and costs are what are pertinent to us. We have used multiple sources to make these predictions (e.g., CattleFax, economists, and industry experts). This is an area where we played the gourmet chef and used intuition to some degree. When it comes to predicting the future, there is inevitably some guesswork involved.

Fortunately, studies have shown that price and cost predictions can be off by a substantial margin and economic indexes still tend to rank animals fairly similarly. This may sound counterintuitive, but there are solid reasons for it: 1) because each trait is only a piece of the overall profitability puzzle, if the economics of a particular trait change dramatically (e.g., the choice/select spread drops to zero), its effect on the index is limited to the degree the trait impacts overall profit, 2) because prices and costs tend to move together over time, the impact of an off-base prediction in one area will likely be counterbalanced by an errant prediction in another. For example, if inflation is predicted to be 3% and ends up being 6% both prices and costs are likely to be underestimated by an average of 3% with the net impact on the index being minimal. A sample of the prices and costs used in index calculation can be found below:

Table 3. **Prices and Costs**

Salvage price: $.45/lb
Hay: $.0325/lb dm
Pasture: $26/ac/yr

Feed; fixed costs

Phase 1: $.036/lb; $.51/d
Phase 2: $.039/lb; $.80/d
Phase 3: $.067/lb; $.80/d

Carcass prices:

Base: $121/cwt
< 550 lb: - $15/cwt
> 950 lb: - $7/cwt
>1000 lb: - $17.50/cwt
Prime: + $8.00/cwt
High Choice: + $3.50/cwt
Choice: + $1.50/cwt
Select: - $11.00/cwt
Standard: - $20.00/cwt
YG 1: + $4.00/cwt
YG 2: + $2.00/cwt
YG 3: $0.00/cwt
YG 4: - $15.00/cwt
YG 5: - $20.00/cwt

Once the base simulation is complete, we have very valuable information — an estimate of the future profitability of the average Simmental x Angus herd. This information provides a benchmark from which we derive weightings for each economically relevant trait. This is accomplished by changing each trait one unit while holding all others steady and comparing the difference in the bottom line with the base herd. (This undertaking would be virtually impossible in the real world; however, computer cows make it a piece of cake!) Armed with EPDs on each animal for the economically relevant traits and weighting factors based on the impact these traits have on profit we calculate economic indexes — the overall economic value of an animal.

There you have it, my attempt at taking some of the mystery out of our economic indexes. In a nutshell, the process is best described as genetic accounting. Though the concept may be new to the beef industry, economic indexes have been central to the monumental genetic progress seen in the poultry, swine, and dairy industries over the last several decades. Given the multitude of biological and economic factors impacting profit, assimilating them all in our minds in the hope of accurately assessing the economic value of a genotype is akin to taking a half-court shot from the seat of your pants to win the game — highly unlikely. Your chances of accurately assessing an animal's economic merit are greatly enhanced by using tools that apply a rigorous, accountant-like method to predicting profit, in other words, ASA's economic selection indexes. ◆

Indexes project the overall economic value of an animal.