

# ESTIMATING THE ECONOMIC VALUES ASSOCIATED WITH EPDS FOR ANGUS BULLS AT AUCTION

by  
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## **Introduction:**

The purebred cattle industry has undergone a period of significant informational change in the last twenty years. The development and use of expected progeny differences (EPDs), which are statistical estimates of performance for a given animal's progeny, has been a primary component of this change. Since their introduction, EPDs have been increasingly accepted and used by purebred producers selling breeding stock, however, the impact EPDs have had in the market place and on commercial cattle producers is less clear. Previous research has demonstrated that some EPDs, specifically birth weight, are valued by producers when they purchase bulls, however, the magnitudes of the economic value of EPDs relative to the corresponding actual underlying phenotypic measures have been found to be surprisingly small (Chvosta, Rucker, and Watts, 2001).

Over the same time period value-based marketing has increased the use of genetic estimation for carcass traits by many cow/calf producers. Premiums for choice and prime graded carcasses have enticed cattle feeders to utilize technology to identify animals possessing these traits. Producers desire measurements which provide reasonable expectations as to the carcass quality of an animal (Greer and Trapp 2000; Schroeder and

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Graff, 2000). Thus, the need for more accurate carcass-related information has become increasingly important to producers in recent years.

Purebred bulls are primarily bought and sold at private auctions, where buyers assign a value for an animal based on both its observed physical characteristics and on information that is disseminated to the buyer through the seller. Information that is provided through the seller often includes actual or adjusted animal weights, EPDs, and ultrasound scan data as well as some information pertaining to the pedigree of the bull. It is important to recognize that both actual weights (birth, weaning, and yearling) and EPDs are viewed by buyers as measures of expected performance of a bull's future offspring. From a statistical standpoint EPDs "should" be a better predictor. However, the relevant question is which of the two do buyers value more highly?

In this study we re-examine the role of performance EPDs in determining value for purebred Angus bulls. Specific consideration will be given to carcass and ultrasound EPDs, in an attempt to define their role in breeding stock selection. These aspects, along with other measures, such as actual weights, ultrasound scores, regional issues, and marketing factors will be examined as they pertain to the value of purebred Angus bulls.

**Previous research:**

Dhuyvetter et al. (1996) examined EPDs as a determinant of a bull's value. They collected data from twenty-six multi-breed Kansas bull sales during the spring of 1993, and modeled bull price as a function of physical and genetic characteristics, expected performance characteristics, and marketing factors. Results showed, that in Angus bulls, both EPDs and actual weights were significant, as well as age, sale order, pictures, and semen retention. Dhuyvetter et al. were able to compare the value of actual weights with EPDs, but their findings left questions of the relative value of EPDs largely unanswered.

Following Dhuyvetter et al., Chvosta, Rucker, and Watts compared values for EPDs and simple performance measures (SPM's), i.e., physically observed traits, for purebred Angus bulls. Data were collected from animals raised on a single Montana ranch from 1982 – 1997 and for bulls sold on eleven ranches in South Dakota and Nebraska from 1986 – 1996. They modeled bull price as a function of beef price, feed price, age, and performance measures. Variables which were significant in explaining price included 205-day weight, 365-day weight, birth and yearling weight EPDs, and age and age squared. Based on their results, Chvosta, Rucker, and Watts concluded that, although both EPDs and SPM's are significant in explaining price, SPM's hold more economic information with respect to price.

**Data:**

Data for this study were collected over a four month period from purebred Angus producers across the Midwest, Rocky Mountain, and Northwest regions of the U.S. Producers were contacted by phone, written correspondence, and email requesting sale catalogs and price data from their most recent production sale. Data were collected on 8285 bulls from sixty sales in an eleven state region. Variables gathered from this process included prices, registration numbers, and various marketing factors specific to each sale. Data relating to actual weights and EPDs were not recorded at this time, although animals found to have incomplete production records were noted for each sale.

The collection of all actual weights, EPDs, and pedigrees was done in cooperation with the American Angus Association (AAA). Registration numbers for each bull were given to AAA, who then generated a database with all relevant genetic information for each bull. This database was then combined with the existing record of prices and marketing factors to create a complete summary of variables for each observation. Summary statistics for price, actual weights, EPDs, and marketing factors are presented in Table 1.

It is important to note that AAA has access to, and provided more information for some bulls than what was reported to buyers at the time of sale. Although AAA encourages breeders to provide as much information to buyers as possible, there is not a standard reporting system followed by every producer. No two sales in this study reported exactly the same number or types of variables in their sale catalogs. These discrepancies were noted and are accounted for in the forthcoming models, but at first glance may appear misleading. An example of this problem appears in Table 1. Even though AAA provided over 7000 observations on adjusted yearling weight, the actual number of observations reported by breeders was far lower. Models were specified using only data that were available to buyers at the time of the sale (i.e., data reported in the sale catalog).

### **Models and results:**

Expanding on the previously mentioned earlier studies, actual production measures, EPDs and marketing factors form the basis for a conceptual model of bull prices that can be specified as

$$(3) \quad \text{Bull Price} = (\text{Actual Production Measures, Production EPDs,} \\ \text{Ultrasound EPDs, Marketing Factors, Sire, Sales}).$$

Actual production measures include age, birth weight, and adjusted weaning and yearling weights; ultrasound scans include adjusted intramuscular fat, ribeye area, and 12<sup>th</sup> rib fat thickness. Production EPDs include birth, weaning, milk, and yearling weights and Ultrasound EPDs include intramuscular fat, ribeye area, fat thickness, and percent retail product. The marketing factors recorded from each sale are sale order, semen retention,

season of the sale (fall versus spring), picture, embryo transfer, pathfinder dam, and the inclusion of full brothers and females in the sale. Sire is a series of dummy variables used to capture bulls who are the progeny of highly ranked Angus sires. Sales are dummy variables used to identify bulls sold in a particular state or sale. A hedonic modeling approach, using OLS regression, is applied to the data to obtain estimates for each of the variables presented in the conceptual model above. Following Dhuyvetter et al. the dependent variable, price, was transformed to log form.

The results of estimating the first actual specification of this model are presented in Table 2 and summary statistics for variables included in the model are given in Table 3. The three actual performance measures were all significant and exhibited the expected signs. Reasoning for this follows closely with their related EPDs. As birth weight increases, it is expected that calving difficulties will increase, which will increase costs. Buyers are likely to pay less for higher birth weights because of these considerations. Adjusted weaning and yearling weights provide buyers with a measure of a bull's ability to add additional pounds of gain. This is desirable because it provides a picture of the expected performance of a bull's progeny.

Comparing the coefficients for the EPDs and actual weights reveals larger values for the EPDs relative to the related actual weights. However this comparison is not appropriate because of varying units involved. Elasticities provide a unit-less comparison between the two genetic measures and offer a measurement which is readily comparable across variables. The elasticities for the actual weights are greater than the elasticities for the EPDs. The results from the comparison of elasticities are similar to those reached by

Chvosta, Rucker, and Watts and possibly provide further confirmation that actual weights are valued higher by buyers than EPDs.

However, a problem with the elasticities is that they only show the effect of the variable at a certain point, here being the mean. This technique ignores the true behavior of most variables by assuming that a 1% change in all variables occurs with equal likelihood. Therefore, it is more reasonable to examine the effect a variable has on price across a standardized range of likely changes. This allows the effects of a variable to be seen at many points while still providing a means for comparison between variables of differing units. In order to compare the relative value of EPDs versus actual weights, standardized premiums were calculated based on standard deviation incremental changes in the variable of interest (e.g. *birthwt* or *birthepd*).<sup>2</sup>

Figure 1 depicts the comparison of the standardized (equally likely) premiums for *birthwt* and *birthepd*. Here it is seen that *birthepd* has slightly larger standardized premiums associated with it, relative to *birthwt*, across the range of data. Based on this, it can be argued that *birthepd* is the more significant genetic measure, despite the higher elasticity of *birthwt*.

The same argument cannot be made for *yearepd*, however. Figure 2 shows that *adjyearwt* has larger standardized premiums relative to *yearepd* across two standard deviations when the relationship between these two variables is accounted for. Thus, while buyers may pay higher premiums for the genetic information in *birthepd* relative to *birthwt*, it appears they are unwilling to do so for *yearepd*.

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<sup>2</sup> Since the variables were modeled in log form, the transformation suggested by Miller (1984) was used to transform the premiums to linear measures. Correlations between variables were accounted for (by using regression estimates) when calculating the standardized premiums.

