



Factors Impacting Dairy Profitability: An Analysis of Kansas Farm Management Association Dairy Enterprise Data

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EXECUTIVE SUMMARY

Net income per cow or per cwt of milk produced is a key measure for determining how successful a dairy operation has been historically as well as an indicator of the financial success the dairy might have in the future. What causes net returns to vary from year to year at the industry level, and more importantly, returns to vary between operations is important information for dairy producers to identify so they can make good management decisions. For example, do direct economic factors like milk price received, feed cost, labor, and other costs have a greater effect on net return variability or is it indirect factors like milk production or size of herd?

To determine which factors have a greater impact on net returns for dairy producers in Kansas, historical returns were analyzed two different ways. The first approach (*Analysis 1*) was performed at a broad level examining annual average Kansas Farm Management Association (KFMA) Dairy Enterprise Analysis data from the 22-year period 1989 to 2010. This analysis focused on which economic factors have the greatest impact on average dairy industry profit over time. Returns over both variable and total costs were examined and their correlations with milk price, variable cost, total cost, and year were evaluated. For the 22-year period, producers covered variable costs every year except in 2009 (average return of \$2.55/cwt over variable cost, ranging from -\$0.19 to \$4.66). However, consistently covering fixed costs was more difficult as returns over total costs were negative in 13 of the 22 years (average return of -\$0.28/cwt over total cost, range of -\$3.96 to \$1.79). If the 22 years were split into thirds based on returns over total cost, the top third of the years had an average return over total costs of \$206 per cow compared to a loss of \$334 per cow for the worst third of the years. Thus, there was a difference in returns over total costs of \$539 per cow between the “best 1/3 years” and the “worst 1/3 years” over this time period. On a per cwt of milk produced basis, returns over total costs averaged \$1.06 in the top 1/3 years compared to -\$1.62 for the worst 1/3 years for a difference of \$2.68/cwt.

A second approach to analyzing historical returns (*Analysis 2*) was to look at variability in returns across producers at a point in time as opposed to average returns over time. In this

analysis, average returns for individual producers participating in the KFMA Dairy Enterprise Analysis over the past six years were evaluated to quantify relationships between revenue, production, and cost factors among groups of high-, medium-, and low-profit dairy operations. When evaluated at the farm level, high-profit operations had average returns of \$1,094 per cow more than the low-profit operations (\$172/cow versus -\$922/cow). High-profit producers had slightly larger operations, lower total costs per cow (\$194), and received slightly higher milk prices (\$0.21/cwt) compared with low-profit producers. However, a more important factor in explaining profitability differences was that the high-profit group produced significantly more milk per cow (4,307 lbs/cow) than the low-profit group.

The year-to-year volatility in milk prices has increased significantly in the past decade, however, the correlation between profitability and milk price over time is not particularly strong because of the influence costs have on profit as well. When analyzing why some producers are more profitable than others, milk production is a much stronger indicator of profit differences than is price or cost. Furthermore, the differences in profitability between producers at a point in time are much greater than the difference in average profits across time. Thus, while macroeconomic factors impacting overall profitability in the dairy industry are important, producers' individual management skills are more important for long-term business survival. In looking at the results presented here, it is important to recognize the analysis was conducted with data reported by small- to midsize-dairy herds. Further research should examine whether these results hold true for larger herds.

INTRODUCTION

Profitability within the dairy industry has been in the spotlight much more in recent years than historically because of the tremendous volatility faced by the industry. Variability of profit stems from extreme volatility in the commodity markets that greatly affects not only income from milk sales but also feed costs, which represent a large percentage of total expenses. Recently, many producers have focused on marketing milk and procuring feed to create set prices received and paid. In addition, because of the decline in the milk price during 2009, some producers cut feed costs to make up for loss in milk income while others focused on improving production to generate more revenue. In spite of these efforts, dairy operations experienced their worst financial year on record in 2009. While conditions improved somewhat in 2010, the compounding effect of the last several years has created significant financial stress for a number

of dairy operations. This financial stress increases the need and importance of benchmarking ones operation to know what impacts profits. More importantly, it is critical for producers to identify how their operations compare relative to others in the industry so they can address potential weaknesses and capitalize on strengths.

Dairy farmers exercise different management approaches to increase profit including: (1) minimizing costs to increase profit, (2) minimizing assets per production unit to reduce fixed costs, (3) marketing milk to receive the best milk price possible to increase revenue, and (4) increasing production to maximize revenue and profit. While managers might strive to balance asset utilization, reduce costs, maximize production, and milk marketing to increase net income, it is difficult to optimize each of these factors given limited management time and resources. Thus, it is important managers identify where they should best spend their limited management time.

The objective of this study was to determine which factors (e.g., receiving a higher milk price, reducing cost, or increasing milk production) a small to midsize dairy enterprise should focus on to increase net income by evaluating data for producers on average across time and between producers at a point in time.

