Differences Between High-, Medium-, and Low-Profit Cow-Calf Producers:

An Analysis of 2010-2014 Kansas Farm Management Association Cow-Calf Enterprise

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In 2014, cow-calf producers experienced one of the largest economic returns in the last 50 years. Although we have recently seen record high returns, cow-calf producers experienced record low returns only six years ago in 2009. Returns to cow-calf producers fluctuate considerably over time and year-to-year swings can be extreme across time as seen below in figure 1.[1] Figure 1 shows the returns over variable costs, on a per cow basis, for producers with cow-calf enterprises enrolled in the Kansas Farm Management Association (KFMA) between 1975 and 2014. Over the 40-year period, there were 91 producers, on average, participating in the enterprise analysis per year and ranged from 67 to 116. Over the entire time period, average annual returns over variable costs averaged $78.01 per cow with a low of -$76.40 per cow in 2009 to a high of $589.50 in 2014. That is a difference of almost $670 per cow in the last six years. Sorting the returns in figure 1 from the high ("good years") to low ("bad years") and dividing into thirds, the average returns for the time periods are $196.64, $68.23, and -$30.10, for the top-, middle-, and bottom-periods, respectively. In other words, there is almost a $227 difference in the average returns per cow in the "good" years compared to the "bad" years in nominal terms.

This variability of returns over time is due to many factors, including the cattle cycle. In other words, producers tend to reduce the size of their herd when cattle prices are lower, which in turn leads to smaller cattle supplies in the future. These smaller supplies lead to higher cattle prices, which then leads to expanding cattle herds resulting in larger supplies and lower prices (and the process starts over again). As cattle producers know, especially in Kansas and the Southern Plains, cattle cycles are not perfectly predictable because factors other than price also influence producers' decisions to expand or contract their herds (e.g., forage availability, input costs). For example, the declining returns in 2007 through 2009 were not the result of herd expansion, but were due more to increasing input costs and weakening beef demand. The record high average return in 2014 was a result of a drought and strengthening beef demand. Given that some factors at the macro level (e.g., interest rates, fuel prices, consumer demand) are not controllable by producers, all producers are effected similarly. It stands to reason that variability of returns over time is inherent to the industry.

[1] This paper is an update to Dhuyvetter and Herbel (2013) - "Differences Between High-, Medium-, and Low-Profit Producers: An Analysis of 2008-2012 Kansas Farm Management Association Cow-Calf Enterprise." Available at: http://www.agmanager.info/livestock/budgets/production/beef/Cow-calf_EnterpriseAnalysis(Aug2013).pdf.

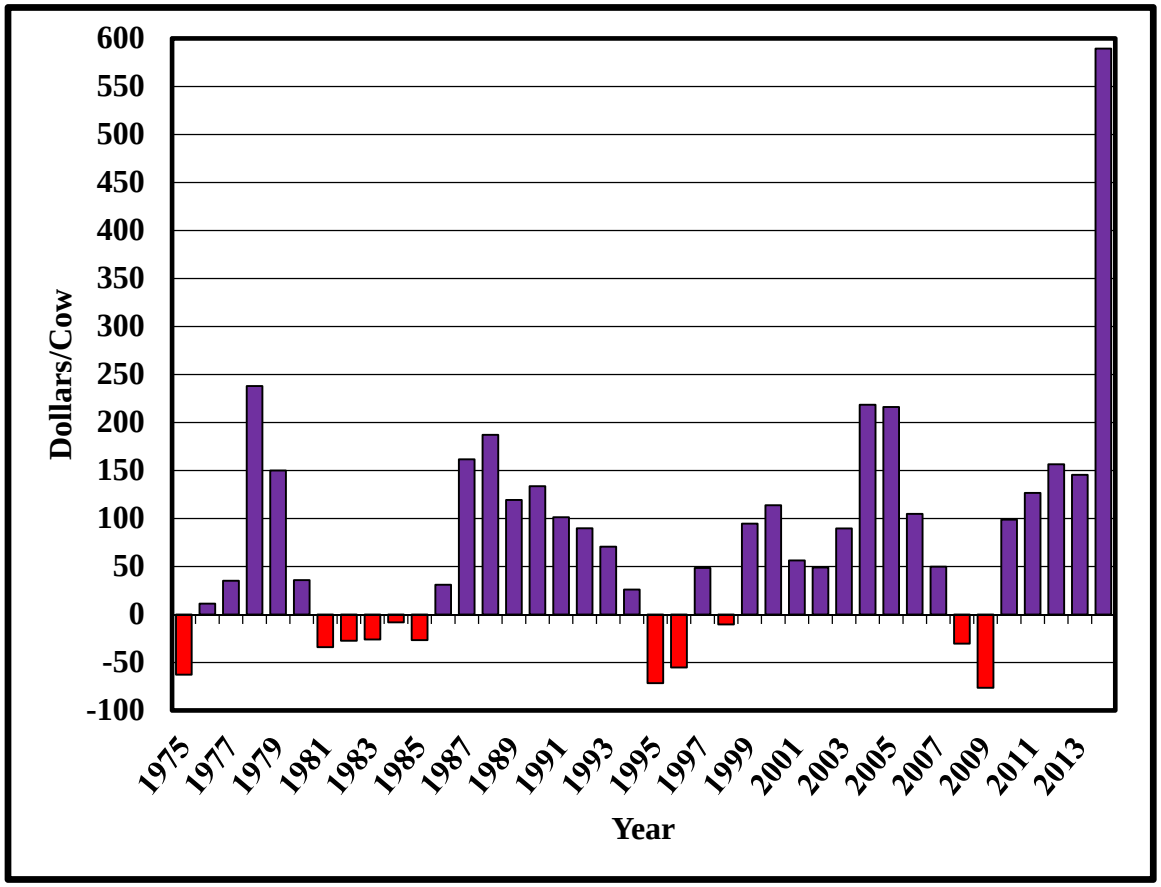

Figure 1. Returns over Variable Cost for Cow-Calf Enterprise, 1975-2014

Figure 2 shows the returns over total costs rather than returns over variable costs (as seen in figure 1). That is, fixed costs (i.e., depreciation, real estate taxes, unpaid operator labor and an interest charge on assets) have been added to the variable costs. Over the 40-year time frame, the average returns over total costs are -$85.72 per cow with a low of -$286.71 and a high of $233.35 (returns over total costs were only positive 6 of the 40 years or 15% of the time). At first glance one might ask why anybody is in the cow-calf business if average returns over total costs are only positive 15% of the time. However, it is important to recognize that the unpaid labor and assets used in the operation reflect opportunity costs and these can vary significantly between operations. The main point of figure 2 is that, regardless of how we might measure returns (e.g., returns over variable costs vs. returns over total costs vs. returns to management vs. returns to labor and management), they are highly variable across time. Because the returns over total costs are also highly variable across years, we sorted the 40-year returns over total costs into thirds, similar to returns over variable costs. The sorting resulted in the following averages for the top-, middle-, and bottom-third of years, respectively: -$25.50, -$89.57, and -$192.81. In other words, there is a large difference in the average returns over total costs per cow between the “good” years and the “bad” years of $218.