Reasons for the difference in these results are not entirely clear. A possible explanation may lie in the accuracy of the EPDs at the time of sale. Bulls are typically sold at one year of age or older. Buyers may believe that the *yearepd* values for yearling bulls are in fact unreliable. Because *yearepd* is based solely on records of related animals (parents, grandparents, and siblings), they may believe that the possible variation in the EPD is quite large and thus place more confidence in the actual weight. Table 4 shows expected changes in value for EPDs over a two standard deviation range as the accuracy of the EPDs increases. The expected accuracy value for *yearepd* on a year old bull would likely be 0.05. At this level, the possible range of change for this variable would be +/- 16.17 pounds from the current value of the EPD. This represents a large change and gives cause for buyers paying larger premiums for *adjyearwt*.

However a similar argument can also be made for *birthepd* with the exception that a yearling bull's own birth weight may be factored in to its birth weight EPD. The accuracy value for *birthepd* on a yearling bull is also likely to be near 0.05. If buyers place less confidence in *yearepd* because of a low accuracy value, it would stand to reason they would behave in a similar manner when faced with a low accuracy value for *birthepd*. Thus it is interesting that the premiums for *birthepd* and *birthwt* do not follow with those found for *yearepd* and *adjyearwt*. The reasoning for this may lie not in the accuracy value associated with *birthepd*, but instead in the buyer's confidence in the value reported for *birthwt*. Because this is an unobservable trait, (i.e., the buyer is unable to observe the weight of the bull at birth where as they can observe the yearling weight) buyers may be less likely to trust it and thus place more confidence in the value given for *birthepd*, even though it may vary considerably as the age of the bull increases.

A second model including carcass ultrasound EPDs was developed to examine the value buyers place on carcass quality.<sup>3</sup> The results of this model are presented in Table 5, with summary statistics of model variables reported in Table 6. Each of the ultrasound EPDs in this model were significant, indicating that buyers value the information they provide. The variables *uimfepd* and *uribepd* were positive, indicating that additional units of intramuscular fat and ribeye increased the price paid for a bull. The coefficient for *ufatepd* was negative implying that increases in fat thickness decreased value. The sign for *uprpepd* was expected to be positive, given that a bull's ability to sire progeny which yield greater quantities of retail product would be desirable to a buyer, however, the estimated coefficient was negative. Reasoning for the negative nature of this variable is unknown. One possible explanation is that buyers are disconnected from the retail end of the cattle they produce and are thus not concerned with increasing retail product. However, if this were true, it is likely that *uprpepd* would be insignificant instead of negative.

Due to the small magnitude and variability of each of these variables, large parameter estimates were predicted by the model. However, elasticities for each variable provide a much clearer picture of the effect of changes in the variable on price. This is evident by the elasticity for *ufatepd*. The large parameter estimate, -3.758, for this variable is reduced to an elasticity measure of -0.015.

Based on elasticities, the variable *uribepd* is found to have the greatest effect on price among the ultrasound EPDs, although its effects are much smaller than any of the actual measures or production EPDs. This shows that the ultrasound EPDs provide

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<sup>3</sup> Additional models were estimated using other carcass-related information (i.e., carcass EPDs, ultrasound scans) but these models did not perform as well based on in-sample accuracy measures (Turner).

additional information to buyers, but do not appear to be as important as other factors used in making purchasing decisions. This result is consistent with arguments that producers are more concerned with producing pounds of beef and less concerned with improving the carcass quality of their animals.

Figure 3 compares the standardized premiums received for *uribepd*, *birthepd*, and *adjyearwt*. The results indicate that the premiums received for *uribepd* are considerably higher than those received by *birthepd* or *adjyearwt* at sales which report all three measures. This contradicts the earlier conclusion, derived from the elasticities, but again provides a more reasonable examination of the effects of the variables (because of the “likelihood” of change in the value). Based on the findings in Figure 3, the inclusion of ultrasound EPDs should be considered by sales which failed to report them, given the high premiums received for bulls possessing large ultrasound ribeye EPDs.

Variables pertaining to various market factors were also included in the models. These factors were shown to be as significant in determining value as genetic measures and indicate that bulls that are aggressively marketed will likely bring premiums relative to bulls not benefiting from marketing. Additional variables used to describe the sire of the bull and sale at which he was sold, showed varying levels of significance as well. The significance of the sire variables indicates that buyers believe additional information, not contained in the bull genetic record, is captured by the bull’s sire. Significance of several sale variables lends to the reputations of breeders and suggests that buyers recognize and are willing to pay premiums or discounts for comparable animals sold at different sales.

## **Conclusion:**

The two primary objectives of this study were to re-examine the economic values of production EPDs and how they relate to the values assigned to actual weights and to assess the impact that ultrasound EPDs have on Angus bull prices. Though the elasticities associated with actual weights were consistently higher than those associated with their corresponding production EPDs, the predicted standardized premiums/discounts for *birthepd* were found to be greater than those associated with *birthwt*. These results indicate that buyers consider *birthepd* more important than its related actual measure when selecting bulls. These results did not hold true for the remaining production EPDs however, and indicate the continued importance of actual measures in bull selection.

This study also examined the value of carcass quality measures. All four ultrasound EPDs were highly significant, with three out of the four exhibiting the expected sign. Comparisons between premiums/discounts associated with ultrasound and production EPDs and actual weights showed one ultrasound EPD, *uribepd*, to have significantly larger price responses than either *birthepd* or *adjyearwt*. This finding is significant because it suggests that buyers understand and place a high value on ultrasound data when making purchasing decision. Based on this finding, breeders that currently fail to report this data should consider its inclusion in future production sales.

Marketing factors were also examined in this study. These factors were found to bring added premiums/discounts in addition to those received for actual weights and EPDs. The significance of the sire variables suggests that the pedigree of the bull is important to buyers. Several sale variables were also found significant and may point to

buyers considering the reputation of the breeder when purchasing a bull. Other variables pertaining to the inclusion of a picture, the order of the sale, and the retention of semen rights were also significant.

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**Table 1 – Summary Statistics**

<b>Variable</b>	<b>N</b>	<b>Mean</b>	<b>Std Dev</b>	<b>Minimum</b>	<b>Maximum</b>
<i>price</i>	8285	2564.8100	1908.1000	875.000	51500.000
<b><i>Production Measures</i></b>					
<i>age</i>	8285	447.211	124.726	98.000	1829.000
<i>age<sup>2</sup></i>	8285	215552.320	144818.150	9604.000	3345241.000
<i>birthwt</i>	7986	83.470	9.894	40.000	124.000
<i>adjweanwt</i>	8063	659.967	71.860	378.000	988.000
<i>adjyearwt</i>	7380	1168.310	113.814	636.000	1742.000
<i>adjpctimf</i>	7255	3.706	0.859	0.810	10.450
<i>adjribeye</i>	7243	12.368	1.569	6.500	18.800
<i>adjribfat</i>	7259	0.269	0.100	0.010	0.770
<b><i>EPDs</i></b>					
<i>birtheptd</i>	8227	2.553	1.562	-3.800	9.600
<i>weanepd</i>	8253	38.256	6.688	11.000	71.000
<i>milkepd</i>	8253	20.284	4.622	0.000	36.000
<i>yearped</i>	8252	72.592	11.358	19.000	125.000
<i>cwtepd</i>	4575	5.185	6.327	-16.000	30.000
<i>marbepd</i>	4575	0.182	0.121	-0.130	0.750
<i>ribepd</i>	4575	0.129	0.127	-0.350	0.590
<i>fatepd</i>	4575	0.002	0.015	-0.045	0.054
<i>prpepd</i>	4575	0.059	0.242	-0.870	0.770
<i>uimfepd</i>	7814	0.065	0.135	-0.400	0.740
<i>uribepd</i>	7814	0.123	0.212	-0.620	1.000
<i>ufatepd</i>	7814	0.004	0.015	-0.059	0.064
<i>uprpepd</i>	7814	0.020	0.279	-0.960	1.200
<b><i>Marketing Factors</i></b>					
<i>saleorder</i>	8285	0.501	0.289	0	1
<i>sementhird</i>	8285	0.197	0.398	0	1
<i>semenhalf</i>	8285	0.078	0.267	0	1
<i>seasonofsale</i>	8285	0.771	0.421	0	1
<i>picture</i>	8285	0.108	0.311	0	1
<i>et</i>	8285	0.214	0.410	0	1
<i>fullbrother</i>	8285	0.101	0.301	0	1
<i>pathfinder</i>	8285	0.058	0.234	0	1
<i>femaleinsale</i>	8285	0.456	0.498	0	1