METHODS

Analysis 1 -- Producer Average Returns over Time

Kansas Farm Management Association (KFMA) Dairy Enterprise Analysis data were taken from the years 1989-2010; where each year represented the average of all producers participating in the enterprise analysis for that respective year. Data evaluated for each year included farm demographics (i.e., herd size, milk production), revenue, and cost factors. Over the 22-year period, the average number of producers enrolled per year was 64 with a range of 33 to 113. Average farm size for the producers in this data set is on the smaller side with an average of 104 cows and a range of 85 to 131 cows. Milk production was calculated per cow per day by dividing the total pounds of milk per farm by the average number of cows and then by 305 days in a typical lactation cycle. Average milk production was 64.5 pounds of milk per cow per day with a range of 57.4 to 71.5 pounds. Both average herd size and milk production per cow have been trending up over time (figure 1) and thus averages over the 22-year period have little meaning for benchmarking current operations.

All farm-level revenue and cost information was normalized by converting it to both per cow and per hundredweight (cwt) of milk produced bases. Returns over both variable and total costs were compared with milk price received, variable costs, and total costs to determine which of these economic factors were the most important in explaining variability in returns over time for Kansas dairy producers. Additionally, returns over variable and total costs for the 22-year time period were sorted into thirds as a measure of how much returns vary over time for “good years” versus “bad years” (i.e., top 1/3 year versus bottom 1/3 years).

Analysis 2 -- Individual Producer Returns at a Point in Time

Thirty eight dairy farms from the KFMA database were selected on the basis of their participation in the Dairy Enterprise Analysis during the past six years (2005 to 2010). To be included in the analysis, a farm must have reported data a minimum of four of the six years. The average number of years farms reported data was 5.2 years (9 farms had 4 years, 12 had 5 years, and 17 had 6 years). The farms were sorted from high to low based on average returns over total costs (i.e., profit) and then separated into top-, middle-, and bottom-third categories (13, 12, and 13 farms, respectively). The multi-year, multi-farm average number of cows per farm was 114 (range of 36 to 278 cows). The various cost categories were aggregated into nine groups, and revenue was grouped into milk sales, net cattle sales, and other income. Other factors evaluated included milk production, culling rate, milk price per hundredweight of milk (\$/cwt), and income over feed cost.

A question often arises within the dairy industry regarding whether data should be analyzed on a per-cow or per-cwt basis. Each method has its advantages and merits for benchmarking and thus results are reported both ways in most cases. The 38 farms were ranked from 1 to 38 (1 = highest profit, 38 = lowest profit) on the basis of both profit per cow and profit per cwt. Figure 2 plots per-cow rankings on the vertical axis against per-cwt rankings on the horizontal axis. Most of the farms fall very close to the 45-degree line, indicating the rankings are quite similar (points falling on the line represent farms with the same ranking for each measure). On the basis of the output for these 38 farms, the ranking of net returns over total cost is closely correlated for both outcomes (profit per cow vs. profit per cwt). Thus, analyzing either measure is sufficient in terms of identifying successful operations. To avoid a lot of repetition, most discussion below pertains to the results on a per cow basis.

The farms were analyzed by calculating an average of each revenue, cost, or other factor category by farm from its years of available data. On the basis of this multi-year farm average, each farm was placed in the top-, middle-, or low-profit group. Once profitability groups were formed, multi-farm averages of the group data were calculated for each category. The group averages of the various farm characteristics (e.g., farm size, milk production, milk price, income, and costs) were compared for all three profitability groups. Differences between the high- and low-profit groups are reported as both absolute and percentage differences. As an additional analysis, regression models were estimated to quantify relationships that existed among farm characteristics (independent variables) and profit and cost (dependent variables). Independent variables included were herd size, milk production (pounds per cow per day), milk price (profit regression only), cull rate, feed as a percentage of total cost, percentage of farm labor allocated to livestock, and years included in the multi-year average.

DISCUSSION

Analysis 1 -- Producer Average Returns over Time

The variability in milk prices has been much higher in the last 10 years than it was in the previous 10 years (figure 3). On average producers received \$14.24 per hundredweight (cwt) for their milk (milk receipts plus patronage refunds); annual average price received ranged from \$11.82 to \$19.71 for the 22-year period from 1989 to 2010. This highly variable milk price impacts gross revenue generated per cow and hence returns over costs.

Figures 4 and 5 show total variable cost, total cost, and gross income per hundredweight (cwt) of milk produced and per cow, respectively. Cost per cwt of production was relatively stable for much of the time period, but increased significantly in 2007 and has remained high since (figure 4). Over the 22-year period, variable costs averaged \$13.25/cwt (ranged from \$11.55 to \$17.96) and total costs averaged \$16.08/cwt (ranged from \$14.00 to \$22.02). On the other hand, costs of production per cow increased at a relatively steady rate from 1989 until 2006 and then increased significantly in 2007 and have remained high since (figure 5). Variable costs per cow averaged \$2,618 (range of \$2,070 to \$3,677) and total costs averaged \$3,178/cow (range of \$2,500 to \$4,509). From 1989 through 2006 costs per cow were increasing steadily, but costs per cwt were relatively stable because of increasing production over this time period (figure 1). However, the increases in per cow costs in 2007 through 2010 were much larger than any production increases and thus costs per cwt also increased significantly in those years. The

variable cost per cwt of milk averaged \$12.42 for the first 18 years of this time period (1980-2006) and ranged from a low of \$11.55 in 2000 to a high of \$13.61 in 2006. In the last four years (2007-2010) variable costs per cwt have ranged from \$15.75 to \$17.96 and averaged \$16.97. Thus, while producers were able to “buffer” the effect of increasing costs per cow through higher production for much of this time period, that has not been the case in recent years.

