What is the True Value of Extra Weaning Weight: Growth vs. Environmental Fit?

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Cattle production has always seen its share of "boom or bust" - all the way back to the cattle dives of the 1860's through the 1880's when 20 million cattle were herded from Texas to railheads in Kansas for shipments to stockyards in Chicago and points east. In many respects, cattle production in 2012 is no different with continued historically high cattle prices and costs of production that are "eating our lunch". On the positive side, what a ride! Let the good times roll! $ 2.00 four weights! $1.30 eight weights! $1.15 feds! $1,800 bred commercial heifers! Even ranchers that have devoted a lifetime to selling calves, yearlings, feds and bred heifers have never seen the cattle prices that we have enjoyed this last couple of years. Of course, this is largely driven by lack of supply as a result of a dwindling inventory- approaching the cow numbers of the 1950s. Fed heifer slaughter as a percent of total fed slaughter continues to run at an all time high indicating that we have not yet begun rebuilding this nations' cow numbers. Assuming we receive adequate moisture and the economic incentive to rebuild, the supply of feeder calves, yearlings and feds will decrease even more as heifers are kept out of the fattening pen and kept for replacements. Given these historically high prices, then why is it that so many commercial cow/calf producers are having a tough time making ends meet? Why are so many ranchers working so hard to go broke faster? Perhaps the answer lies in the fact that the beef cattle industry is characterized by ever increasing volatility and unpredictability resulting in great vulnerability to outside forces that are beyond our control. The headline stories include topics that did not exist just a few years ago:

- residual fuel standards and the ethanol trade
- high corn, hay, fertilizer, fuel and equipment prices
- land value escalation driven by the non-agriculture sector
- export trade issues dependent upon devaluation of US dollar
- industry consolidation to gain efficiencies of production
- severe drought conditions resulting in herd liquidation
- animal rights versus animal welfare issues and additional consumer misperceptions
- reproductive challenges such as Trichomoniasis
- generation transition with the next generation coming back to the ranch
- genetic defects
- E. Coli 0157:H7 and consumer misperceptions about food safety
- ……and the list goes on.

  Needless to say, this is not our grandfathers beef industry.

Though many issues and factors either directly or indirectly play a role in the "ups and downs" of the cattle industry, long term staying power of commercial cow/calf profitability really boils down to the profitability equation:

Commercial cow/calf profitability = Value of output – Cost of inputs

In recent years, the US beef cattle industry has focused on the "value of outputs" side of this equation. Increased "value of outputs" has been achieved through intense selection for increased growth rate (weaning weight, yearling weight, feedlot gain, etc.) and carcass merit (carcass weight, marbling, yield grade, etc.). This all made sense when fuel and corn were valued at less than $2.00. However, our industry has focused very little attention on reducing "cost of inputs". Profitability is driven by net income after "costs of inputs" are accounted for, not gross income driven by maximum selection for the traits that contribute to "increased value of outputs".

In general, beef cattle production traits that would increase "value of outputs" are antagonistic to traits that would reduce "costs of inputs" for a commercial cow herd. In other words, intense selection for growth rate and carcass merit would be counterproductive to selection for lower input, maternal function. This represents one of the true antagonisms within beef production.

What is Maternal Function?

Maternal function includes all the convenience traits that we take for granted in a beef cow. Things that we do not tend to think about until they become a problem. Things like fertility, conception rates, pregnancy maintenance, calving ease, maternal instinct at calving, adequate milk production, udder quality, fleshing ability (with minimal supplementation), sound feet and legs, disposition, etc. which collectively contribute to cow longevity. Cow longevity is important to your profitability because it reduces female replacement rate. Maternal function is the key to reducing "costs of inputs". Let's dig deeper into this equation.

Value of output

This issue has been cussed and discussed many times. Output in the minds of many cow-calf producers is the same as average weaning weight. Sale barn braggin' rights have targeted sale weight of calves for years. Even though numerous Standardized Performance Analyses (SPAs) indicate virtually no relationship between average calf weaning weight and return on investment, this remains one of the few tangibles that many producers can grasp. Indeed, through the years, one of the easiest ways to increase weaning weight has been to emphasize selection for growth rate or milk production through crossbreeding and/or through direct selection within breed. Perhaps the easiest way to increase weaning weight has been to simply make the calves older at weaning by calving earlier. Both of these ploys have had little regard for increased cow size, excessive milk production, increased maintenance requirements and associated increased cost of production. For commercial cow-calf producers who retain ownership through harvest, increased output value can be captured through heavier carcasses and high quality carcass premiums. However, in the bottom-line analysis, these are truly premiums only if no efficiency has been lost in the production of the superior carcass characteristics. If the cow has become less functionally adapted to the given environment through long-term single-trait selection for growth and/or carcass merit or if the feedlot cattle have to be fed expensive feedstuffs longer to achieve heavier carcass weights and sufficient quality grades, what has been gained?