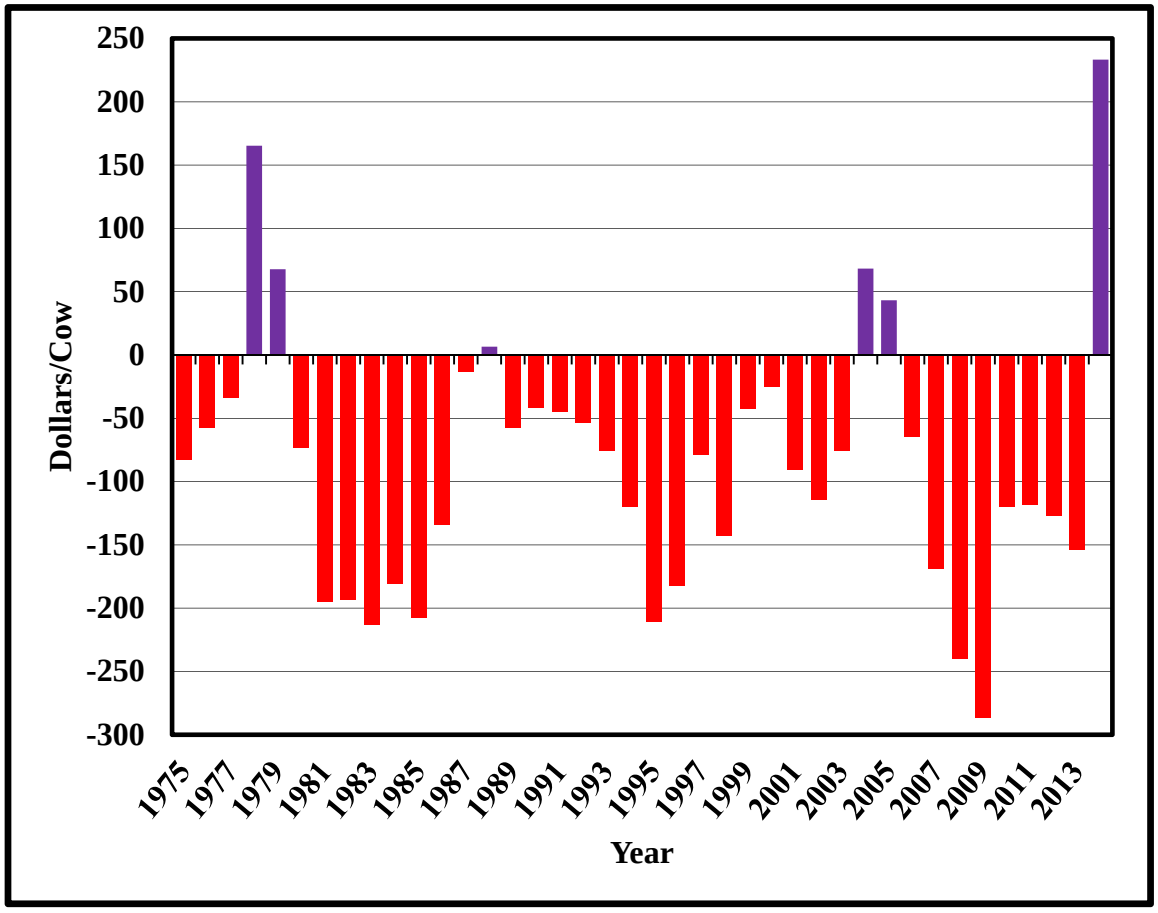

Figure 2. Returns over Total Cost for Cow-Calf Enterprise, 1975-2014

Figures 1 and 2 show the variability in annual average returns across time, where the annual averages are calculated across producers. It was pointed out that this variability across time is due largely to macro-economic factors that producers have limited ability to manage. However, an important question for producers to ask is what do the returns for individual producers look like at a point in time? That is, how much variability is there in the returns across individual producers in good or bad years? The answer to this question is important from a management perspective because while producers might not be able to influence overall market conditions, they do have more control of profitability at the farm level relative to other producers. In other words, while numerous factors beyond the producer's control impact the *absolute* level of profitability, producers' management abilities impact their *relative* profitability. In a competitive industry that is consolidating, such as production agriculture, relative profitability will dictate which producers will remain in business in the long run. Thus, it is important to recognize which characteristics determine relative farm profitability between producers. Specifically, it is important to be able to answer questions like the following. Does size of operation impact profitability? Do profitable farms sell heavier calves or receive higher prices? Do they have lower costs? If they have lower costs, in what areas are their costs lower? Answering these questions, and others related to why some producers are more (less) profitable than average provides valuable information for making management decisions.

To address these questions, cow-calf enterprise costs and returns data from the Kansas Farm Management Association (KFMA) Enterprise Analysis for individual producers were divided into three profitability groups, high, middle, and low, based on the per cow return to management.[2] A potential problem with analyzing the returns from a group of producers in a given year is that differences could be due more to chance than management. For example, if producers in one part of the state received little or no summer rain, they might have lower weaning weights or higher feed costs (due to supplemental feeding) and hence have below average returns due to weather conditions as opposed to poor management. To reduce the problem of random differences in returns across producers in a given year, a multi-year average is used for each producer. Specifically, the returns for producers that had a minimum of three years of data over the 2010-2014 five-year time period were included in the analysis.[3]

Operations with an average calf selling weight greater than 750 pounds were excluded from the analysis. In addition to being excluded because of insufficient years of data (i.e., less than three years from 2010-2014), operations also were excluded from the analysis if they had less than 10 cows, if they had not recorded production, if their cattle purchases were greater than 25% of their herd in any one year, or if their net sales (sales less purchases) of breeding stock were greater than 25% in any one year. After these "filters" were applied, there were 79 operations with multi-year average returns to analyze (14 had five years of data, 21 had four years of data, and 44 had three years of data). These multi-year averages of individual producers' returns should do a better job of characterizing profitability differences that are due to management abilities as opposed to random returns, which might be the case if only a single year were considered.

To allow for easier comparisons, a number of the income and expense categories reported in the KFMA cow-calf enterprise report were aggregated. Gross income per cow is the sum of cattle (calves and breeding stock) sales and other miscellaneous income less cattle purchases. Expense categories considered were feed, pasture, vet, marketing, labor, depreciation, machinery, interest, and other.[4] In addition to the variables from the cow-calf enterprise analysis, a variable was created to represent the percentage of labor used for the cow-calf enterprise. This variable was created by summing the hired labor and operator labor costs for the cow-calf enterprise and dividing it by the total amount of labor ($) for the entire operation. The total amount of labor ($) for the entire operation was pulled from the KFMA whole-farm database. The percent of labor variable provides an indication as to the relative importance of the cow-calf enterprise to the total farm. A high percentage indicates a farm specializes in beef cow-calf, whereas, a low percentage indicates the operation relies relatively more on crop enterprises.

[2] The words profitability and profit used in this paper refer to the Net Return to Management measure reported in the Kansas Farm Management Association Enterprise *PROFITCENTER* Summary reports (see Enterprise Reports at www.agmanager.info/kfma/). Net Return to Management is gross income less total costs, which includes unpaid labor, depreciation and an interest charge for assets used in the enterprise.

[3] It would be preferred to have examined the returns for all producers having three or five years of continuous data; however, when that stipulation was used the sample size dropped significantly because not all cow-calf producers conduct an enterprise analysis every year. For example, there were only 14 operations that had data each year from 2010-2014.

[4] Disaggregated income and expense categories in the enterprise reports can be seen in historical reports available at www.agmanager.info/kfma/.

Multi-year averages were calculated for all variables for each of the 79 operations that had a minimum of three years of data. The operations were sorted from high to low based on the average return to management (return over total costs) and then classified as high-, mid-, and low-profit farms. Table 1 reports average returns and costs for all 79 operations and for each of the three profit categories. Also, the differences between the high- and low-1/3 profit groups both in absolute terms and percentages are reported. High-profit farms had larger herds on average and had slightly heavier calves.[5] The number of calves sold per cow in the herd averaged 0.907 across all operations and was similar for each of the three profit categories. High-profit farms had a higher percentage of their farm labor allocated to livestock compared to the low-profit farms (i.e., high-profit farms were more specialized in livestock than low-profit farms). This is not unexpected given that the average herd size for the high 1/3 category is considerably larger than for the low 1/3 (172 versus 117 cows). The high-profit farms received a similar price for calves as the low-profit operations, but both were slightly higher than mid-profit farms. High-profit operations generated about $133.51 (+16%) more revenue per cow than the low-profit operations.

When compared to the revenue differences, the differences in costs between operations were much larger. High-profit operations had a $282 per cow cost advantage over low-profit farms (24% advantage) and a $97 cost advantage over the mid-profit farms. High-profit operations had a cost advantage in every cost category compared to the mid- and low-profit operations, except for pasture.

Since we are looking at the enterprise data across a period of years, with each operation not necessarily having data in each year, it could be asked if there is any impact of this "year effect" on the comparisons. The average year for the high-profit operations was 11.97, where 2010=10, 2011=11, and so on, compared to 11.82 for the mid-profit farms and 11.79 for the low-profit farms. These averages were not statistically different from each other at the 5% level, suggesting that profit differences likely were not driven by specific years in which producers had data for (remember not all farms have data all years). However, it is possible that part of the profitability differences is due to a year effect (this is discussed more in a later section – *Characteristics Impacting Profit and Cost Differences*).

Combining the gross income and cost advantages for the high-profit farms results in a net return advantage of $415.03 and $189.26 per cow compared to the low-profit and mid-profit farms, respectively. Thus, even though figure 2 suggests that the average cow-calf producer participating in the KFMA enterprise analysis rarely covers their total costs, the information in table 1 indicates that some producers might consistently earn positive returns. That is, even when the macroeconomic conditions led to an average loss of $119.65 per cow over this 5-year time period, the top third of the producers fared much better than the average (average gain of $81.62). Furthermore, 21 of the 79 producers realized a positive return over total costs (average of $107.86 per cow) over this time period. In other words, even though cow-calf enterprise returns are highly variable over time due to hard-to-manage macro-economic factors, the variability across producers at a point in time is even larger. These larger differences across individual operation can potentially be managed and therefore represent opportunities.

Table 2 shows similar information as reported in table 1 except the analysis only considers variable costs (i.e., data similar to that shown in figure 1). In this case, the difference in returns between the high- and

[5] While the objective of this analysis is to focus strictly on the cow-calf enterprise by excluding operations with average weights greater than 750 pounds, it is possible that operations with heavier weights fed their calves for a short time period (i.e., preconditioned their calves). However, given that the weight differences are relatively small, the heavier weights could also be due to management and genetics.