In addition to variable and total costs, the annual average gross income is also shown on figures 4 and 5. At first glance, it is clear that gross income and costs tend to move in the same direction (i.e., income was also high in 2007 and 2008 when costs were high). However, upon closer examination, it can be seen that the relationship between income and costs in any particular year is not all that strong, which leads to large swings in net returns (profitability) from year to year. The extreme case is 2009 where costs remained at very high levels and gross returns dropped significantly from 2008 levels leading to the worst financial year on record for dairies participating in the KFMA enterprise analysis.

Because costs are relatively constant from year to year, but milk prices display considerable variability, there is great variability in net returns received by dairy producers. Figure 6 shows returns over variable costs both per cow and per cwt of milk produced. Variability of returns over variable cost on a whole farm basis can be due to many factors like milk price received and variable input costs. Larger components of variable cost are feed purchased, marketing and breeding, hired labor, interest, machinery, and utilities. The average return over variable costs per cow (cwt) was \$500 (\$2.55) and ranged from -\$39 to \$963 (-\$0.19 to \$4.66). Gross income was sufficient to cover variable costs every year over this 22-year period with the exception of 2009.

Figure 7 shows returns over total costs both per cow and per cwt of milk produced. Variability of returns over total cost on a whole farm basis can be due to many factors like milk price received, variable cost, and fixed costs. Total costs include variable costs as well as returns to unpaid operator labor, depreciation, real estate tax, and interest charge. The average return over total costs averaged -\$61/cow (-\$0.28/cwt) and ranged from -\$818 to \$371 (-\$3.96 to \$1.79). Gross income was sufficient to cover total costs only nine of the 22 years. Unpaid operator labor is charged an opportunity cost in this analysis; therefore, if the operator does not take account of this opportunity cost, their individual cash return will be greater than reported. With a range of \$1,188 per cow in returns over total cost (-\$818 to \$371) across the 22-year

period, it is evident that producers must be able to accumulate equity in the good years to survive the bad years for their business to survive in the long run.

When the 22-year returns are sorted from high to low and separated into thirds (high-third years, middle-third years, and low-third years), the average returns per cow over variable costs are \$769, \$460, and \$270, respectively. Comparable values per cwt of milk produced are \$3.89, \$2.40, and \$1.36. The average returns over total costs are \$206, -\$54, and -\$334 per cow, respectively (\$1.06, -\$0.29, and -\$1.62 per cwt). On average there is a \$539 per cow (\$2.68/cwt) difference in returns over total costs between the “good” and “bad” years. Table 1 reports the correlations between the various profitability measures (i.e., returns over variable cost (VC) and total cost (TC) per cow and per cwt) with milk price, variable and total costs, and year. The correlation is a statistical measure of how 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, while a value of 1.0 indicates the two variables move up and down together proportionally. Values close to zero indicate the two variables have little relationship to each other. Most of the correlations are relatively low suggesting variability in returns is affected by multiple factors as opposed to one key driver. Milk price and returns over variable cost are correlated at 0.45 (per cow) and 0.39 (per cwt) suggesting a positive but weak relationship (i.e., higher milk prices are associated with higher returns over variable costs). This positive correlation is what would be expected and is supportive of why many producers feel they need to spend more management time devoted to marketing. However, there is essentially no correlation between milk price and returns over total costs per cow or per cwt of milk produced. The correlation between returns and year simply is an indication of returns have been trending up (positive correlation) or down (negative correlation) over time. There is a very weak negative correlation over with returns over variable costs suggesting little to no trend over time. However, the correlation between total costs and year was higher and negative indicating that producers are increasingly having a more difficult time covering total costs over time. While it is important to not place too much emphasis on this simple correlation analysis, it does provide some insight into broader industry issues.

Analysis 2 -- Individual Producer Returns at a Point in Time

Table 2a reports farm information, income, and cost data for the three profitability groups (high, medium, and low) where returns are analyzed per cow (similar information are reported in

Table 2b where returns are analyzed per cwt of milk produced). Farms in the high-profit group had larger herds than the medium- and low-profit farms. Culling rate, defined as cows purchased divided by herd size, was similar for high- and low-profit farms but considerably higher for the medium-profit farms. Pounds of milk produced per cow was the most significant independent factor affecting profit, with a total difference between the top and bottom profitability groups of 23% (4,307 lb per cow). Milk price was similar for all three groups with the medium-profit farms averaging the highest price (\$16.39/cwt) and the low-profit farms having the lowest average price (\$16.15/cwt). Given the greater milk production and comparable price, the high-profit farms generated \$776 per cow more income from milk sales. As profitability increased, net cattle sales increased because of greater culling rates or because cows sold had greater value as a result of increased production or genetics. Given that culling rates were similar, greater net cattle sales for the high-profit farms were likely the result of cows in the high-profit group being sold for greater value than those in the low-profit group. Other income was a fairly minor category, and no major differences existed among the three profitability groups. When all categories were included, the high-profit farms averaged \$899 more income per cow than the low-profit farms and \$629 more per cow than the medium-profit farms.