Average WW versus "Whole herd pounds"

Weaning weight does have significance in the output side of the equation if it is placed in the context of "whole-herd weaning weight" or "total pounds of calf weaned from the whole herd." "Whole herd pounds" accounts for every cow in the herd that incurred expenses – not just those that weaned a calf. "Whole herd pounds" accounts for cows that did not breed, did not maintain a pregnancy, did not deliver a live calf and did not bring a calf to weaning. This can be put into perspective only through understanding of the missing ingredients — stocking rate and cow size. The age-old discussions about matching cow size and genetic potential for milk production to the environment implies that larger, more highly productive cows are a better match for environments characterized by higher rainfall and more lush, abundant feedstuffs. In contrast, smaller, more moderately productive cows are better matched to drier, sparser vegetation environments. Again, the missing ingredient is stocking rate. Various cow sizes and stocking rates can help put these relationships into perspective in Table 1.

Table 1. Cow size, stocking rate, pounds of calf weaned and return

Cow weight, lb.	**1400#**	**1250#**	**1,100#**
No. of cows	100	110	120
Pregnancy rate, %	95	95	95
Calving rate, %	99	99	99
Weaning rate, %	98	98	98
No. calves weaned	92	101	110
Ave. WW, lb.	630	600	550
Total pounds weaned	57,960	60,600	60,500
Value/lb., $	$1.45	$1.50	$1.60
Total $	$84,042	$90,900	$96,800
Difference		$6,858	$12,758

Let's talk about the numbers. I have made numerous assumptions, which may or may not be applicable to individual ranching enterprises. I would encourage you to input your own numbers, hopefully based on historical data from your own situation. Let's assume we have grazing and harvested forage resources (summer range and winter hay) that can maintain 100, 110 and 120 cows that range in mature weight from 1,400 to 1,100 pounds (lb.), respectively. All cows have the same calving season. Calving later, closer to green grass, is a topic for another discussion. Let's assume that fertility (95% pregnant), calving rate (99% pregnancy retention) and calf death loss at and after calving (98% weaning rate) are identical for all cow weights. Evidence exists for increased fertility, pregnancy retention and less calving difficulty and calf death loss in smaller cows; however, for the sake of a simplistic stocking rate discussion, let's hold these numbers constant. Multiplying pregnancy rate, calving rate and weaning rate together yields a constant 92% calf crop across cow weights. Smaller cows tend to wean a higher percentage of their body weights than heavier cows (45%, 48% and 50% of body weight, respectively).

Even though the 1,400-lb. cows weaned calves that were 80 lb. heavier than calves from 1,100# dams, they weaned 2,540 fewer total pounds of calf from the whole herd due largely to differences in stocking rate. Admittedly, total-herd fixed costs on a per-cow basis would be cheaper for fewer cows; however, in this simplistic example, the increased number of 1,100-lb.

cows returned an additional $12,758 over the 1,400-lb. cows, again largely due to differences in stocking rate or cow inventory. **In short, "whole herd pounds" is far more economically driven through cow inventory than selection for growth.**

Value of Extra Weaning Weight

It seems as though a day never goes by that the industry press or spokespersons are not touting the economic signals to select for more growth in our beef cattle herds. It's a "no brainer" that cattle selected for higher growth rate will gain faster and hang up heavier carcass weights. Of course this is a commercial feeders dream because the cattle can be fed longer. And we hear no arguments from the packing industry as heavier carcass weights result in greater plant efficiencies through greater throughput. This all sounds well and good, however, it totally ignores one very important production component of the industry – the commercial cow/calf industry. All this performance hype makes no mention of how selection for increased growth rate will impact the mother cow. It makes no mention of the increased cow size and corresponding maintenance requirements resulting in the need for greater supplementation, less environment fit and greater cow "fall out", especially during the tough climatic times of drought, severe winter, etc. Those 700# weaned calves sure do make a guy sit up and take notice as they "dollar up" at the sale barn. However, this is gross income and pays no heed to the other side of the profitability equation – what did it cost to get the heavier weaning weights? It is likely that the 700# calf does not account for the more expensive cow, especially those that did not bring a calf to the weaning pen. So, what is the true value of those extra pounds of weaning weight? The following example puts this into perspective. According to the July 24-27, 2012 Superior Livestock Auction Video Royale XX held in Winnemucca, NV (region 2- western high plains and intermountain), 720 # feeder steers sold for around $1.38 ($993/head) and 580# feeder steers sold for around $1.58 ($916/head).
But, what is the value of the extra pounds?