**Table 2 - Regression Results for Actual Weights & Production EPD's by Sale**

Variable	Parameter Estimate	Standard Error	t-statistic	P-value	Marginal Effect at Average Price	Discrete Variable Shifts	Elasticities at Variable Averages
<i>Intercept</i>	4.824690	0.240200	20.09	0.0000			
<b>Production Measures</b>							
<i>age***</i>	0.003220	0.000443	7.28	0.0000	8.61		1.44
<i>age2***</i>	-0.000002	0.000000	-4.76	0.0000			
<i>birthwt***</i>	-0.001810	0.000700	-2.59	0.0100	-4.84		-0.15
<i>adjweanwt***</i>	0.000588	0.000124	4.75	0.0000	1.57		0.39
<i>adjyearwt***</i>	0.001330	0.000098	13.57	0.0000	3.56		1.59
<b>EPDs</b>							
<i>birthepd***</i>	-0.052010	0.005043	-10.31	0.0000	-139.06		-0.13
<i>weanepd</i>	0.000048	0.001622	0.03	0.9760	0.13		0.00
<i>milkepd***</i>	0.004490	0.001234	3.64	0.0000	12.00		0.09
<i>yearepd***</i>	0.005110	0.000998	5.12	0.0000	13.66		0.38
<b>Marketing Factors</b>							
<i>saleorder***</i>	-0.345070	0.019870	-17.37	0.0000	-922.60		-0.16
<i>picture***</i>	0.226080	0.020790	10.88	0.0000		989.25	
<i>et**</i>	0.045310	0.018190	2.49	0.0130		180.76	
<i>sementhird***</i>	0.163960	0.031120	5.27	0.0000		694.79	
<i>semenhalf***</i>	0.519760	0.099390	5.23	0.0000		2658.11	
<i>fullbrother</i>	0.011270	0.023210	0.49	0.6270		44.20	
<i>pathfinder*</i>	0.044420	0.024870	1.79	0.0740		177.13	
<i>seasonofsale**</i>	-0.266420	0.104600	-2.55	0.0110		-912.07	
<b>Sires</b>							
<i>sr1</i>	0.018420	0.028560	0.64	0.5190		72.50	
<i>sr2</i>	-0.014670	0.027070	-0.54	0.5880		-56.79	
<i>sr3**</i>	-0.051540	0.023470	-2.20	0.0280		-195.90	
<i>sr4*</i>	0.051590	0.029210	1.77	0.0770		206.46	
<i>sr5*</i>	0.072590	0.038750	1.87	0.0610		293.61	
<i>sr6</i>	0.073330	0.047860	1.53	0.1260		296.71	
<i>sr7</i>	-0.009380	0.058940	-0.16	0.8740		-36.41	
<i>sr8**</i>	0.056620	0.025650	2.21	0.0270		227.17	
<i>sr9**</i>	0.087860	0.039680	2.21	0.0270		358.13	
<i>sr10</i>	-0.003350	0.035720	-0.09	0.9250		-13.04	
<i>sr11</i>	0.019470	0.040780	0.48	0.6330		76.67	
<i>sr12</i>	-0.004200	0.030680	-0.14	0.8910		-16.34	
<i>sr13***</i>	0.200030	0.060010	3.33	0.0010		863.54	
<i>sr14***</i>	0.119590	0.043130	2.77	0.0060		495.39	
<i>sr15**</i>	0.090250	0.043900	2.06	0.0400		368.32	
<i>sr16</i>	-0.094660	0.113900	-0.83	0.4060		-352.21	
<i>sr17</i>	-0.085420	0.071980	-1.19	0.2350		-319.28	
<i>sr18***</i>	0.166290	0.041150	4.04	0.0000		705.51	
<i>sr19***</i>	0.289240	0.042380	6.83	0.0000		1308.00	

**Table 2 – Continued**

Variable	Parameter Estimate	Standard Error	t-statistic	P-value	Marginal Effect at Average Price	Discrete Variable Shifts	Elasticities at Variable Averages
<i>sr20</i>	0.000708	0.036330	0.02	0.9840		2.76	
<i>sr21</i>	0.016050	0.057230	0.28	0.7790		63.09	
<i>sr22</i> ***	0.167700	0.040670	4.12	0.0000		712.01	
<i>sr23</i> *	0.063780	0.034550	1.85	0.0650		256.82	
<i>sr24</i>	0.077310	0.057430	1.35	0.1780		313.44	
<i>sr25</i>	-0.013770	0.061070	-0.23	0.8220		-53.33	
<b>Sales</b>							
<i>sale2</i> ***	-0.299080	0.050090	-5.97	0.0000		-1008.07	
<i>sale6</i>	0.018690	0.050590	0.37	0.7120		73.57	
<i>sale7</i>	0.006470	0.048430	0.13	0.8940		25.31	
<i>sale10</i> ***	-0.502890	0.065620	-7.66	0.0000		-1541.23	
<i>sale11</i> ***	-0.289390	0.109800	-2.64	0.0080		-979.91	
<i>sale12</i> ***	-0.292490	0.038960	-7.51	0.0000		-988.95	
<i>sale13</i> **	-0.256520	0.110100	-2.33	0.0200		-882.34	
<i>sale15</i> ***	-0.353470	0.136100	-2.60	0.0090		-1161.14	
<i>sale16</i> **	-0.134510	0.056110	-2.40	0.0170		-490.80	
<i>sale18</i> ***	0.190250	0.054960	3.46	0.0010		817.19	
<i>sale19</i> ***	0.162840	0.055410	2.94	0.0030		689.65	
<i>sale20</i> ***	0.305420	0.055740	5.48	0.0000		1392.95	
<i>sale21</i> ***	0.257810	0.047080	5.48	0.0000		1146.87	
<i>sale22</i> ***	0.321280	0.046780	6.87	0.0000		1477.56	
<i>sale23</i> ***	0.202470	0.046370	4.37	0.0000		875.18	
<i>sale24</i> ***	0.184600	0.046570	3.96	0.0000		790.61	
<i>sale26</i> ***	0.160090	0.042750	3.75	0.0000		677.05	
<i>sale28</i> *	0.108910	0.056110	1.94	0.0520		448.70	
<i>sale29</i>	0.045880	0.044600	1.03	0.3040		183.09	
<i>sale30</i>	-0.021650	0.053200	-0.41	0.6840		-83.52	
<i>sale34</i> **	-0.099870	0.045830	-2.18	0.0290		-370.64	
<i>sale36</i> ***	-0.352000	0.055990	-6.29	0.0000		-1157.11	
<i>sale37</i> ***	0.140290	0.047200	2.97	0.0030		587.32	
<i>sale38</i> *	-0.215630	0.120400	-1.79	0.0730		-756.41	
<i>sale39</i> ***	-0.598000	0.118800	-5.03	0.0000		-1755.20	
<i>sale41</i> ***	-0.394050	0.046030	-8.56	0.0000		-1270.05	
<i>sale42</i> ***	-0.349330	0.044880	-7.78	0.0000		-1149.78	
<i>sale43</i> ***	0.263350	0.060250	4.37	0.0000		1174.90	
<i>sale44</i> ***	-0.145100	0.036420	-3.98	0.0000		-526.71	
<i>sale46</i>	0.046980	0.059790	0.79	0.4320		187.58	
<i>sale48</i>	0.018100	0.045950	0.39	0.6940		71.23	
<i>sale49</i>	-0.037320	0.062010	-0.60	0.5470		-142.85	
<i>sale51</i> ***	-0.487100	0.116500	-4.18	0.0000		-1503.69	
<i>sale52</i> ***	0.366290	0.069070	5.30	0.0000		1725.11	
<i>sale53</i>	0.079720	0.049260	1.62	0.1060		323.61	
<i>sale54</i> **	-0.154150	0.073800	-2.09	0.0370		-557.09	
<i>sale55</i>	0.043340	0.049880	0.87	0.3850		172.73	

**Table 2 – Continued**

<b>Variable</b>	<b>Parameter Estimate</b>	<b>Standard Error</b>	<b>t-statistic</b>	<b>P-value</b>	<b>Marginal Effect at Average Price</b>	<b>Discrete Variable Shifts</b>	<b>Elasticities at Variable Averages</b>
<i>sale58***</i>	0.219500	0.046120	4.76	0.0000		957.19	
<i>sale59***</i>	-0.196740	0.049820	-3.95	0.0000		-696.47	
<i>sale60***</i>	0.256410	0.046410	5.53	0.0000		1139.81	
$R^2$	0.6363						
<i>Observations</i>	4150						

\*\*\*Denotes Significance at the 0.01 level.

\*\*Denotes Significance at the 0.05 level.

\*Denotes Significance at the 0.10 level.