Table 1. Beef Cow-Calf Enterprise Returns over Total Costs, 2010-2014 (minimum of three years)*

		Profit Category			Difference Between High 1/3 and Low 1/3	
	All Farms	High 1/3 Head / $	Mid 1/3 Head / $	Low 1/3 Head / $	Absolute	%
Number of Farms	79	26	27	26		
Labor allocated to livestock, %	29.0	32.6	28.0	26.5	6	23%
Number of Cows in Herd	140	172	130	117	55	47%
Number of Calves Sold	127	159	116	106	53	51%
Calves Sold per Cow in Herd	0.907	0.924	0.890	0.904	0.02	2%
Weight of Calves Sold, lbs.	611	628	607	598	30	5%
Calf Sales Price / Cwt	$143.41	$145.46	$141.30	$143.56	$1.90	1%
Gross Income	**$913.87**	**$989.37**	**$897.03**	**$855.86**	**$133.51**	**16%**
Feed	$340.92	$281.46	$328.79	$412.98	-$131.52	-32%
Pasture	$150.27	$158.88	$150.69	$141.23	$17.65	12%
Interest	$140.99	$131.04	$140.03	$151.93	-$20.89	-14%
Vet Medicine / Drugs	$25.18	$23.47	$23.31	$28.82	-$5.35	-19%
Livestock Marketing / Breeding	$19.63	$13.26	$21.33	$24.23	-$10.97	-45%
Depreciation	$55.89	$37.67	$53.58	$76.49	-$38.82	-51%
Machinery	$93.53	$80.49	$86.93	$113.42	-$32.93	-29%
Labor	$160.58	$145.30	$155.25	$181.40	-$36.11	-20%
Other	$46.55	$36.18	$44.76	$58.76	-$22.58	-38%
Total Cost	**$1,033.52**	**$907.75**	**$1,004.67**	**$1,189.26**	**-$281.51**	**-24%**
Net Return to Management	**-$119.65**	**$81.62**	**-$107.64**	**-$333.40**	**$415.03**	

*Sorted by Net Returns over Total Costs per Cow

low-1/3 operations are $370.13 per cow (compared to $415.03 with total costs). High-profit operations now have the smallest number of cows in the herd when compared to mid- and low-profit operations. The differences are smaller than reported in table 1 and mid-profit operations are actually the largest. This is not necessarily unexpected given that fixed costs are excluded from the analysis (i.e., the benefit to spreading fixed costs over more cows is not a factor here). The operation size for the different groups is different between the two analyses (i.e., tables 1 and 2) because that the producers in each profit category are not the same in both tables. That is, a producer that receives a high return over variable costs does not guarantee that this same producer will have a high return over total costs. However, there is a strong correlation (r=0.90) between the producers' return over total costs and their return over variable costs. This high correlation suggests that producers that fare well with one measure tend to fare well with the other as well. For example, of the 26 high-profit operations in table 1, 20 were in the high-1/3 category in table 2. While the total difference between the high-1/3 and low-1/3 operations is less when only including variable costs, the conclusion reached earlier still holds. That is, there is more variability between producers at a point in time than there is on average for the industry across time.

Table 2. Beef Cow-Calf Enterprise Returns over Variable Costs, 2010-2014 (minimum of three years)*

		Profit Category			Difference between	
	All	High 1/3	Mid 1/3	Low 1/3	High 1/3 and Low 1/3	
	Farms	Head / $	Head / $	Head / $	Absolute	%
Number of Farms	79	26	27	26		
Labor allocated to livestock, %	29.0	29.8	29.5	27.8	2	7%
Number of Cows in Herd	140	128	149	142	-14	-10%
Number of Calves Sold	127	119	135	126	-7	-5%
Calves Sold per Cow in Herd	0.907	0.932	0.905	0.887	0.05	5%
Weight of Calves Sold, lbs.	611	634	606	593	41	7%
Calf Sales Price / Cwt	$143.41	$146.26	$142.45	$141.57	$4.69	3%
Gross Income	**$913.87**	**$1,038.39**	**$876.31**	**$828.36**	**$210.03**	**25%**
Feed	$340.92	$312.09	$327.15	$384.05	-$71.96	-19%
Pasture	$150.27	$150.02	$153.47	$147.20	$2.81	2%
Interest	$23.64	$13.61	$22.48	$34.88	-$21.27	-61%
Vet Medicine / Drugs	$25.18	$25.15	$19.95	$30.64	-$5.49	-18%
Livestock Marketing / Breeding	$19.63	$19.12	$12.84	$27.19	-$8.06	-30%
Machinery	$93.53	$81.83	$87.39	$111.61	-$29.78	-27%
Labor	$17.26	$13.07	$13.86	$24.98	-$11.91	-48%
Other	$46.55	$42.21	$40.99	$56.66	-$14.45	-25%
Total Variable Cost	**$716.98**	**$657.10**	**$678.14**	**$817.20**	**-$160.10**	**-20%**
Return over Variable Costs	**$196.89**	**$381.29**	**$198.17**	**$11.16**	**$370.13**	

*Sorted by Net Returns over Variable Costs per Cow

Given the large differences in returns across producers, a reasonable question is what are the factors that lead to these differences? Looking at the data in table 1, one can see that the cost differences represent a much larger portion of net return differences than differences in income. In fact, 67.8% of the average difference in net return to management between high- and low-profit farms is due to cost differences. The other 32.2% is due to differences in gross income per cow, which is primarily because the high-profit farms had heavier calves. This is not unexpected in a commodity market where producers are basically price takers, i.e., the ability to differentiate oneself financially from the average is typically done through cost management.

Relationships between key economic and productivity variables

Figures A1-A17 in Appendix A are scatter graphs showing the relationship between different sets of variables for all 79 operations (here the focus is on returns over total costs again; i.e., the data summarized in table 1). The high-, mid-, and low-profit operations are identified with different symbols in all figures (green circles are the top 1/3, blue squares are the middle 1/3, and red triangles are the

bottom 1/3). The correlation between the two variables is reported in the figure title.[6] Scatter plots and correlations are important as it can help give a general feel for what might be going on. However, it is important not to place too much weight on these results as they do not account for other factors that also might be impacting the results. The following is a brief discussion of the different figures.

Gross Income

As expected, profit and gross income are positively correlated (figure A1) indicating that operations generating greater income tend to be more profitable. However, with a correlation of 0.48, having a higher gross income does not guarantee a higher profit. This can also be seen where several of the bottom 1/3 operations had relatively high gross income. Likewise, some of the most profitable operations had low gross income levels. Remembering that gross income was a compilation of all income, it still stands to reason that it will be heavily influenced by price and weight. The data for gross income versus price and gross income versus weight are plotted in figures A2 and A3, respectively. While there is a positive relationship between price and gross income, the relationship is not particularly strong (r=0.37). On the other hand, there is a stronger positive relationship between gross income and average selling weight of calves (r=0.55). That is, producers selling more pounds tend to generate more income, but those getting higher prices may or may not actually have higher income. Thus, strictly from a gross income standpoint, this would suggest producers would be better off to focus on production (i.e., pounds sold per cow) than on price. However, it is also important to remember that the relationship between gross income and return over total costs (profit) was not particularly strong, and thus, there are likely even more important variables, such as cost variables, to focus management efforts on.

Total Costs

Figure A4 shows the relationship between profit and total costs. As one would expect, this relationship is negative (i.e., higher costs lead to lower profits, and the relationship is relatively strong; r=-0.64). This is consistent with what was shown in table 1 – the majority of the differences in returns are due to costs and not due to income. Given that cost management is so important, the next question is what drives differences in costs across operations? Figure A5 shows total costs versus total feed costs[7]. These costs have a strong positive correlation as would be expected (r=0.77). While total feed costs represent 47.5% of the total costs, it is clear that other costs are important as some of the top 1/3 operations have higher feed costs than some of the bottom 1/3 operations. As we would expect, operations that market calves at heavier weights have higher total feed costs per cow (r=0.42; figure A6). Figure A7 shows there is almost no relationship between total feed costs and the size of the cow herd (r=-0.01). One might expect the larger operations would have lower total feed costs per cow; however, this analysis would not show economies of size to be present related to cowherd feed costs. The data used in this analysis do not allow us to know exactly why there is no relationship between feed costs and size of cow herd. While larger operations likely receive volume discounts on the feed they do purchase, it is also likely they rely less on

[6] Correlation is defined as a measure of the strength of the relationship between two variables. In other words, it is a statistical measure of how well two variables move together and is bounded by -1.0 and 1.0. A value of -1.0 would indicate the two variables move together perfectly, but in opposite directions. A value of 1.0 indicates two variables move up and down together proportionately. Values close to zero indicate the two variables have little relationship to each other.