A comparison of per cow cost categories among the different profitability groups showed that high-profit farms had greater costs in some categories and lower costs in others, and they had a slightly lower total cost per cow (Table 2a). High-profit farms spent about \$90 per cow more on feed costs, which, given the large difference in milk production, clearly indicates a considerably smaller feed cost per cwt of milk (see Table 2b). Labor costs per cow were about \$210 lower for the high-profit farms, which is likely due to high-profit farms being larger and therefore relying on more hired labor (i.e., operator labor makes up a smaller percentage of total labor). When aggregated, veterinary, dairy supplies, and marketing/breeding costs were about \$90 per cow greater for the high-profit farms compared with the low-profit farms. Machinery and utilities/fuel were lower for the high-profit farms (\$43 and \$54, respectively), which likely is a result of spreading costs over more cows (i.e., economies of size). The high-profit farms averaged \$194 per cow lower cost and when coupled with the significantly greater income (\$899) resulted in a difference in net returns of almost \$1,100 per cow. High-profit farms had higher costs than the medium profit farms (\$3,948 compared to \$3,790) but because of their higher income they had a \$472 per cow advantage in net returns over medium-profit farms. While a number of factors contribute to the differences between high-profit farms and medium-

and low-profit farms, much of the differences are the result of high-profit farms producing more milk while holding costs constant.

To independently evaluate the effects of various farm characteristics on economic variables, two regression models were estimated: one focused on profit and one on total costs. As was the case with data reported by thirds (i.e., Tables 2a and 2b), regression models were estimated using both per cow and per cwt of milk produced with results reported in Table 3a and 3b, respectively. Results discussed here pertain to those from the per cow models. In the profit analysis, pounds of milk produced per cow per day accounted for the most variation in profitability, revealing that production is the driving factor behind profitability differences between operations (Table 3a). Milk price in relation to profit, with all other variables held constant, was also a key factor with higher prices being associated with higher profit. Feed as a percentage of total costs was also important and indicated that those operations having a higher percent of their total costs as feed are more profitable. In other words, operations that manage their non-feed costs efficiently are more profitable. The coefficient on the number of cows in the herd variable indicates that larger operations are more profitable, but this variable was only marginally significant. Percentage of farm labor devoted to livestock and culling rate were not significantly related to profit.

When costs per cow were evaluated with farm characteristics variables, pounds of milk produced per cow per day again was the most economically significant factor (Table 3a). Culling rate, which was not statistically related to profitability, was positive and significantly affected total cost. In other words, higher culling rates did not affect profit, but greater culling rates were associated with higher total costs per cow. Similarly, percentage of labor allocated to livestock was positively associated with costs per cow even though this variable was not significant in explaining profitability differences. This positive relationship may indicate that farms that are more diversified (i.e., lower percentage of labor devoted to livestock) have lower costs per cow than farms that are more specialized. Feed cost as a percentage of total costs was significant and negatively related to total costs per cow. This suggests that this measure likely is capturing the impact of having low non-feed costs more so than it is of having high feed costs (i.e., producers are doing a good job of managing non-feed costs). As with the profit model, the number of cows in the herd is only marginally significant, but it does indicate that larger operations tend to have lower costs per cow.

A variable for number of years included in the multi-year average for each producer was also included in both the profit and cost models. This variable was included to account for the fact that some operations might have had only four years of data included compared to others with six. Or, more importantly some producers might have had data for the years 2005-2008 and others for 2007-2010, which could impact relative profit and cost values (see figure 7). However, in neither model was this variable statistically significant indicating the varying years in the multi-year averages for the different producers is not significantly influencing the results. This result strengthens the results reported in Tables 2a and 2b because it suggests that the producers falling in the high (low) profit categories is not due to a year affect, but rather the differences are indicative of management differences. Thus, one can be confident in the results that suggest that increasing milk production is a key way to increasing profit for small to midsize dairy enterprises in Kansas.

CONCLUSION AND REMARKS

The study evaluating Kansas Farm Management Association data found that there is extreme volatility in dairy profitability from year to year on an industry level based on both macro and micro economic factors. While broad macro economic factors are beyond individual producers' control, producers do have control over some of the micro level factors at the farm level. Specifically, this analysis suggests that producers that are significantly more profitable than average are much more productive in terms of milk production per cow while having similar to slightly lower costs on a per cow basis. Furthermore, it was found that the variability in returns across producers at a point in time is much larger than the variability in average industry returns over time. Thus, while macroeconomic factors impacting overall profitability in the dairy industry are important, producers' individual management skills are more important for long-term business survival. A potential weakness of this study is there is little non-economic data evaluated in this data set (e.g., facility type and age, years in business, etc.) that would help better identify specific management styles of individual producers. Additionally these data are not necessarily representative of the Kansas dairy industry as larger operations (greater than 500 cows), such as are more common in western Kansas, are not included in the KFMA data base. Nonetheless, it is believed that results from this study can be useful for operations of all sizes as they think about what they need to focus on for long-term business survival.