**Table 3 - Summary Statistics for Model 1**

<b>Variable</b>	<b>N</b>	<b>Mean</b>	<b>Std Dev</b>	<b>Minimum</b>	<b>Maximum</b>
<i>price</i>	4151	2673.66	2089.56	950.00	45000.00
<i>age</i>	4151	446.31	108.51	298.00	1107.00
<i>birthwt</i>	4151	83.05	10.14	45.00	120.00
<i>adjweanwt</i>	4151	666.97	72.22	408.00	988.00
<i>adjyearwt</i>	4151	1192.17	104.03	784.00	1676.00
<i>birthepd</i>	4151	2.49	1.51	-2.50	7.80
<i>weanepd</i>	4151	38.53	6.84	11.00	71.00
<i>milkepd</i>	4151	20.48	4.59	5.00	34.00
<i>yearepd</i>	4151	73.44	11.82	19.00	125.00
<i>saleorder</i>	4151	0.46	0.28	0.00	1.00

**Table 4 - Changes Associated with EPD Accuracy Values**

Accuracy Value	Production EPDs				Carcass EPDs					Ultrasound EPDs			
	<i>Birth</i>	<i>Wean</i>	<i>Milk</i>	<i>Year</i>	<i>Carcass</i>	<i>Marbling</i>	<i>Ribeye</i>	<i>Fat</i>	<i>%Retail</i>	<i>%IMF</i>	<i>Ribeye</i>	<i>Fat</i>	<i>%Retail</i>
0.05	2.73	11.01	9.21	16.17	15.42	0.25	0.27	0.03	0.53	0.18	0.30	0.02	0.35
0.10	2.59	10.43	8.73	15.32	14.61	0.23	0.26	0.03	0.51	0.17	0.29	0.02	0.33
0.15	2.44	9.85	8.24	14.47	13.80	0.22	0.25	0.03	0.48	0.16	0.27	0.02	0.32
0.20	2.30	9.27	7.76	13.62	12.99	0.21	0.23	0.03	0.45	0.15	0.26	0.02	0.30
0.25	2.15	8.69	7.27	12.77	12.17	0.19	0.22	0.03	0.42	0.15	0.24	0.02	0.28
0.30	2.01	8.12	6.79	11.92	11.36	0.18	0.20	0.03	0.39	0.14	0.22	0.02	0.26
0.35	1.87	7.54	6.30	11.06	10.55	0.17	0.19	0.02	0.36	0.13	0.21	0.01	0.24
0.40	1.72	6.96	5.82	11.21	9.74	0.16	0.17	0.02	0.34	0.12	0.19	0.01	0.22
0.45	1.58	6.38	5.33	9.36	8.93	0.14	0.16	0.02	0.31	0.11	0.18	0.01	0.20
0.50	1.44	5.80	4.85	8.51	8.12	0.13	0.14	0.02	0.28	0.10	0.16	0.01	0.19
0.55	1.29	5.22	4.36	7.66	7.30	0.12	0.13	0.02	0.25	0.09	0.14	0.01	0.17
0.60	1.15	4.64	3.88	6.81	6.49	0.10	0.12	0.01	0.22	0.08	0.13	0.01	0.15
0.65	1.01	4.06	3.39	5.96	5.68	0.09	0.10	0.01	0.20	0.07	0.11	0.01	0.13
0.70	0.86	3.48	2.91	5.11	4.87	0.08	0.09	0.01	0.17	0.06	0.10	0.01	0.11
0.75	0.72	2.90	2.42	4.26	4.06	0.06	0.07	0.01	0.14	0.05	0.08	0.01	0.09
0.80	0.57	2.32	1.94	3.40	3.25	0.05	0.06	0.01	0.11	0.04	0.06	0.00	0.07
0.85	0.43	1.74	1.45	2.55	2.43	0.04	0.04	0.01	0.08	0.03	0.05	0.00	0.06
0.90	0.29	1.16	0.97	1.70	1.62	0.03	0.03	0.00	0.06	0.02	0.03	0.00	0.04
0.95	0.14	0.58	0.48	0.85	0.81	0.01	0.01	0.00	0.03	0.01	0.02	0.00	0.02

Source: [www.angus.org/sireeval/accuracy.htm](http://www.angus.org/sireeval/accuracy.htm)

**Table 5 - Regression Results for Ultrasound EPDs**

<b>Variable</b>	<b>Parameter Estimate</b>	<b>Standard Error</b>	<b>t-statistic</b>	<b>P-value</b>	<b>Marginal Effect at Average Price</b>	<b>Discrete Variable Shifts</b>	<b>Elasticities at Variable Averages</b>
<i>Intercept</i>	5.663660	0.153	37.020	0.0000			
<b>Production Measures</b>							
<i>age</i> ***	0.001950	0.000208	9.375	0.0000	5.17		0.891
<i>age2</i> ***	-0.000001	0.000000	-5.431	0.0000			
<i>birthwt</i> ***	-0.002760	0.000735	-3.753	0.0000	-7.32		-0.230
<i>adjweanwt</i> ***	0.000437	0.000122	3.602	0.0000	1.16		0.291
<i>adjyearwt</i> ***	0.000807	0.000098	8.238	0.0000	2.14		0.961
<b>EPDS</b>							
<i>birthept</i> ***	-0.048550	0.005034	-9.645	0.0000	-128.78		-0.125
<i>weanepd</i>	0.000470	0.001691	0.278	0.7810	1.25		0.018
<i>milkepd</i> ***	0.006460	0.001148	5.625	0.0000	17.14		0.134
<i>yearepd</i> ***	0.004080	0.001111	3.672	0.0000	10.82		0.301
<i>uimfepd</i> ***	0.279700	0.042070	6.649	0.0000	741.90		0.020
<i>uribepd</i> ***	0.695340	0.086760	8.014	0.0000	1844.39		0.098
<i>ufatepd</i> ***	-3.758050	0.799200	-4.703	0.0000	-9968.23		-0.015
<i>uprpepd</i> ***	-0.365540	0.074640	-4.898	0.0000	-969.59		-0.014
<b>Marketing Factors</b>							
<i>saleorder</i> ***	-0.270650	0.020260	-13.360	0.0000	-717.90		-0.134
<i>picture</i> ***	0.246400	0.022100	11.150	0.0000		723.75	
<i>et</i> ***	0.055660	0.017660	3.152	0.0020		148.26	
<i>sementhird</i> **	0.091100	0.039600	2.301	0.0210		247.06	
<i>semenhalf</i> ***	0.390340	0.075680	5.157	0.0000		1236.82	
<i>fullbrother</i>	-0.012560	0.021370	-0.588	0.5570		-32.33	
<i>pathfinder</i>	0.040890	0.026990	1.515	0.1300		108.11	
<b>Sales</b>							
<i>sale2</i> ***	-0.284630	0.039270	-7.249	0.0000		-641.63	
<i>sale4</i> ***	-0.282470	0.059190	-4.773	0.0000		-637.42	
<i>sale10</i> ***	-0.537660	0.064810	-8.296	0.0000		-1077.26	
<i>sale11</i> **	-0.205610	0.090510	-2.272	0.0230		-481.40	
<i>sale12</i> ***	-0.242700	0.037440	-6.482	0.0000		-558.19	
<i>sale15</i>	-0.081500	0.071990	-1.132	0.2580		-202.73	
<i>sale16</i> ***	-0.140600	0.054610	-2.575	0.0100		-339.75	
<i>sale23</i> **	0.101810	0.049930	2.039	0.0420		277.61	
<i>sale24</i> ***	0.156120	0.050670	3.081	0.0020		437.67	
<i>sale27</i> **	-0.143670	0.069380	-2.071	0.0380		-346.65	
<i>sale28</i> *	0.101730	0.054170	1.878	0.0600		277.38	
<i>sale29</i>	-0.039970	0.049270	-0.811	0.4170		-101.49	
<i>sale34</i> ***	-0.101940	0.042710	-2.387	0.0170		-251.04	
<i>sale36</i> ***	-0.261310	0.051270	-5.097	0.0000		-595.66	
<i>sale37</i> ***	0.131130	0.050080	2.619	0.0090		362.94	
<i>sale38</i>	0.045470	0.060710	0.749	0.4540		120.50	
<i>sale39</i> ***	-0.364370	0.059440	-6.130	0.0000		-790.98	

**Table 5 – Continued**

Variable	Parameter Estimate	Standard Error	t-statistic	P-value	Marginal Effect at Average Price	Discrete Variable Shifts	Elasticities at Variable Averages
<i>sale41</i> ***	-0.367990	0.042380	-8.683	0.0000		-797.49	
<i>sale42</i> ***	-0.354450	0.037730	-9.393	0.0000		-773.05	
<i>sale44</i> ***	-0.138050	0.034070	-4.052	0.0000		-334.00	
<i>sale46</i>	0.033910	0.057060	0.594	0.5520		89.34	
<i>sale48</i>	-0.030620	0.047150	-0.649	0.5160		-78.11	
<i>sale51</i> ***	-0.234240	0.055340	-4.233	0.0000		-540.92	
<i>sale52</i> ***	0.387810	0.052840	7.339	0.0000		1227.15	
<i>sale53</i>	0.081670	0.055170	1.480	0.1390		220.43	
<i>sale54</i> ***	-0.275670	0.058180	-4.738	0.0000		-624.09	
<i>sale55</i>	0.037280	0.052180	0.715	0.4750		98.39	
<i>sale60</i> ***	0.250160	0.052150	4.797	0.0000		736.24	
$R^2$	0.6286						
Observations	3760						

\*\*\*Denotes Significance at the 0.01 level.