[7] Total feed costs include the value of all purchased feed and all raised feed, along with owned and rented pasture costs.

purchased feeds[8]. Figure A8 shows the very strong relationship between total feed costs and non-pasture feed costs (r=0.90). The producers that are able to control their non-pasture feed costs also have lower total costs, which is expected given 33% of the total costs are due to non-pasture feed costs. Figure A9 shows the negative relationship between non-pasture feed costs and pasture costs (r=-0.37). That is, as non-pasture feed costs go up (down), pasture costs go down (up). Figures A10 and A11 shows the relationship between total costs versus pasture costs and pasture costs versus total feed costs, respectively. Both of these relationships are quite weak (r=0.02 and r=0.08, respectively). With pasture costs representing a small percent of total costs and having a negative correlation with non-pasture costs, this suggests producers could be making "tradeoffs" between pasture and non-pasture feed costs.[9]

As would be expected, higher labor costs per cow, and higher depreciation and machinery[10] costs per cow, are associated with higher total costs per cow (figures A12 and A14). Furthermore, the relationship between depreciation and machinery costs and total costs is quite strong (similar to feed costs). Both labor and depreciation and machinery are negatively related to operation size (figures A13 and A15). That is, operations with larger cow herds tend to have lower costs per cow in both of these categories. The somewhat stronger negative relationship between operation size and depreciation and machinery costs and labor costs (compared to feed costs and operation size) is likely due to the "fixed cost" nature of depreciation and machinery and labor. That is, feed costs per cow are generally considered to be variable costs and thus will not vary as much with operation size, on a per cow basis, compared to costs which are more fixed on a whole-farm basis.

Figure A16 plots the total costs against the number of cows in the herd. Although the negative relationship suggests that economies of size exist (i.e., producers with larger operations tend to have lower costs per cow), several points should be made. First, there are only four herds in this analysis with over 300 cows so we cannot say much about the costs for very large operations. That is, while it appears that costs decrease, on average, as herd sizes increase from 50 to 250 cows, we cannot say what they might be for herds with 1000+ cows. Second, there is a tremendous amount of variability in costs for a given herd size. This suggests that simply being a "large" operation does not guarantee one of having low costs. For example, as seen in figure A16 there are smaller operations that compete quite well with larger operations. Figure A17 plots the percentage of labor allocated to livestock (measure of specialization) against total costs (r=-0.20). The negative relationship indicates that those producers that specialize in livestock (i.e., have a higher percent of their total farm labor allocated to livestock) tend to have lower costs, and hence, be more profitable compared to operations who have relatively more of their labor allocated to crops. While this relationship is not particularly strong, it does hint at the advantage to specializing.

[8] More study should be given to gain an understanding of this relationship.

[9] For more information concerning feed costs differences of cow-calf producers, see Pendell and Herbel (2015) – ***Feed Costs: Pasture vs. Non-pasture Costs: An Analysis of 2010-2014 Kansas Farm Management Association Cow-Calf Enterprise.*** Available at www.AgManager.info.

[10] Machinery costs include machinery repairs, gas, fuel and oil, auto expense and custom hire.

Characteristics Impacting Profit and Cost Differences

Figures A1 through A17, and table 1, provide some indication as to the factors impacting profit and costs; however, correlations only reflect relationships between two variables rather than accounting for multiple factors simultaneously. Additionally, while it is interesting to examine relationships such as gross income versus herd size, it is more important to think about causal relationships. That is, what characteristics of an operation lead to it being more profitable? Accordingly, the following equation was statistically estimated using multiple regression to identify factors affecting profit differences between operations:

$$Profit_i = A_0 + A_1 * Cows_i + A_2 * Cows_i^2 + A_3 * Weight_i + A_4 * Wean\%_i + A_5 * Price_i + A_6 * Feed\%_i + A_7 * Labor\%_i + A_8 * Year_i, \quad (1)$$

where *Profit* is the profit (return over total costs) per cow, *Cows* is the number of cows in the herd (head), *Cows*^{2} is the number of cows squared, *Weight* is the average weight produced (lbs. per cow), *Wean%* reflects weaning percentage (calves sold per cow in herd), *Price* is the average selling price ($ per cwt.), *Feed%* is the percentage of total costs represented as total feed costs (%), *Labor* is the percentage of total farm labor allocated to livestock (%), *Year* is the average of the years included in the multi-year average,[11] *i* is an index for individual operations, and A_0 through A_8 are parameters to be estimated. All variables are multi-year averages based on the number of years of data each operation had over the 2010-2014 period. It is expected that the coefficients on *Cows* and *Cows*^{2} will be positive and negative, respectively, as the profit will increase as the herd size increases, but at a decreasing rate. *Weight* and *Price* are expected to be positive, as well. *Feed%* will be positive because operations that have total feed costs as a high percent of total costs are doing a good job of minimizing non-feed costs and thus are expected to have higher profits. Based on data in figure A17, it is expected that the coefficient on *Labor%* will be positive. *Year* is included to account for the different time periods included in the multi-year averages between the operations.

Similar to equation (1), the following equation was estimated to identify factors leading to cost differences between operations:

$$Cost_i = B_0 + B_1 * Cows_i + B_2 * Cows_i^2 + B_3 * Weight_i + B_4 * Wean\%_i + B_5 * Feed\%_i + B_6 * Labor\%_i + B_7 * Year_i, \quad (2)$$

where *Cost* is the multi-year average total cost per cow, the other variables are as previously defined, and B_0 to B_7 are parameters to be estimated. *Price* is not included in equation (2) because there is no reason to expect that price received for cattle would have any impact on costs per cow.

[11] *Year* is calculated as follows: 2010=10, 2011=11,…, and 2014=14. Next, an average of the years an operation conducts an enterprise analysis is calculated. *Year* is bounded by 11.0 (3-year average including years 2010, 2011, and 2012) and 13.0 (3-year average including years 2012, 2013, and 2014). If a producer had data for all five years, the *Years* variable would take on a value of 12.0 (average of 2010, 2011, 2012, 2013, and 2014). The average value of *Years* across all 79 operations was 11.86.

Table 3 reports the results of estimating equations (1) and (2). In the profit model, equation (1), coefficients on *Cows*, *Cows*^{2}, and *Year* were statistically significant. The coefficients on *Weight*, *Wean%*, *Feed%*, and *Labor%* were all positive as expected, but were not statistically significant. The *Price* coefficient was negative, but was not statistically significant. The coefficients on *Cows* and *Cows*^{2} suggest that profit increases at a decreasing rate as herd size increases up to 547 cows at which point profit begins to decrease. That is, there is a benefit for operations to increase in herd size, but this advantage diminishes as operations get larger. *Year* was significant and positive suggesting that an operation with more years later in the sample period had higher profits when compared to those operations with data in the earlier years, all else equal. For example, an operation with data from 2012, 2013, and 2014 (*Year*=13) would have been $145.24 more profitable than an operation with data from 2011, 2012, and 2013 (*Year*=12) and $290.48 more profitable than an operation with data from 2010, 2011, and 2012 (*Year*=11). Using the regression coefficient for *Year*, the difference between the high- and low-profit farms is a profit of $27.47 per head. Thus, the general conclusions from tables 1 and table 2 would not change. The R-square value for equation (1) was 0.209 implying that roughly 21% of the variation in the dependent variable (profit per cow) was explained by variability in the independent variables included in the model.

Table 3 also lists regression output from the cost model (equation (2)). Although the statistically significant number of variables is the same in the cost model as in the profit model, only the *Year* variable is significant in both models. The coefficient on *Weight* was positive and significant suggesting producers selling heavier cattle have higher costs. This is makes sense given that heavier weight calves likely come from larger cows that require more feed per head or the heavier weight was the result of supplemental feed. For every one-pound increase in the average selling weight, total costs per cow increase by $0.86. The coefficient on *Feed%* is negative suggesting that producers who do a good job managing non-feed costs have lower total costs and hence will be more profitable. For every 1% increase in *Feed%*, total costs decreased $6.26 per cow, all else equal. Similarly, the coefficient on *Labor%* was negative and significant indicating that producers who specialize more on livestock production, relative to crop production, tend to have lower costs per cow. The R-square value for equation (2) was 0.199 implying that roughly 20% of the variation in the dependent variable (cost per cow) was explained by variability in the independent variables included in the model.

Table 3. Regression Results for Profit and Cost Models (Equations (1) and (2))

	Profit ($/cow)		*Cost ($/cow)*	
Variable	Coefficient	p-value*	Coefficient	p-value*
Intercept	-2,518.345	0.000	16.668	0.979
Cows	1.093	0.052	-0.057	0.910
Cows^2	-0.001	0.087	0.000	0.878
Weight	0.170	0.705	0.859	0.015
Wean%	3.464	0.368	-0.759	0.833
Price	-0.934	0.715	n/a	n/a
Feed%	5.283	0.158	-6.256	0.075
Labor%	1.120	0.441	-2.789	0.042
Years	145.244	0.037	80.244	0.049
R-square**	0.209		0.199	

*p-values associated with hypothesis test that coefficient is significantly different from zero. A value of 0.05 would imply we are 95% confident that value is significantly different from zero (0.01 implies 99% confidence, and so on).