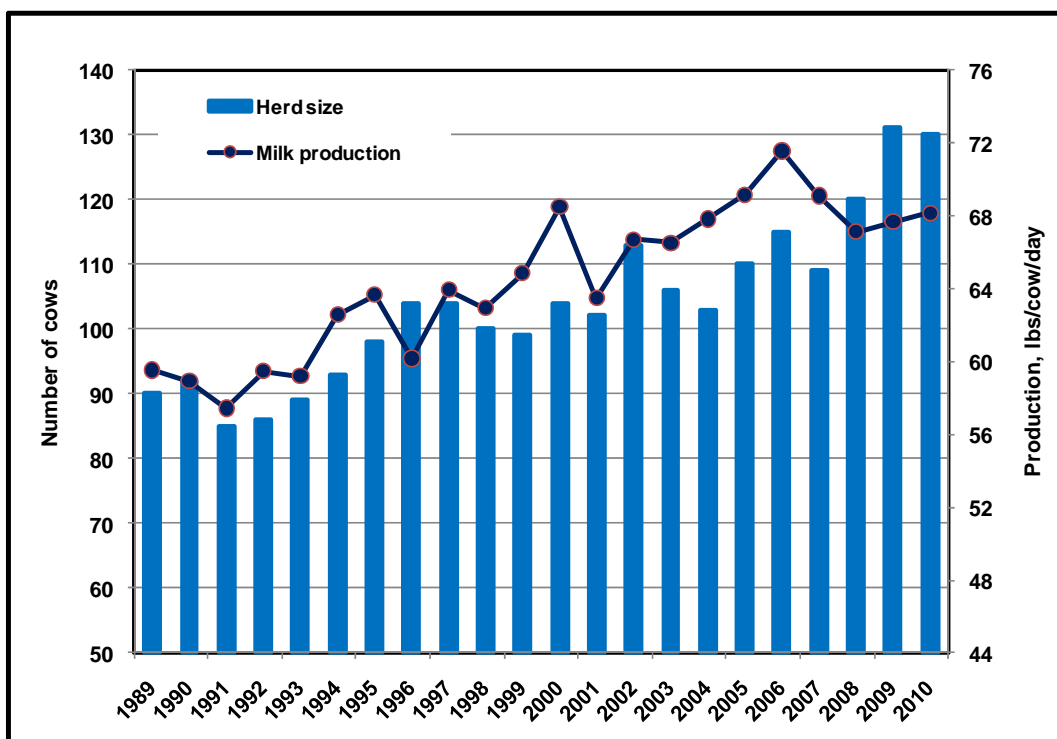


Figure 1. Average Herd Size and Milk Production per Cow

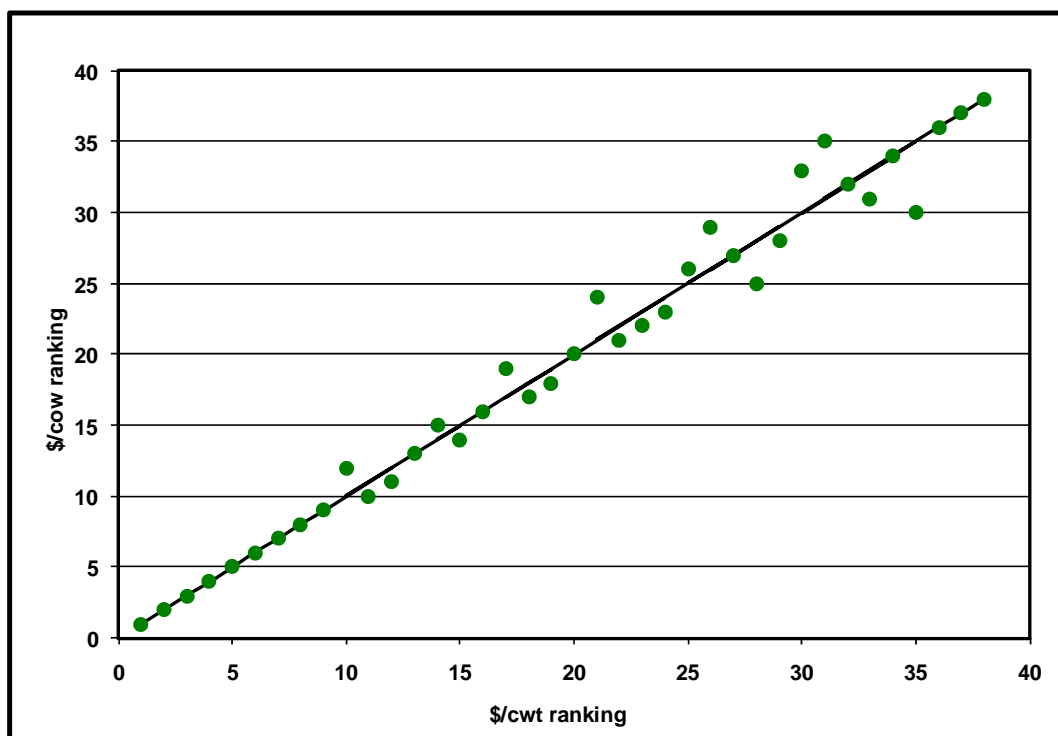


Figure 2. Ranking of Return over Total Costs (i.e., profit) on a Per Cow versus Per Cwt Basis (correlation = 0.99).