$993 - $916 = $77 / 140# additional pounds = $.55/pound.

The greater cow fallout coupled with today's skyrocketing input costs will not justify producing the extra pounds for $.55/ pound.

Costs of Inputs

Cow Size Relationships

Let's look at a real world commercial data set. The following data were compiled by a commercial Red Angus producer in eastern Colorado that took both calf and cow weights at calf weaning time in the fall and collected this information on every calf each cow weaned in her lifetime. The ranch divided actual calf weight by cow weight as a measure of cow efficiency. From a scientific approach, we would divide calf weight by cow weight to the ¾ power, but let's keep it simple. They then ranked the cows based on lifetime efficiency. The cows were split into "50 cow efficiency groups" based on average lifetime efficiency and results are displayed in Table 2.

Table 2. Cow Efficiency Rankings (50 Cow Groups)

Group	**Calf Actual W**	**Cow Actual W**	**Group Efficien**	**Ave. Calving D**
1st (top group)	672#	1300#	51.7%	Feb.7
2nd group	642#	1399#	45.9%	Feb.6
3rd group	621#	1414#	43.9%	Feb. 8
4th group	600#	1426#	42.1%	Feb.8
5th group	596#	1474#	40.4%	Feb. 19
6th group	568#	1461#	38.9%	Feb.14
7th group	538#	1452#	37.1%	Feb. 16
8th group	528#	1487#	35.6%	Feb. 20
9th group	488#	1454#	33.6%	Feb. 15
10th group	428#	1416#	30.2%	Feb. 25
Bottom group	384#	1532#	25.1%	March 8

Remember, these groups are ranked on cow efficiency. Note that the most efficient group was the lightest weight cows. Note that they also had one of the earliest average calving dates. The earliest calving cows were the most readily adapted to the production environment and grazing forage resource provided by this ranch and tended to conceive earlier during the breeding season, calve earlier in the calving season, weaned the heaviest calves and wean more "whole herd pounds" than any other cow size group.

Genetic Selection for Reduced Costs of Production

Meat Animal Research Center (MARC) data

Let's take a look at what is happening with genetic selection within the high use breeds within the US. The results of the Cycle VII (1999-2000) Meat Animal Research Center (MARC) breed comparison research indicates that high use Hereford and both black and Red Angus genetics produced heavier mature cow weight and steers that outgained and hung heavier carcass weights than some Continental breed sired females and steers.

MARC Cycle VII. Postweaning Growth and Carcass Traits.

	Cow Weight, 5 yrs	ADG	Slaughter Weight	Carcass Weight
Hereford	1417	3.32	1322	803
Angus	1408	3.32	1365	836
Red Angus	1406	3.26	1333	811
Simmental	1401	3.26	1362	829
Gelbvieh	1320	3.12	1312	800
Limousin	1388	3.12	1285	795
Charolais	1368	3.21	1348	826

Much of our industry has chased maximum growth and carcass merit (value of outputs) resulting in mature cow size / maintenance requirements and carcass weights challenging the Continental breeds. The traditional maternal breeds have become more terminal and the traditional growth type breeds have become more maternal. What is wrong with this picture? Note that these

research results come from matings to the high use bulls from these 7 breeds from over 10 years ago. Genetic selection over the last 10 years has likely resulted in even greater terminal selection.

Genetic Trait Continuum

If all the beef cattle production traits were lined up as they occur chronologically from conception to consumption, the genetic trait continuum would look something like what appears in Diagram 1. Draw a line at weaning, and, in general, the preweaning traits are the "cow function traits" and the postweaning traits are the "growth traits". One would select for the preweaning traits to reduce cost of production and select for the postweaning traits to increase value of outputs. In general, the preweaning traits are lowly heritable and enhanced through systematic crossbreeding and the postweaning traits are highly heritable and enhanced through individual sire selection.