**R-square represents the proportion of variability in the dependent variable (*Profit* and *Cost)* that is explained by variation in the independent variables.

Summary

There are some significant conclusions to be drawn from the information in this paper. The economic returns to beef cow-calf producers vary significantly over time due to a number of factors, including the cattle cycle. For example, over the last 40 years there has between $218 to $227 difference in returns per cow, depending on how returns are calculated, between the good (top 1/3) and the bad (bottom 1/3) years. This is a significant amount of variability, but unfortunately this risk is difficult to manage because much of it is due to macro-economic factors and conditions that are typically beyond the control of individual producers. However, what is much more important is that the variability across producers at a point in time is much larger than the variability over time. In other words, even in the “good years” some producers are losing money and even in the “bad years” some producers are making money. This is important because it indicates there are management changes producers can make to seek to improve their operations.

This analysis suggests that while both production (weight) and price do impact profit, they are much less important in explaining differences between producers than costs. In the data analyzed here, economies of size exist such that larger operations tend to have lower costs and hence are more profitable than

smaller operations. However, it is important to point out that being a large operator does not guarantee low costs and high profits, as a number of mid-sized to smaller operations were competitive. Operations that specialized in the cowherd enterprise, relative to crop enterprises, based on their labor allocation, tended to have lower costs and be slightly more profitable. The factor that is extremely important regarding profit and cost differences between producers is how well they manage their non-feed costs. Producers that had a high percentage of their total costs as feed (i.e., a low percentage as non-feed) had significantly lower costs and hence significantly higher profits. One of the ways to manage these non-feed costs is operation size, as larger operations tended to have lower costs per cow for labor and especially for machinery operating costs and depreciation.

As the data reported here clearly show, there is tremendous variability across producers, which means there is room for producers to improve their relative situations. However, before one can improve they need to know where they stand relative to other producers. Thus, benchmarking and identifying an operation's strengths and weaknesses is the first step to deciding where to focus management efforts. Because total feed costs (i.e., pasture and non-pasture feed costs) represent the single largest cost category for cow-calf producers, it is important for producers to identify how they compare with other producers regarding this critical cost. This paper focused on profitability differences without getting into details of total feed cost differences across producers. For those individuals that are interested in learning more about the total feed cost differences, please see ***Feed Costs: Pasture vs. Non-pasture Costs: An Analysis of 2010-2014 Kansas Farm Management Association Cow-Calf Enterprise,*** which is available at www.AgManager.info.

Appendix A. Scatter Plots of Various Variables for 79 Beef Cow-Calf Operations.

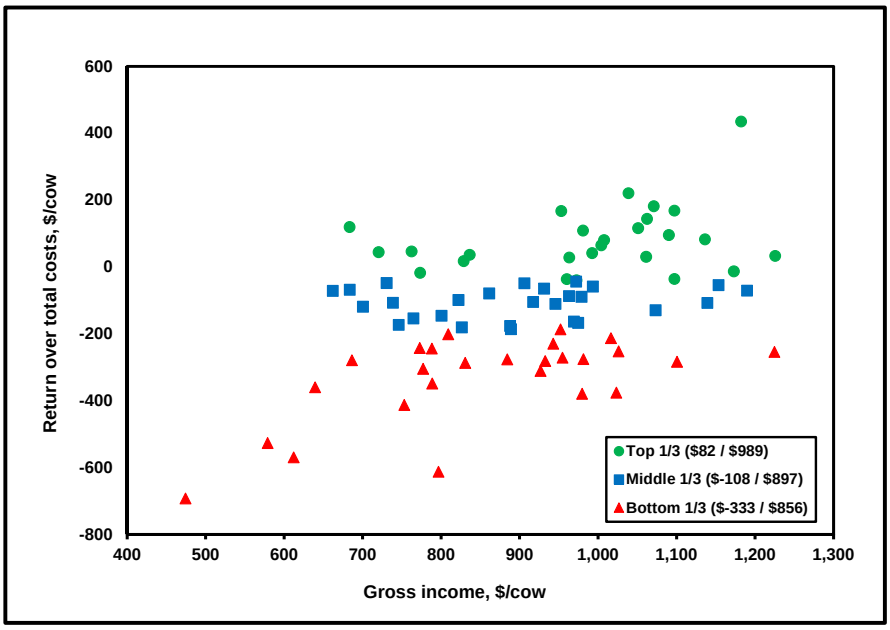

Figure A1. Profit versus Gross Income (correlation = 0.48)

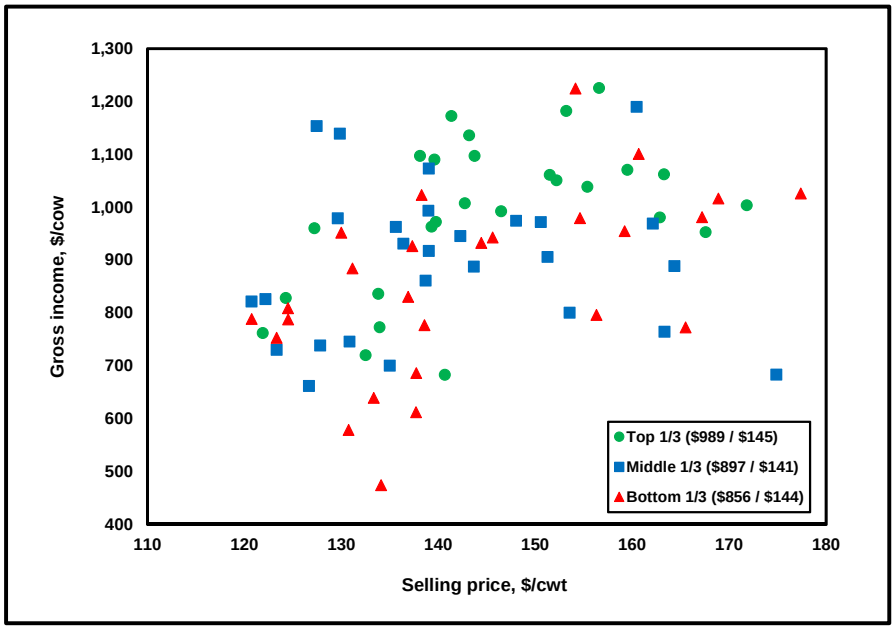

Figure A2. Gross Income versus Selling Price (correlation = 0.37)

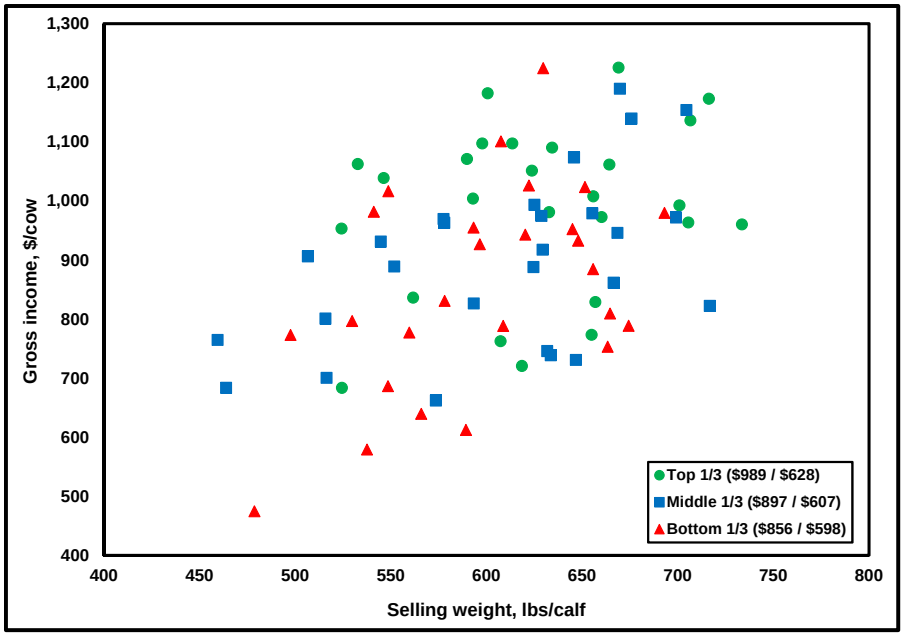

Figure A3. Gross Income versus Calf Selling Weight (correlation = 0.55)