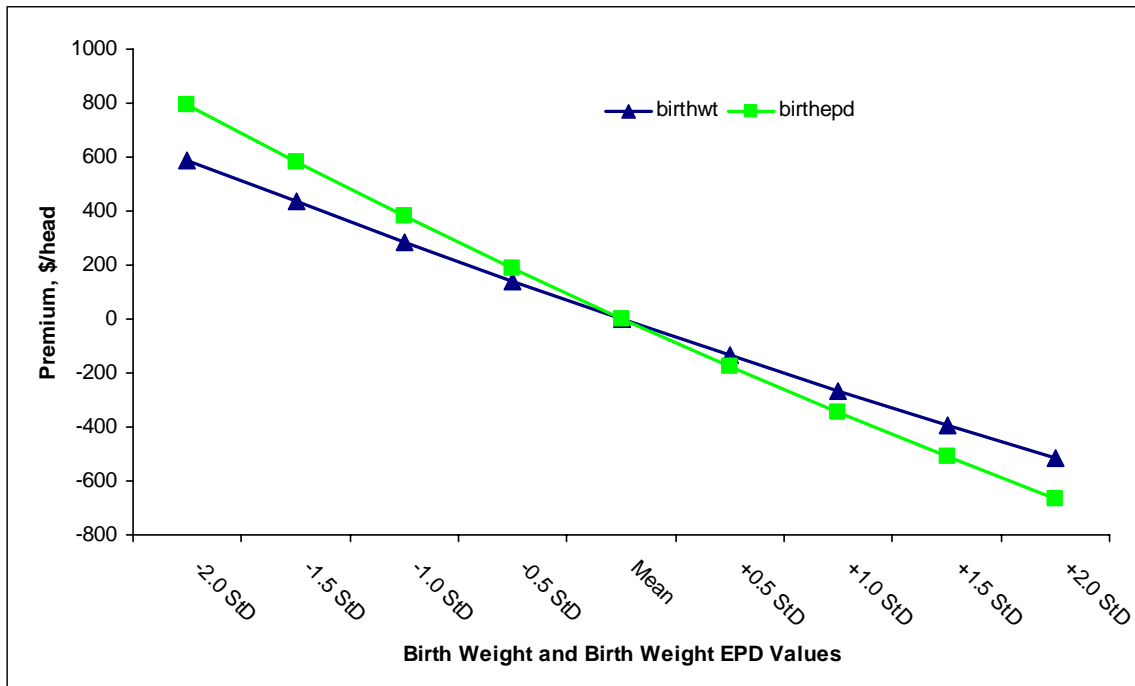
\*\*Denotes Significance at the 0.05 level.

\*Denotes Significance at the 0.1 level.

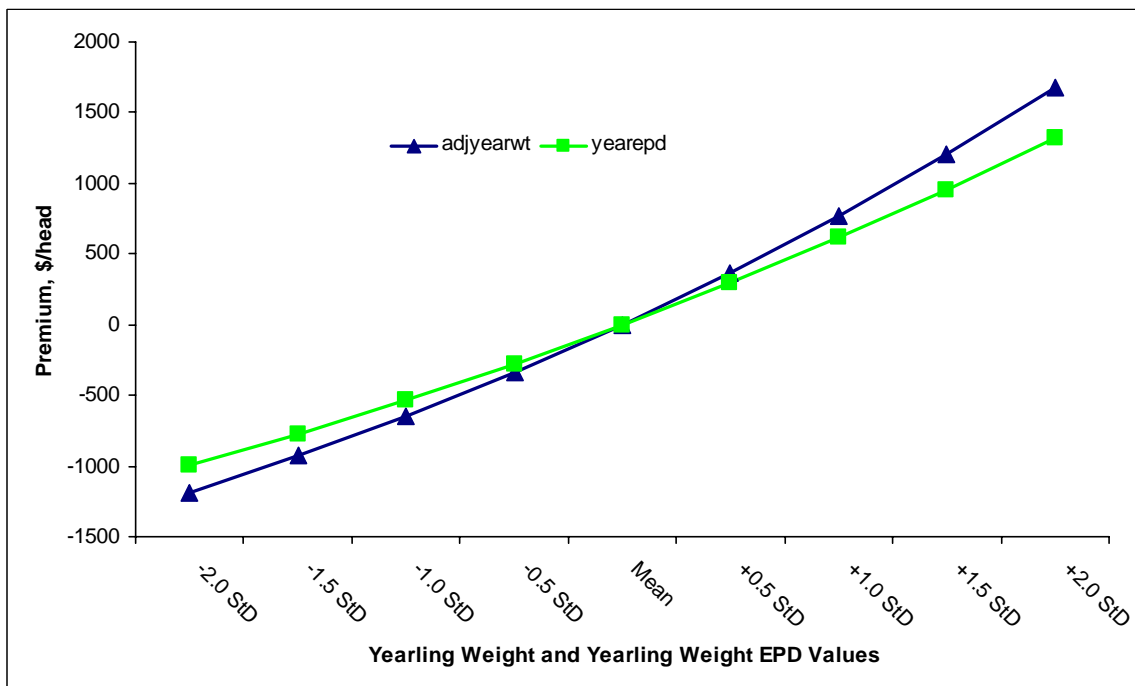
**Table 6 - Summary Statistics for Model 2**

Variable	N	Mean	Std Dev	Minimum	Maximum
<i>price</i>	3768	2652.50	2157.25	875.00	40000.00
<i>age</i>	3768	456.91	121.22	285.00	1829.00
<i>birthwt</i>	3768	83.29	10.14	45.00	120.00
<i>adjweanwt</i>	3768	664.07	70.92	408.00	930.00
<i>adjyearwt</i>	3768	1190.09	103.53	842.00	1742.00
<i>birthe pd</i>	3761	2.58	1.48	-2.50	7.80
<i>weanepd</i>	3761	38.53	6.34	14.00	59.00
<i>milkepd</i>	3761	20.77	4.50	1.00	34.00
<i>yearepd</i>	3761	73.86	11.18	29.00	108.00
<i>uimfepd</i>	3768	0.07	0.14	-0.40	0.74
<i>uribepd</i>	3768	0.14	0.22	-0.58	1.00
<i>ufatepd</i>	3768	0.00	0.02	-0.06	0.06
<i>uprpepd</i>	3768	0.04	0.28	-0.87	1.20
<i>saleorder</i>	3768	0.50	0.29	0.00	1.00

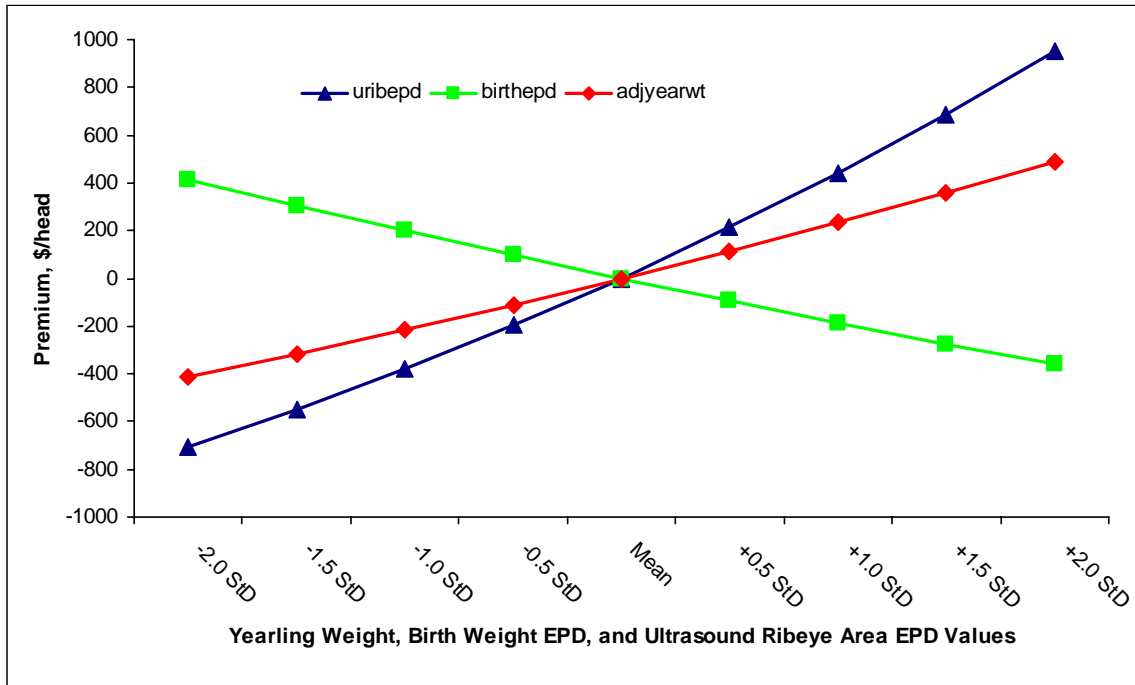
**Figure 1 – Predicted Premiums for Birth Weight and Birth Weight EPD**