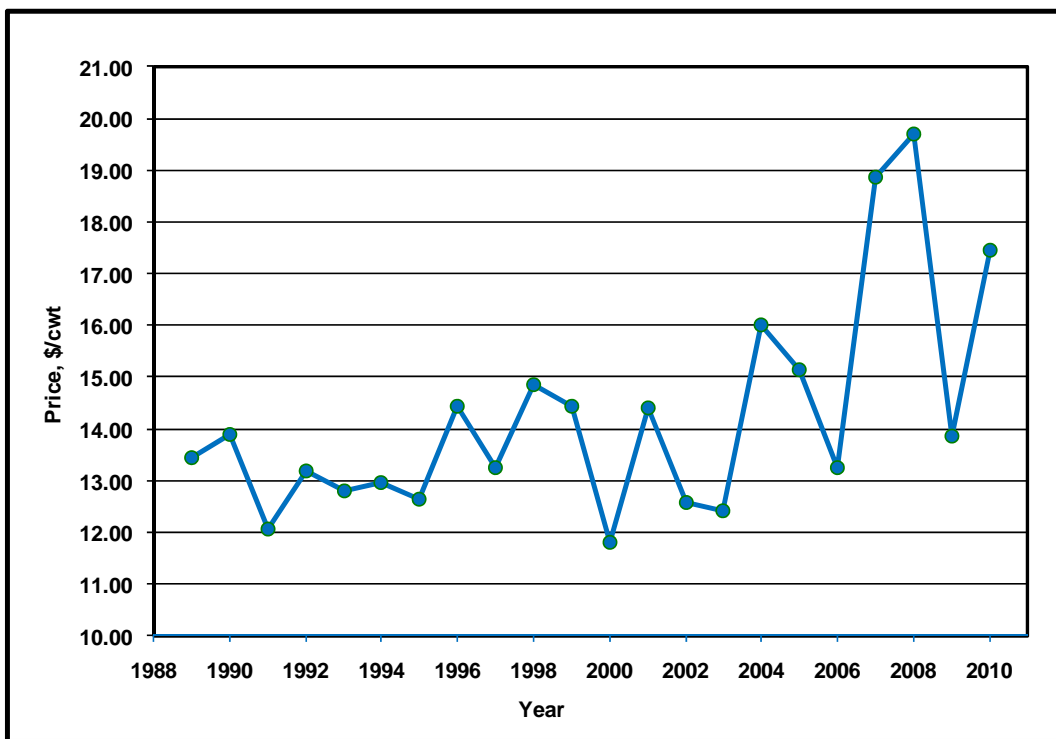


Figure 3. Annual Average Milk Price Received

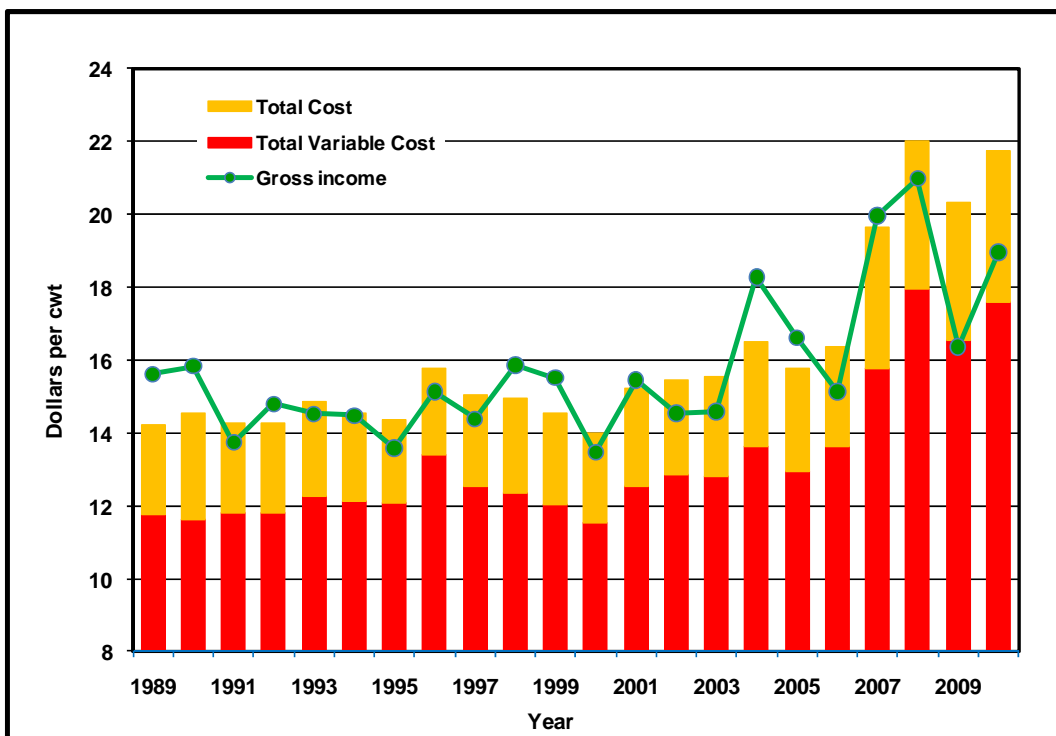


Figure 4. Annual Variable and Total Costs versus Gross Income per Hundredweight of Milk Produced