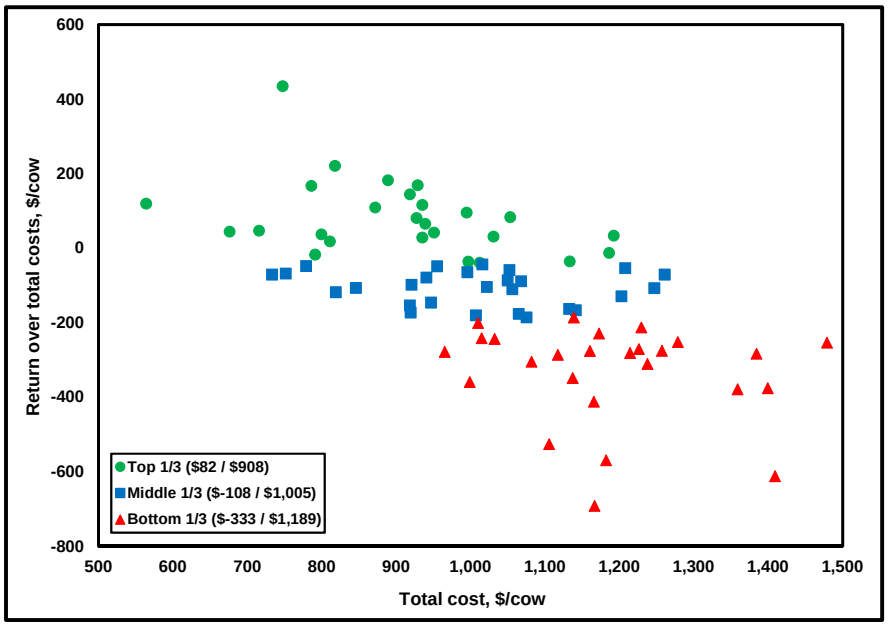

Figure A4. Profit versus Total Cost (correlation = -0.64)

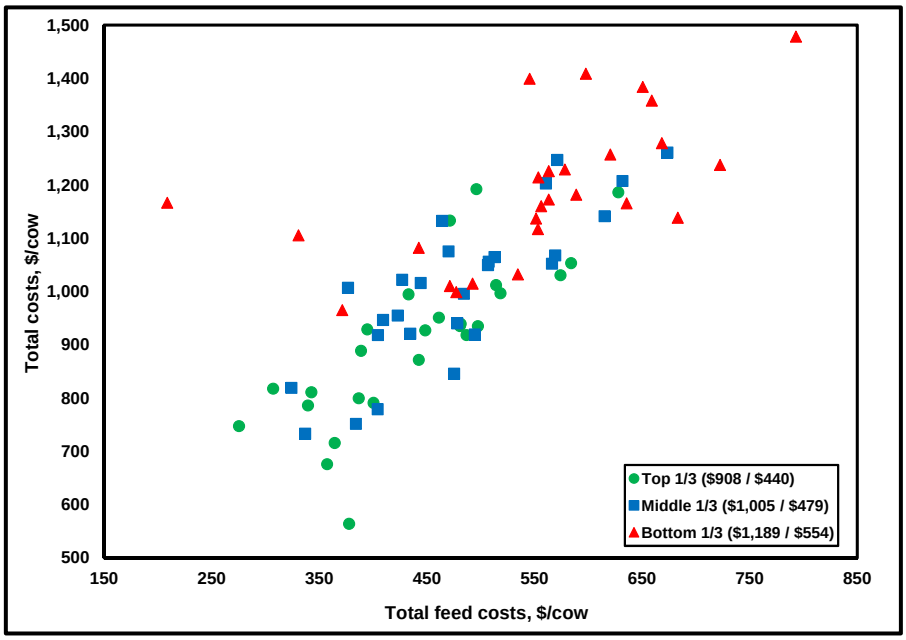

Figure A5. Total Cost versus Total Feed Cost (correlation = 0.77)

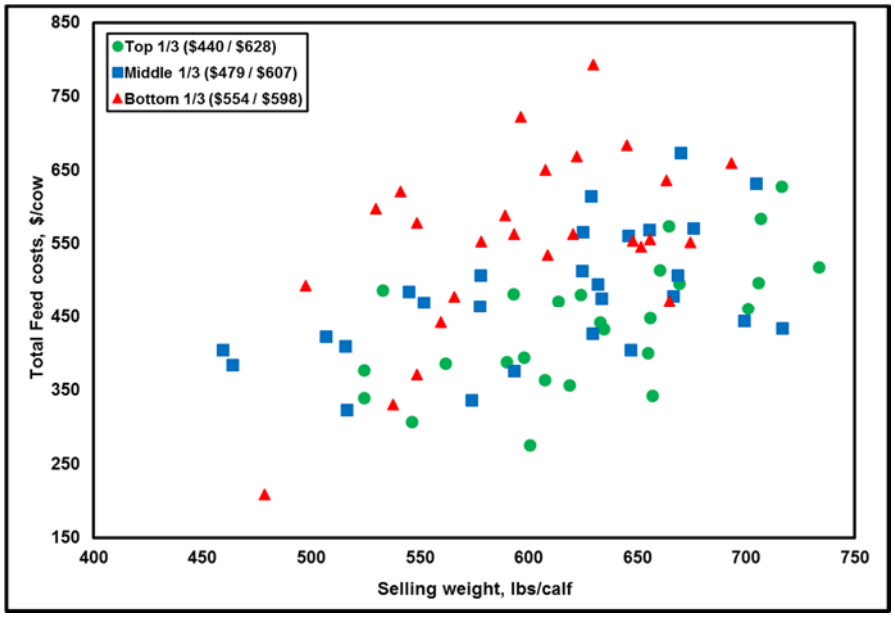

Figure A6. Total Feed Cost versus Calf Selling Weight (correlation = 0.42)

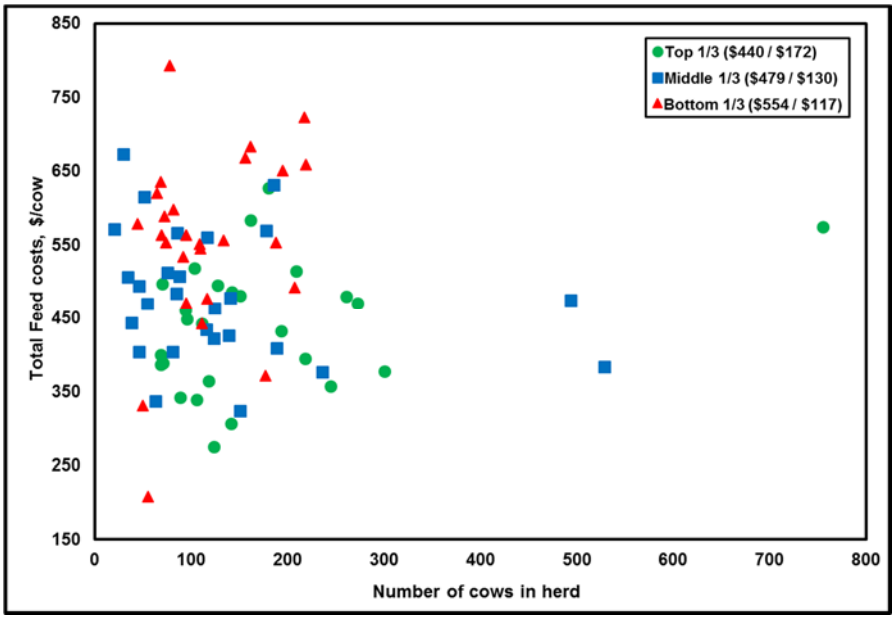

Figure A7. Total Feed Cost versus Size of Cow Herd (correlation = -0.01)

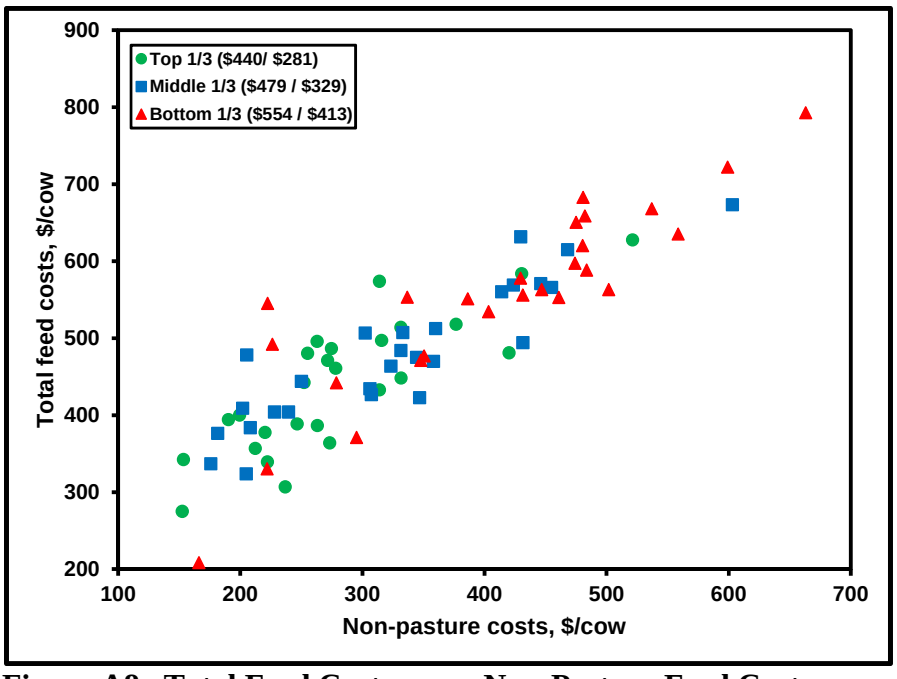

Figure A8. Total Feed Cost versus Non-Pasture Feed Cost (correlation = 0.90)