Diagram 1. Genetic Trait Continuum

Conception……Weaning….....……Consumer Palatability

Preweaning	**Postweaning**
Early puberty	Disease resistance
Fertility	Gain
Conception	Feed Efficiency
Pregnancy Maintenance	Marbling (USDA Quality Grade)
Calving Ease (direct and maternal)	REA (Muscling)
Milk	Yield Grade (fat, REA, carcass weight)
Rebreeding (stayability)	Tenderness
Longevity (udder, feet, disposition, fleshing ability, ME or $ Energy)	

Dead Calves Don't Weigh Much at Weaning

Calving Ease Direct (CED) predicts the probability of calves being born unassisted out of two year old heifers. This requires an understanding of "economically relevant traits (ERTs)" vs. "indicator traits". Economically relevant traits (ERT) are those traits that directly affect your profitability – decrease your costs and/or increase your income. In contrast, 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 (BW). BW is an indicator trait and of itself has little value—a commercial producer receives no more income if the birth weight is 75 pounds than if the birth weight 85 pounds. In fact, the calves that are heavier at birth tend to weigh more at sale time. Selection on actual BW is flawed. It is influenced by non-genetic factors such as last trimester nutrition and weather. The CED EPD includes variation in BW plus influential genetic factors such as gestation length, calf shape, etc. Producers want and need live calves, born unassisted, not only light BW. BW is measured and included in the genetic analysis because it is related to the ERT, as a measure of probability of a dystocia or difficult birth. What really matters to the commercial producer is whether that potential replacement female produces calves that are born unassisted and still weans sufficient pounds to "pay her way". Increased calving difficulty results in increased labor costs and increased calf mortality.

Genetic selection decisions should be based only on those traits that are economically relevant – that truly impact your profitability. For instance, when there is a calving ease EPD and a BW EPD, focus selection on the calving ease EPD. Calving ease is the ERT and has actual BW built

into the CED calculation. In addition, calving ease EPD accounts for other factors that may influence calving ease such as pelvic relaxation, desire to calve and shape of the calf. Caution: Stacking 3-4 generations of light BW EPD bulls in successive generations can create females that have an increased incidence of calving difficulty, unless bred back to lighter BW EPD bulls, which simultaneously decreases performance. A mature commercial female that cannot calve unassisted to a +4-5 lb. BW EPD is the wrong female.

Calving Ease Maternal (CEM) predicts the probability of a bull's daughters calving unassisted at two years of age. Replacement heifers need to calve on their own to reduce labor requirements. It includes not only the predisposition for a female to calve unassisted, but also her contribution to her calf's traits (BW, calf shape, etc.) that make it more likely to be born unassisted. The secret to reducing calving difficulty is creating "cows that can calve" rather than just producing lighter BW calves, resulting in reduced performance.

Profit Starts at Reproduction…..Heifer Pregnancy

Research has shown that reproduction has four to ten times the economic impact of carcass traits. Heifer Pregnancy (HPG) predicts the probability of heifers conceiving to calve at two years of age. Many breeds offer genetic predictions of yearling bull scrotal circumference as an indicator of age of puberty. While puberty is a prerequisite, many factors influence pregnancy rate. HPG EPD offers a tool which selects directly for what is economically relevant to ranchers-pregnant heifers.

Cows Need to Last Longer…..Stayability (STAY) predicts the probability that a bull's daughters will remain in the herd until six years of age. Research has shown the breakeven point on replacement heifers is five to six years of age due to expensive heifer development costs. Females that fail to stay in the herd that long are losing money, and they also contribute to a higher rate of replacement females that producers must retain instead of being cash cropped.

Cows Eat Money

Genetic selection for lower (negative) Maintenance Energy (ME) EPD in Red Angus or increased (positive) $ Energy EPD in Angus helps reduce cow cost. The Red Angus ME EPD predicts differences in energy requirements of mature daughters of an individual and is expressed in mega-calories per month. Angus Cow Energy Value ($EN), expressed in dollars savings per cow per year, assesses differences in cow energy requirements as an expected dollar savings difference in daughters of sires. With $EN, a larger value is more favorable when comparing two animals (more dollars saved on feed energy expenses). Components for computing the cow $EN savings difference include lactation energy requirements and energy costs associated with differences in mature cow size.

Table 3. Top 10 Red Angus Sires by Progeny Registered

Name	ME EPD
Nessmer Packer 5008	-5
Red Six Mile Sakic 832S	0
LJC Mission Statement P27	10
5L Norseman King 2291	-2
HXC Jackhammer 8800U	5
HXC Conquest 4405P	5
Beckton Nebula P P707	-12
Badlands Net Worth 23U	2
Buf Crk The Right Kind U199	-4
Red Crowfoot Ole's Oscar	7
Average ME EPD	.6
Average % Rank	Top 30%

Table 4. High Use Young black Angus Sires

Name	$EN EPD
Syngen CC and 7	-37.34
BR New Day	-7.02
GAR Game On	-6.49
SAV Mandan	-20.00
Connealy Final Product	-11.41
Hoover Dam	-21.93
Sydgen Mandate	-29.87
Harb Pendleton	-13.66
Connealy Stimulus	-.59
Basin Payweight	-10.65
Average $ EN EPD	-15.9
Average % Rank	(Bottom 7 %)