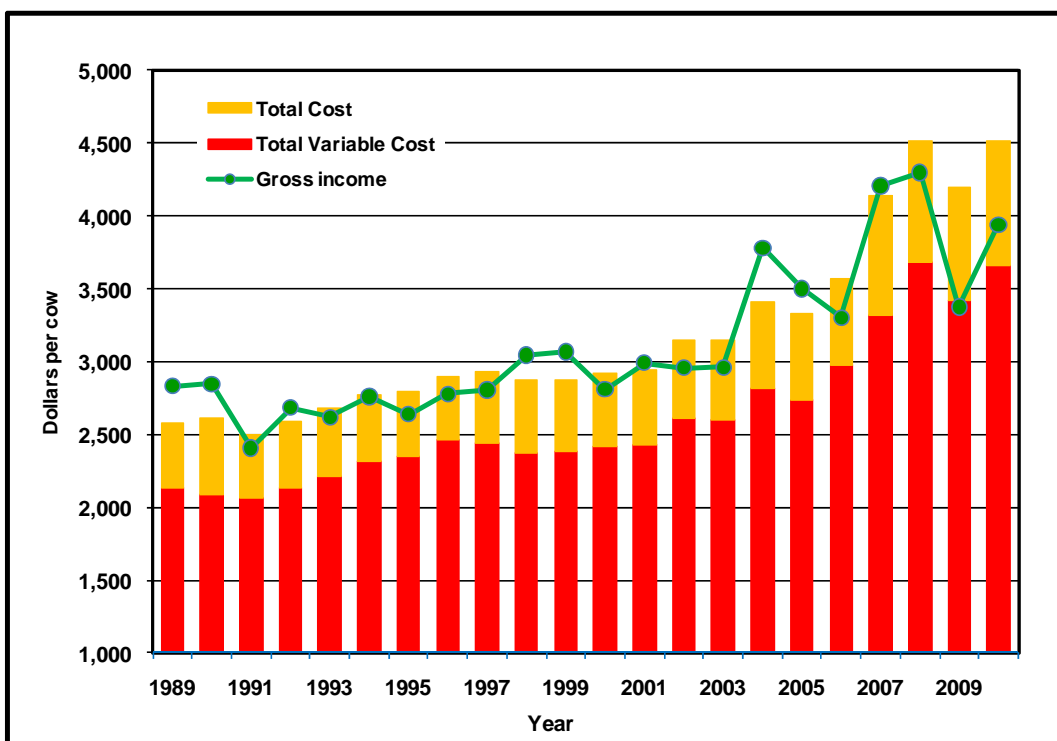


Figure 5. Annual Variable and Total Costs versus Gross Income per Cow

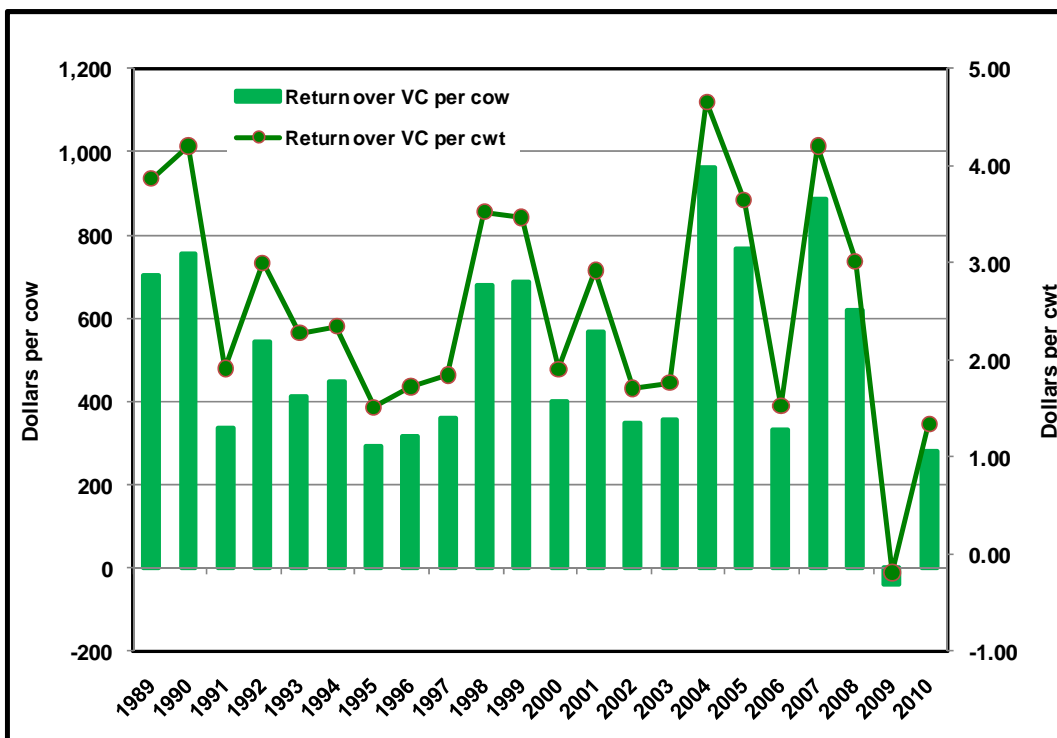


Figure 6. Returns Over Variable Costs

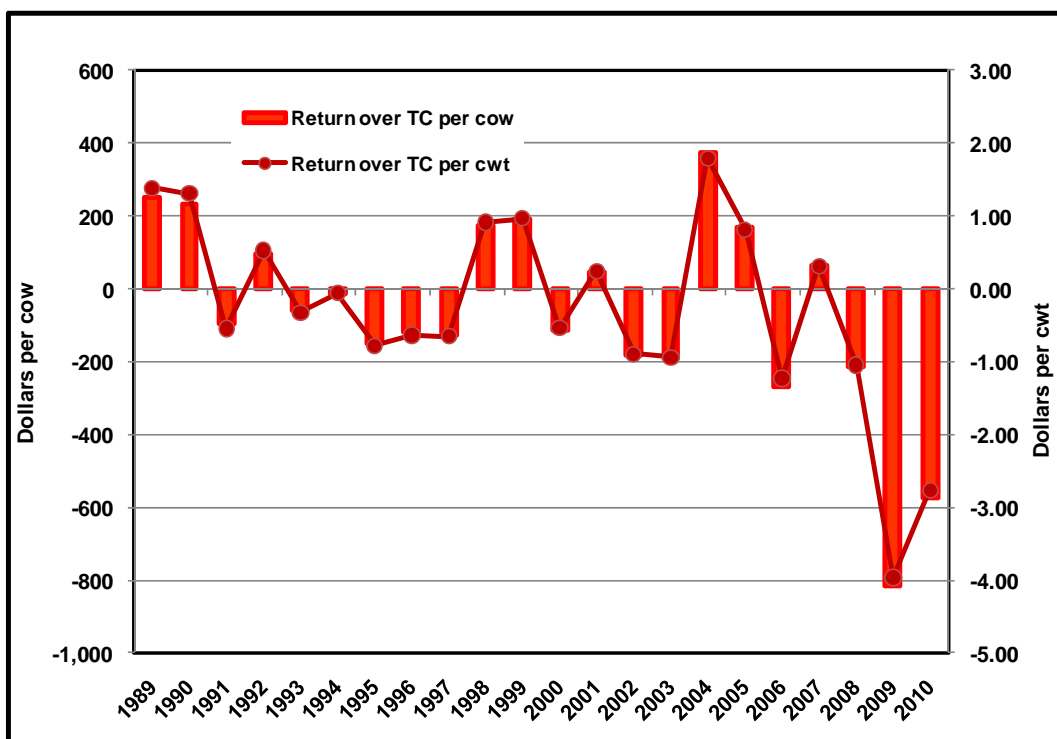


Figure 7. Returns Over Total Costs

Table 1. Correlations of Price, Costs, and Year with Profitability Measures

| Profitability measure | Unit | Milk price (\$/cwt) | Variable cost (\$/cow) | Total cost (\$/cow) | Year |
|----------------------------|--------|---------------------|------------------------|---------------------|--------|
| Returns over variable cost | \$/cow | 0.454 | -0.113 | -0.086 | -0.091 |
| Returns over total cost | \$/cow | 0.003 | -0.577 | -0.562 | -0.502 |
| Returns over variable cost | \$/cwt | 0.390 | -0.214 | -0.186 | -0.218 |
| Returns over total cost | \$/cwt | 0.004 | -0.575 | -0.559 | -0.505 |

Table 2a. Dairy enterprise measures among high, medium, and low profit groups (\$/cow)¹