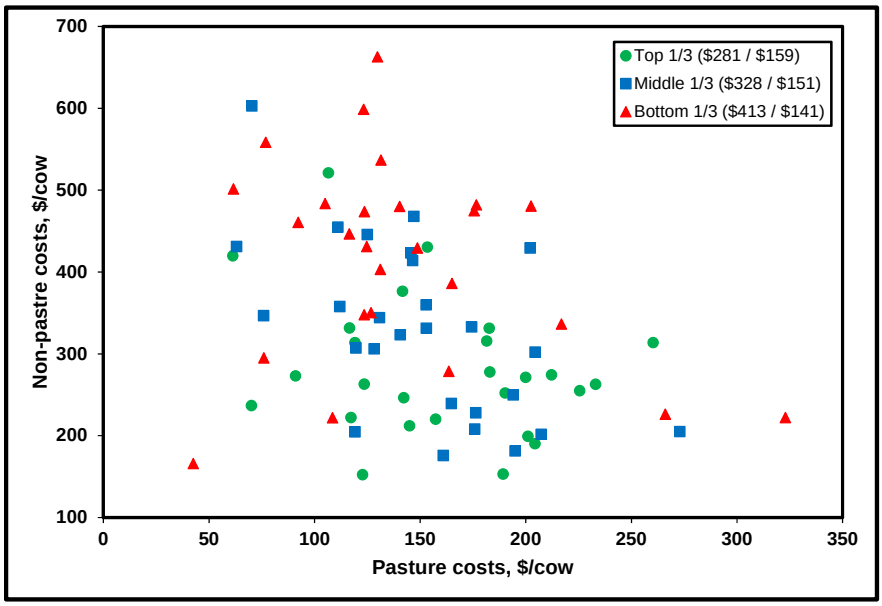

Figure A9. Non-Pasture Feed Cost versus Pasture Cost (correlation = -0.37)

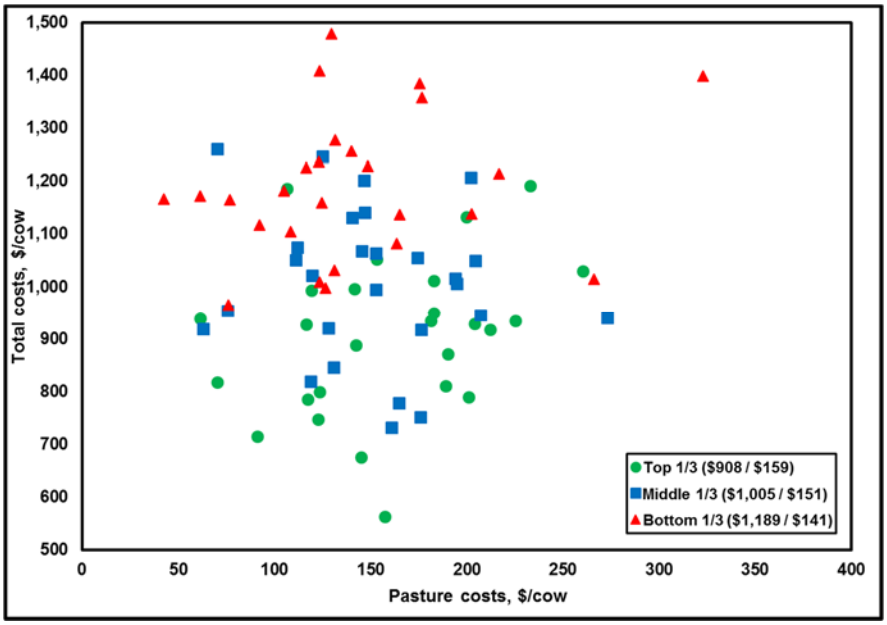

Figure A10. Total Cost vs. Pasture Cost (correlation = 0.02)

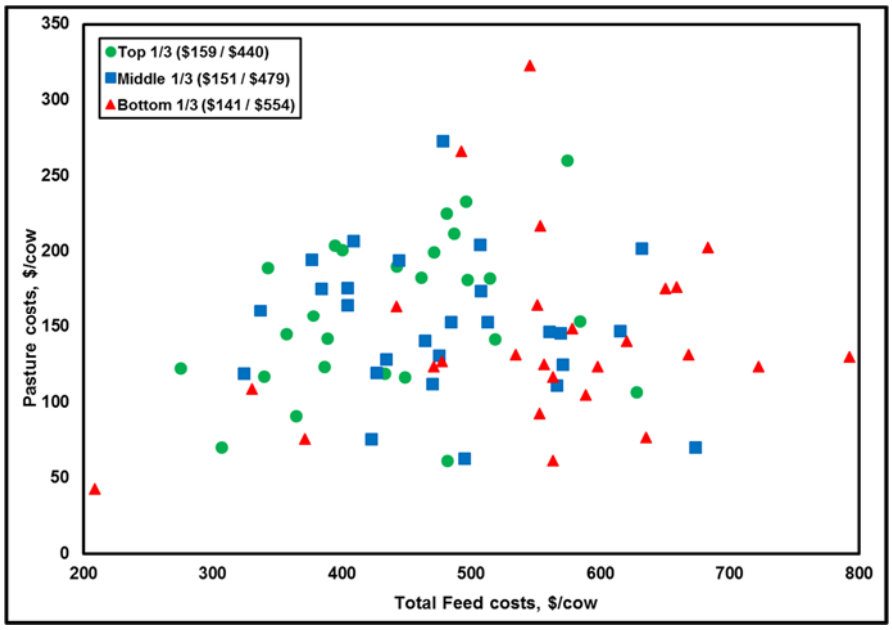

Figure A11. Pasture Cost vs. Total Feed Cost (correlation 0.08)

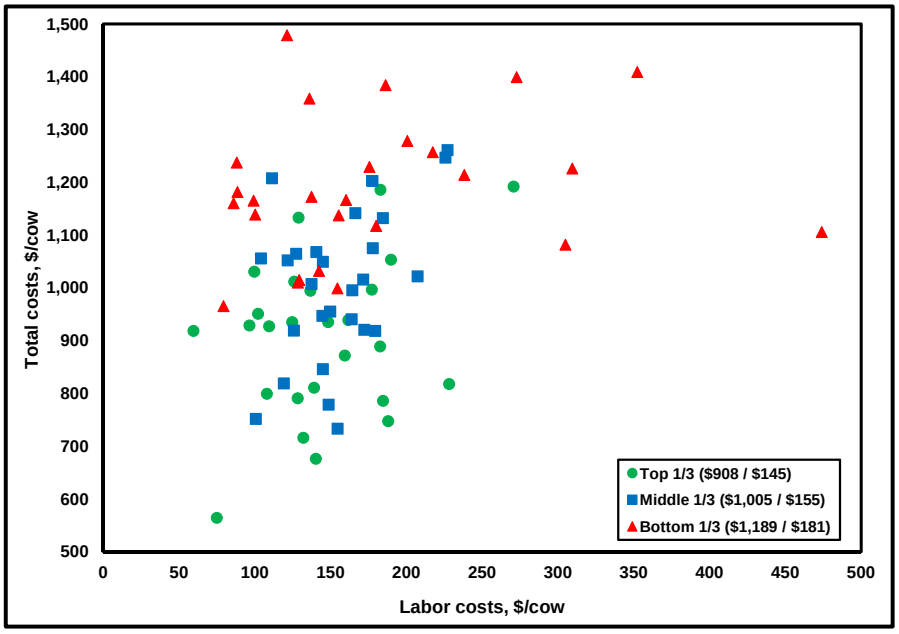

Figure A12. Total Cost versus Labor Cost (correlation = 0.33)