Looks like the Red Angus breed has somewhat emphasized easier maintenance, whereas the "up-and-coming" black Angus bulls have been bred for too much milk and growth resulting in higher maintenance requirements. Within breed genetic selection for ME and $EN can easily translate into differences in feed required to maintain body weight. Cattle run in all types of environments, and each has different availability of feedstuffs. When cattle have higher maintenance energy requirements than their environment will support, producer basically have 3 options:

1) supplement feed
2) decrease stocking rate
3) accept decreasing body condition scores of the cattle which can adversely affect reproductive performance Longer term

Crossbreeding

Systematic crossbreeding is certainly nothing new, though our industries' general lack of acceptance until the last few years represents a loss of production efficiency. No other management practice has as much to offer as a sound, simplistic, "well-thought-out" crossbreeding program-especially those that have been adhered to over time. The positive results have been known for years:

- Results in up to 25% increase in pounds of calf weaned per cow exposed (terminal sires on crossbred females).
- Enhances lowly heritable traits.
- Three questions:
  1) What crossbreeding system?
  2) What breeds logically fit the system?
  3) What individual bulls within breed?

Ruthless Culling

In the words of the late Tom Lasater, founder of the Beefmaster breed, "Ruthless culling may occasionally result in losing a good one, however, you will get rid of every bad one." As a result, inferior individuals are culled and no longer have an opportunity to make a genetic contribution to further generations. Likewise, the inferior individuals are no longer competing with the superior cattle in the same environment for, sometimes, limited forage resources.

Numerous obvious reasons exist for culling females from a herd including:

1) Fertility- failure to breed with reproductive pressure (45-60 day breeding seasons). Great cow herds receive some form of reproductive pressure wherein a few females fall out. Long breeding seasons and/or over supplementation resulting in 100% pregnancy rates do not allow identification of those individuals that can get it done under lower input environments. Select for early pregnancy.
2) Udder quality- cows requiring human intervention to get a calf nursing due to poor udder quality greatly increase labor requirements
3) Feet –foot issues greatly reduce cow longevity particularly in extensive grazing conditions. Many foot issues are assumed to be environmentally induced; however, evidence exists that some foot issues may be genetically transmitted. Culling foot issues avoids genetic transmission.
4) Fleshing ability –particularly important in lower input environments. Many profit minded commercial producers insist that females can lay down adequate body fat reserves when forage availability is plentiful to be used when forage resources may be in limited supply. In other words, the cows will fluctuate in body condition at various times of the year. If increases in body condition are timed appropriately, subsequent reproduction can be enhanced, as cows increasing in weight and body condition score tend to be more fertile. Research data would suggest that a BCS 4 female on a positive plane of nutrition is more fertile that a BCS 6 female losing weight.
5) Disposition –beyond the obvious human safety issues, calmer cattle tend to grow faster and USDA quality grade higher
6) Longevity-cows remaining in the herd longer reduce the expensive heifer replacement rate. There are reasons why individual cows remain in the herd until an extremely old age. These reasons will likely never be quantified in an EPD. Seek out the old cows that have withstood the test of time. Spread these old cows across your cowherd by using their sons. However, these sons must be sired by bulls that have a proven track record of siring daughters that are highly functional.

Growth vs. Environmental Fit

Matching the Environment to the Genetics

Traditionally, the approach that many producers have taken is to provide the amount of nutrition necessary to make the desired cattle function adequately (matching the environment to the genetics). In other words, as many breeding programs have increased growth, milk and carcass merit in recent years, additional supplementation beyond what the farm or ranch can economically provide has been needed and provided. This made logical sense when the additional value of increased production exceeded the cost of the additional supplementation. However, in the new era of drastically increased input costs (grain, fuel, land values, lease rates, etc.), the increased costs of inputs may outweigh the increased value of outputs.

Matching the Genetics to the Environment

Environmental fit is allowing the environment to help identify the right genetics that can function on what the environment can provide with minimal excessive expensive supplementation. Environmental fit involves allowing the environment to select the parents of successive generations through reproductive pressure and minimal supplementation. Former CSU Animal

Science Teacher and Mentor, Dr. Robert Taylor stated many times, “Weaning weights over 550# represent a mismatch of biological type to the environment”.

Surviving Tomorrow

The maximum production era, based on low-cost inputs was great fun while it lasted. However, that era is gone. Greater understanding of the profitability equation including value of outputs and cost of inputs, whole herd pounds, cow size relationships, systematic crossbreeding and genetic selection for reproductive traits and lower cost of production will determine survival for the next generation. Lower input, maternal function is the key to staying in the game.