**Figure 2 – Predicted Premiums for Adjusted Yearling Weight and Yearling Weight EPD**



**Figure 3 – Predicted Premiums for Ultrasound Ribeye EPD, Birth Weight EPD, and Adjusted Yearling Weight**



# ECONOMIES OF SCALE IN FINISHING CATTLE

by Richard W. Porter and Rodney Jones<sup>1</sup>

## **Introduction:**

In 1964 more than 60 % of all cattle in the United States were fed in feedlots with less than 1,000 head capacity. Today, only 18 % of all cattle in the United States are fed in feedlots with less than 1,000 head capacity. (For Kansas the figure is only 2 %.) This is a dramatic change, yet, there are still small farmer-feeders that continue to feed cattle profitably. Intuitively, one might assume that economies of scale so strongly favor the large commercial feedlots that the small farmer-feeder could not possibly be competitive, however, this must not always be the case.

The purpose of this paper is to compare operating cost information for the smaller farmer/feeder with similar information obtained from large commercial feedlots. We examine various measures of costs for the two data sets to see how they compare. Because the two classes of feedlots are dramatically different in size we make all comparisons on a cost per pound of gain basis. In addition, we attempt to determine what factors drive any cost differences between these two data sets.

## **Relevant Previous Work:**

Relatively few previous studies have examined the impact of size on the cost structure in cattle feeding. Dietrich et al (1985) analyzed the economies of size in Texas feedlots. The study representing over half of the cattle fed in Texas during 1980 and

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<sup>1</sup> The authors are a cattle backgrounder-finisher and former graduate student, and an associate professor in the department of Agricultural Economics, Kansas State University

1981, found that fixed costs were significantly lower for feedlots larger than 16,000 head capacity.

Loy and Wilson (1985) analyzed data for Iowa feedlots and found that non-feed costs were fairly flat over a range of sizes. However, Iowa feedlots tended to be diversified with farming and other livestock operations so economies of scope might mask economies of scale. They also analyzed Texas feedlots and found that non-feed costs only fell off for feedlots larger than 50,000 head of capacity. Approximately a third of the fixed costs of Texas feedlots are for the feed mill. Iowa feeders tend to transfer much of the feed milling costs to higher costs for prepared feed.

In addition, several fairly recent studies have examined various aspects of cattle feeding profitability (not specifically related to economies of scale). For example, Langemeir, Schroeder, and Mintert (1992) found that from 1980 to 1989 feedlot profitability was most affected by sale price and input prices, but feed conversion and average daily gain were also significant. Lawrence, Wang, and Loy (1999) did a study similar to the Langemeir, Schroeder, and Mintert study but compared it over many different feedlots rather than over time. Their results were similar and found that sale price was the largest determinant of profitability followed by feeder cattle price. The next two most important factors were feed conversion and average daily gain. Mark, Schroeder, and Jones (2000) found that the input and selling prices of cattle were the most important factors affecting feedlot profitability, followed by feed conversion rate and average daily gain. Most recently, McDonald and Schroeder (2003) found that for cattle marketed on grids that feeder cattle price was the most important factor in cattle profitability followed in order by selling price (base grid price) and cost of gain.

## **Economies of Scale:**

Just what does this term “Economies of Scale” (EOS) mean? EOS are said to have occurred when more units are produced at a lower cost per unit, when compared to smaller scale operations. Economists suggest that division of labor and specialization are the two main ways that EOS are achieved. A larger feedlot can certainly employ division of labor and specialization, such as one person driving a feed truck all day while another employee processes cattle all day. With this specialization one might expect the employees to have greater skill with the tasks that they perform. Alternatively, such employees could be lower skilled, and thus lower paid, because they are not required to master so many different tasks.

Spreading of overhead (fixed costs) over more production units can be achieved by larger feedlots. Equipment may be operated more hours, and larger equipment can be justified. Furthermore, larger feedlots can spread costs such as sophisticated feed milling equipment and consultants over more units of output. Finally, larger feedlots may enjoy lower input costs because of volume discounts for inputs, and more negotiating effort.

An argument can be made that higher selling prices might be achieved by larger feedlots if they are in a stronger bargaining position and can attract several packer buyers every week. Many have suggested that this is a major driver of the consolidation in the feedlot industry. While this presents an interesting issue for discussion, it does not fall under the “classic” definition of economies of scale, and is not explored in this study.

It is, however, quite plausible to reason that some diseconomies of scale are possible in the cattle feeding business. For example a feedlot under 1,000 head of capacity might not be required to capture its runoff in lagoons or meet other costly

environmental compliance restrictions. A smaller feedlot may be better prepared to offer specialized services such as caring for high stress cattle (paying more attention to details).

**Data:**

The data for this study come from Kansas Farm Management Association (KFM), and a sample of large commercial feedlots (LCF). The KFM data represent 35 backgrounder-feeders that provided cattle feeding enterprise data for three consecutive years (97, 98, and 99). These feeders ranged in size from operations that finished from 100 head per year to 1,900 head per year. The LCF data represent 55 feedlots, finishing an average of 78,251 head per year. The LCF data include lots from Kansas, Texas, and Oklahoma for the same 3 year time period.

**Table 1: Summary Statistics**

<u>COST CATEGORY</u>	<u>KFM DATA</u>			<u>LCF DATA</u>
	<u>SMALL</u>	<u>LARGE</u>	<u>AVERAGE</u>	<u>VERY LARGE</u>
FEEDLOT SIZE				
TOTAL FEED COST	\$.62	\$.50	\$.56	\$.52
FEED ONLY COST	\$.46	\$.42	\$.437	\$.445
NON FEED COST	\$.16	\$.08	\$.122	\$.075

The summary data for small and large KFM feedlots (Table 1) were calculated by using the “best fit” equations presented in Figures 1 through 3, computed where the smallest (100 head) and largest (1900 head) intercept the trend line. The LCF data are averages from the actual data set.

Additional data from LCF provided results of a “Feed Yard Cost Survey”. These data included a more comprehensive breakdown of cost categories that could be compared with KFM cost categories. This LCF data comes from 19 to 28 feedlots

(depending on year), that are not necessarily the same as the 55 feedlots in the previous data set.

The KFM raw data were aggregated into categories that mirror a close out from a commercial feedlot. To do this, all feed and non-feed costs were included. Not included were costs that would customarily be born by the owner of cattle in a commercial feedlot. An example of excluded costs would be the interest costs on the cattle. In addition, no adjustment was made in the KFM data for the expected returns above all accounting costs that a feedlot would expect to recover from operating a feedlot (returns to management and risk). Included interest cost (operating interest) was derived from the depreciation and variable interest costs. Transportation costs (either “to” or “from” the feedlot) were not included.<sup>2</sup>

The KFM data are rich enough to demonstrate the change in costs as the size of the enterprise increases. However, the data from the large commercial feedlots did not show variation in costs as a function of feedlot size, as individual commercial feedlot size was not reported due to confidentiality concerns of the suppliers of the data set. Therefore, the KFM individual firm data are compared to averages from LCF.