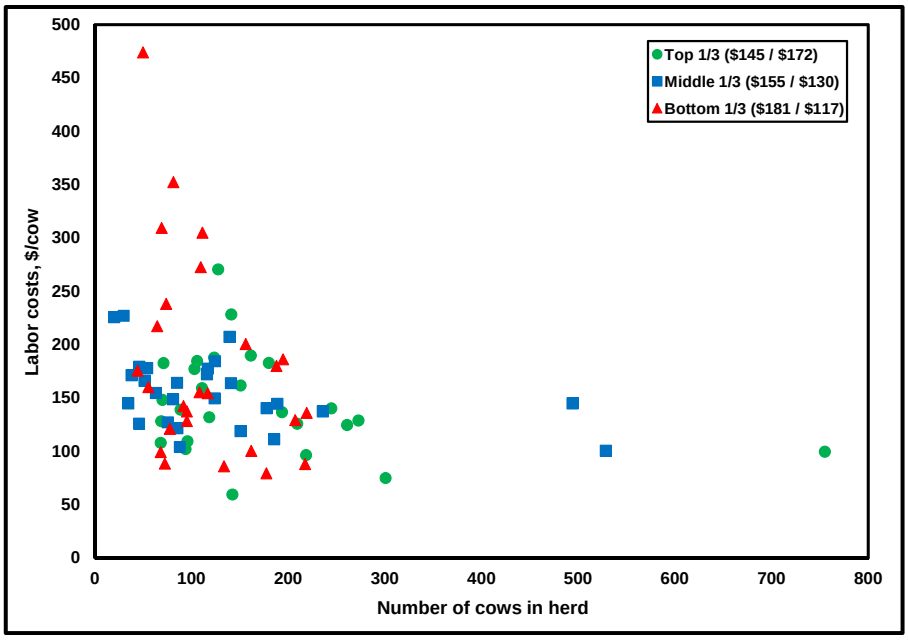

Figure A13. Labor Cost versus Size of Cow Herd (correlation = -0.29)

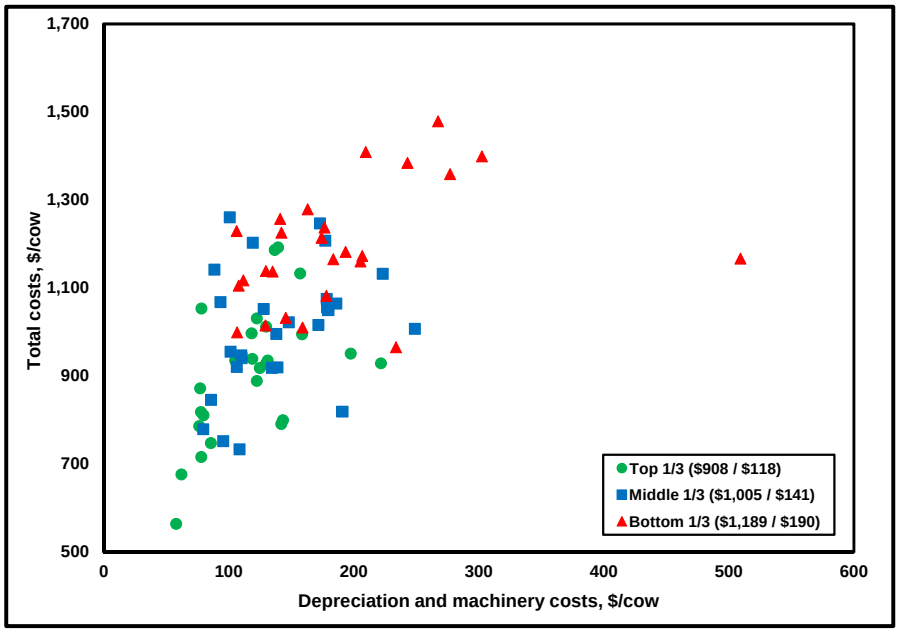

Figure A14. Total Cost versus Depreciation and Machinery Costs (correlation = 0.54)

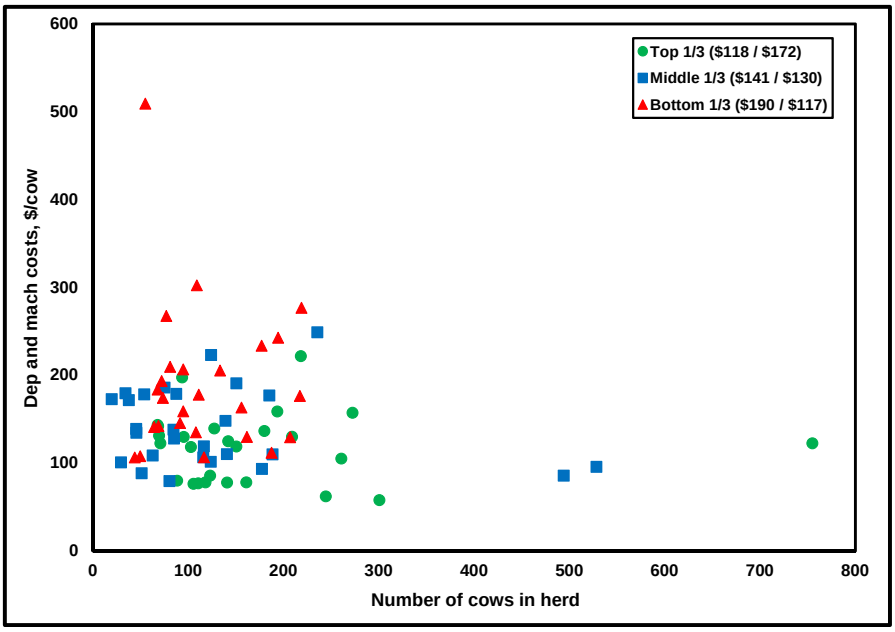

Figure A15. Depreciation and Machinery Costs versus Size of Cow Herd (correlation = -0.15)

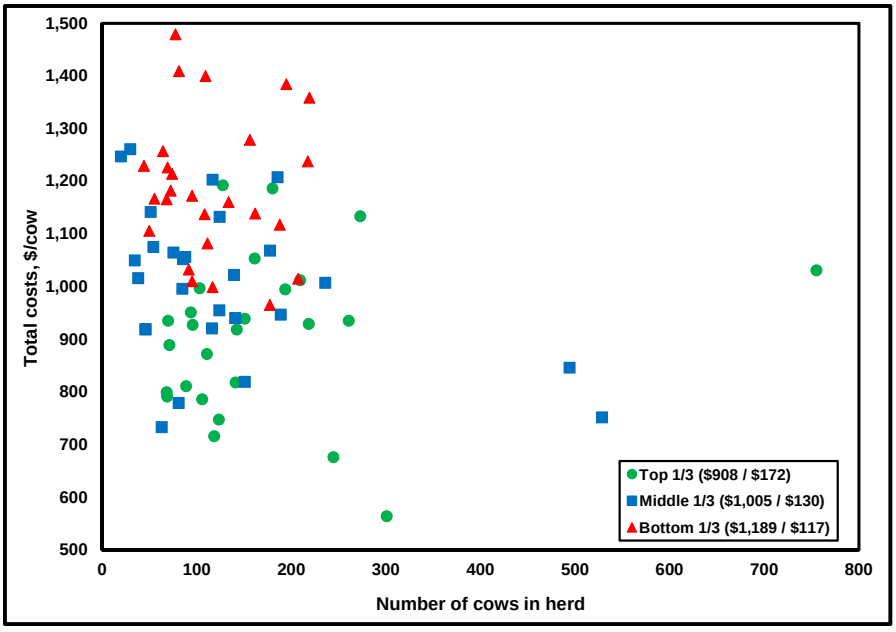

Figure A16. Total Cost versus Size of Cow Herd (correlation = -0.19)

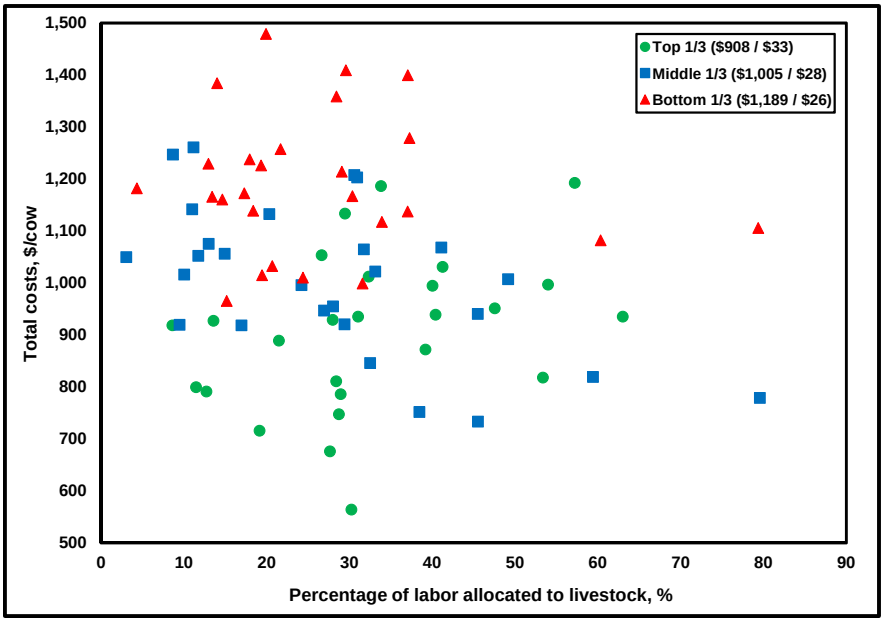

Figure A17. Total Cost versus Labor Allocated to Livestock (correlation = -0.20)