### **Results:**

The following graph (Figure 1) perhaps best summarizes the results of this study. The KFM feedlots had a calculated average total cost of gain that started at \$.62 per pound of gain for the smallest feedlots (100 head per year) declining to \$.50 per pound of gain for the largest feedlots (1,900 head per year).<sup>3</sup> This compares to the LCF data which

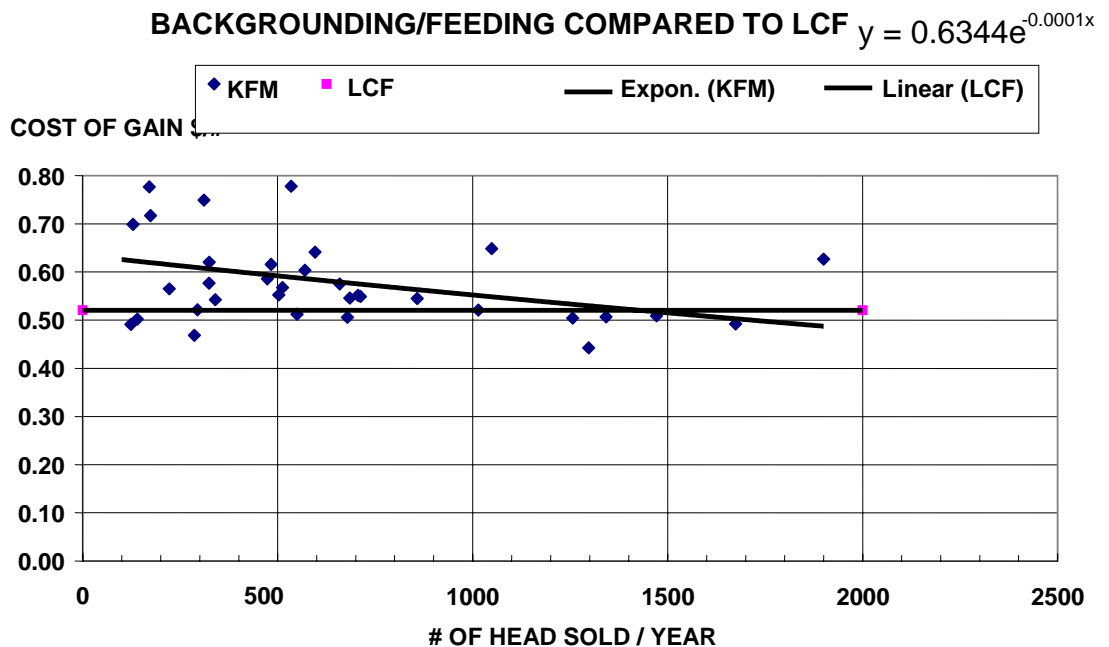
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<sup>2</sup> An argument can be made that a farmer-feeder would be more likely to bear transportation costs, especially to the packer, as the cattle would more likely be sold on a grid.

<sup>3</sup> Calculated based on the “best fit” equation revealed on the graph itself.

reveal a total cost of gain of \$.52 for feedlots averaging 78,252 head per year. This comparison alone reveals that it is quite possible for the larger farmer-feeders to be competitive with the large feedlots from a total cost of gain perspective.

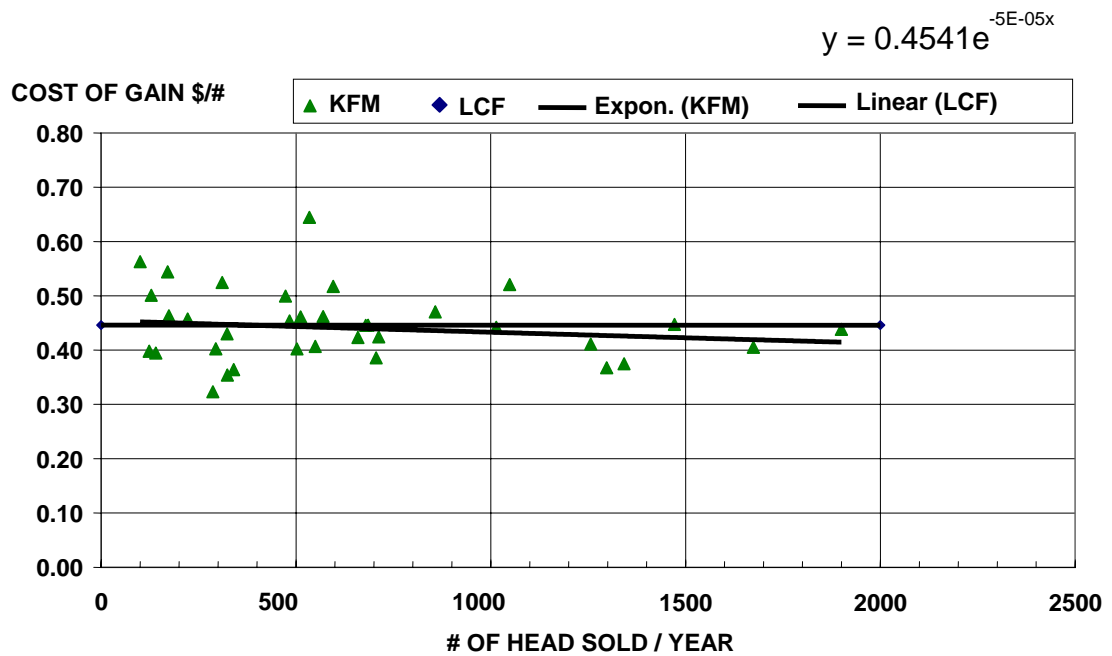
**Figure 1: 1997-1999 Cost of Gain for Farm Management**



The next graph (Figure 2) summarizes the results examining feed-only cost of gain. The KFM feedlots had a calculated average feed-only cost of gain that started at \$.46 per pound of gain for the smallest feedlots (100 head per year), declining to \$.42 per pound of gain for the largest feedlots (1,900 head per year).<sup>4</sup> These results compare to the LCF average which suggests a feed only cost of gain of \$.445 for feedlots averaging 78,252 head per year.

<sup>4</sup> These calculations are again based on the “best fit” equation revealed on the graph

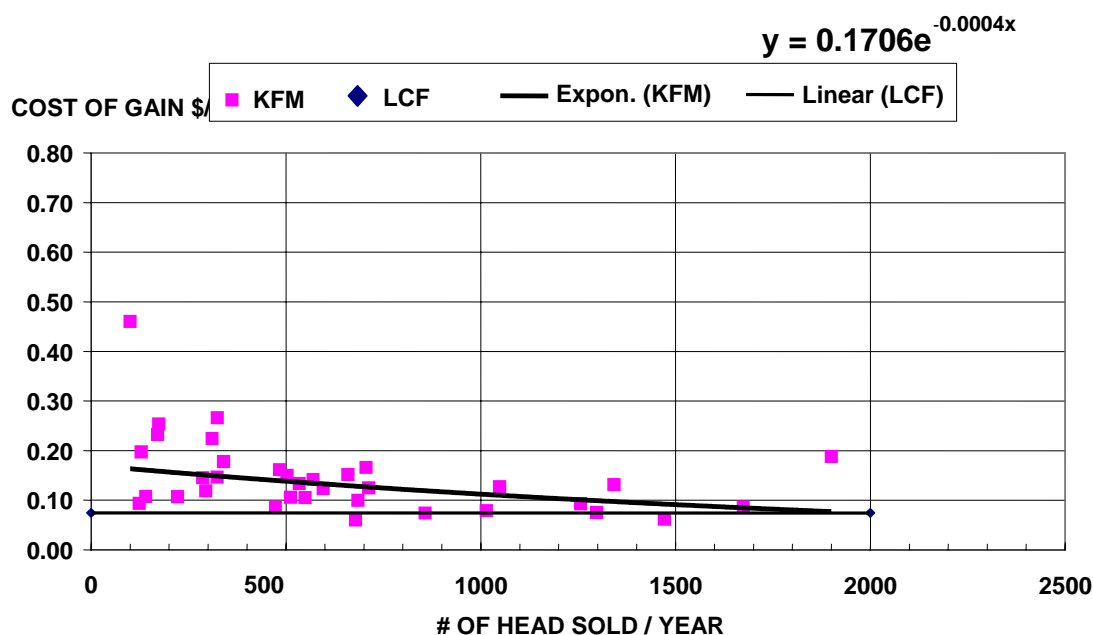
**Figure 2: 1997-1999 Feed Cost of Gain for Farm Management  
BACKGROUNDING/FEEDING COMPARED TO LCF DATA**



The final graph (Figure 3) summarizes the results of the non-feed cost of gain. The KFM feedlots had a calculated average non-feed cost of gain that started at \$.16 per pound of gain for the smallest feedlots (100 head per year), declining to \$.08 per pound of gain for the largest feedlots (1,900 head per year).<sup>5</sup> These results compare to the LCF averages which showed a non-feed cost of gain of \$.075 for feedlots averaging 78,252 head per year.

<sup>5</sup> Calculated in the same manner as the earlier calculations, based on the “best fit” equation revealed on the graph.

**Figure 3: 1997-1999 Non-Feed Cost of Gain for Farm  
MANAGEMENT BACKGROUNDING/FEEDING**



**Table 2: Concise Table of Results**

COST CATEGORY	KFM DATA			LCF DATA
	SMALL	LARGE	AVERAGE	VERY LARGE
TOTAL FEED COST	\$.62	\$.50	\$.56	\$.52
FEED ONLY COST	\$.46	\$.42	\$.437	\$.445
NON FEED COST	\$.16	\$.08	\$.122	\$.075

These results (both Figures 1 – 3, and Table 2) show that larger KFM feedlots can be competitive with the very large commercial feedlots on total cost. Surprisingly, the feed-only costs are similar for both. One might hypothesize that the lower feed efficiency of dry rolling grain in the KFM feedlots was offset by the lower processing costs from not having a steam flaker and a lower grain cost because the farmer would otherwise be selling grain at wholesale prices while the large commercial feedlots buy

their grain at higher costs that include transaction costs. Hay and silage are usually priced much lower at the farm than at a large commercial feedlot. Another possible explanation for the farmer-feeders having lower feed costs is that many farmer feeders feed their own cattle and these cattle would not have to adapt to a new feedlot (private discussions with cattle feeders suggest that these “adaptation” costs can be quite high).

The most striking difference is that the KFM feedlots had non-feed costs that were on average more than 60% higher than the non-feed cost for the very large commercial feedlots. Even the larger feedlots in the KFM data set had non-feed costs that were still slightly above the costs for the large commercial feedlots. The following breakdown of the data helps to explain why the KFM feedlots had these higher non-feed costs.

**Table 3: Breakdown of Non-Feed Costs**

<b><u>DATA SOURCE</u></b>	<b><u>KFM</u></b>	<b><u>LCF</u></b>	<b><u>KFM/LCF</u></b>
FEED, & MEDICINE	0.4369	0.446	0.98
LABOR	0.029	0.0373	0.78
INSURANCE	0.0022	0.001822	1.22
INTEREST	0.0248	0.0067	3.72
TAXES	0.0022	0.00301	0.72
UTILITIES	0.007	0.0058	1.21
DEP, REP &, MAINT	0.027	0.0091	2.97
MARKET PRO. ORG.	0.0298	0.0091	3.27
TOTAL NON FEED	0.122	0.0745	1.64
TOT COG	0.5589	0.5205	1.07

Table 3 shows some striking differences in the non-feed costs between the KFM feedlots and the LCF feedlots. As mentioned earlier, an obvious problem with this data is that we do not know exactly how the allocations were made. The operators had a total cost that they had to allocate among the various categories. Some subjective allocation

likely occurred. Thus there is higher confidence in the aggregate of these non-feed costs than there is in each individual cost category.

With that said, results presented in Table 3 reveal that the labor cost for the KFM data is only 78% of the cost for LCF. Smaller feedlots may not account for all of the unpaid farm labor when reporting costs, or they may value their work at a lower rate. In addition, they are not subject to workmen's compensation costs, and would have a simpler feeding system, perhaps requiring less labor. The insurance cost for KFM is 22% higher than for LCF. This is likely because the smaller feedlots have more value per head in buildings and equipment to insure.

The interest cost for KFM is 3.72 times that of LCF. This is likely because the smaller feedlots have a higher investment cost per head. It is also possible that we were not able to adequately separate from the data set the interest cost on the cattle from the interest cost on the facilities, equipment, and variable costs. The tax cost for the KFM is only 72% of the tax cost for LCF. This is hard to reconcile with the insurance and interest costs being higher because there is more facility cost per head. It is possible that the smaller feedlots are taxed at a lower rate because they are classified as agriculture while the feedlots are classified as commercial. The utilities cost for KFM is 21% higher than for LCF. It is possible that non-feedlot utilities were included in the reported cost measure as it is harder for the farmer/feeder to allocate such costs to the appropriate enterprises.

The depreciation, repair, maintenance, and machine hire costs for KFM are 2.97 times as high as LCF. It is quite plausible that total machine costs are very subject to economies of scale so it just costs the smaller operators more on a per unit basis. Larger

feedlots would have larger equipment; however it would be used more hours per day and would be spread over significantly more units of gain. Similarly, the marketing and professional organization costs are 3.27 times higher for the KFM than for LCF. This is plausible because the smaller feedlot may have to hire someone to help in marketing the cattle and they may sell cattle on a delivered basis (grade and yield) so that the smaller feedlot is responsible for the trucking cost to the packer. In contrast the larger feedlots probably sell most of their cattle FOB the feedlot.

**Conclusions:**

The results of this study indicate that farmer-feeders that finish more than 700 head per year can compete with the large commercial feedlots from a cost perspective. The data even suggests that some individual farmer-feeders smaller than 700 head may be competitive. The lack of a sophisticated feed mill did not prevent the farmer feeder from being competitive with the large commercial feedlots in feed costs. This might be explained by the farmer feeder producing much of the feed, which reduced transportation and transaction costs.

It was also revealing that that the farmer feeder had non-feed costs that averaged 64% higher than the large commercial feedlots. The significantly higher marketing costs may be partly explained by the producer incurring the transportation costs to the packer because they are more likely to sell grade and yield. The significantly higher costs for depreciation, repairs, and maintenance is likely explained by having fewer head of cattle to spread the equipment over. It is possible that the data capture some “dual use” of equipment that would need to be owned anyway for farming even if cattle were not being feed. Therefore, these costs could be over-stated in this study. Similarly, the

significantly higher interest cost for the farmer/feeder might be related to the higher depreciation expense.

**Farmer-feeder possible success factors:**

If a feeder both grows cattle and finishes cattle then the feeder can use the same feeding equipment for a larger number of cattle, allowing him to either spread fixed equipment costs over more units or have larger and more efficient equipment. Of course a given pen can only be used for one type of cattle but a given pen can be used a higher fraction of the time. In addition, the cattle will have much less adaptation time if finishing occurs at the same facility where they are grown, and trucking costs are reduced. If a feeder both farms and feeds cattle, the feeder can use equipment and labor more efficiently throughout the year. The farming tractors are available as backup to the feeding tractors. The farming operation can sell feed to the feedlot with a minimum of transportation and transaction costs.

If the feeder shifts from placing his own cattle in a commercial feed lot to finishing them at home following the backgrounding or growing phase, then the feeder has increased the size of his operation without increasing his market risk exposure to the cattle market. This may result in better utilization of labor, management, equipment, etc. If a feeder finishes all of his own cattle then he has more control of his feedlot occupancy, and is not dependent on a customer to place cattle in his feedlot. The feeder does not need a sophisticated system to bill feed and medicine to a large customer base. The feeder can sort the finishing cattle into several outcome groups without having to mix different customers' cattle in the same pen, which further complicates record keeping and billing.

In really tough economic times (in this case meaning extended periods of unfavorable buy-sell spreads on the cattle, or periods of prohibitively high feed costs) the farmer/feeder can live off depreciation, donate family labor, get an off farm job, or mothball the feedlot until better economic times return. These strategies are not available to the large commercial feedlots, as large fixed costs continue to accrue during times of capacity under utilization.

Obviously, many of the aforementioned efficiencies would not apply if a small feedlot is finishing a customer's cattle rather than his or her own cattle. Therefore, one of the elements that can contribute to the viability of the relatively small farmer-feeder is the ability to control most if not all of the cattle in the lot are under one ownership.

Smaller feedlots may find that they can fill a niche that is difficult for a large feedlot. They might attract cattle to their feedlot with a specialized starting program for high stress cattle, an associated growing program, pens for a small number of cattle, or cater to a specialized market such as feeding all organic feed.

A farmer-feeder will not individually come to the table with enough volume to bargain aggressively with the packers. Furthermore, if the farmer-feeder is in Eastern Kansas they may only have one viable packer option. The usual successful strategy is to become effectively a "captive" of that packer. Often price is not negotiated, but rather set by the packer. The feeder protects himself by finding ways to be valuable to the packer. This may include such strategies as being willing to deliver cattle at the times that are most valuable to the packer (i.e., early on Monday morning, or on a weekend with little advance notice).

If a feeder has a total capacity under 1000 head then he may have less strict waste water runoff restrictions, and therefore have lower costs associated with waste management. If total capacity is over 1,000 head then the feeder will probably have to meet the same restrictions as the very large commercial feedlots, but will have fewer cattle to spread compliance costs over. This appears to be resulting in a size bifurcation among farmer-feeders. For example, some keep their size below 1,000 head capacity to prevent needing to install waste water lagoons. Others decide that once they cross the threshold of 1,000 head capacity they need to increase size to several thousand head to make more economical use of their lagoons and other associated waste handling equipment.

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