| Item | All Farms | Profit Category | | | Diff. between High 1/3 & Low 1/3 | |
|---------------------------------|----------------|-----------------|----------------|----------------|----------------------------------|------------|
| | | High 1/3 | Mid 1/3 | Low 1/3 | Absolute | % |
| Number of Farms | 38 | 13 | 12 | 13 | | |
| Number of Cows in Herd | 114 | 133 | 120 | 90 | 44 | 49% |
| Cull rate, % | 26.0 | 24.27 | 30.78 | 23.44 | 0.83 | 4% |
| Pounds of milk/cow | 20,326 | 22,788 | 19,655 | 18,482 | 4,307 | 23% |
| Milk price, \$/cwt | \$16.29 | \$16.36 | \$16.39 | \$16.15 | \$0.21 | 1% |
| Milk sales, \$/cow | 3,292 | 3,720 | 3,206 | 2,944 | 776 | 26% |
| Net cattle sales, \$/cow | 221 | 295 | 195 | 171 | 124 | 73% |
| Other income, \$/cow | 101 | 105 | 90 | 106 | -1 | -1% |
| Gross Income | \$3,613 | \$4,119 | \$3,491 | \$3,220 | \$899 | 28% |
| Feed | \$1,888 | \$1,956 | \$1,839 | \$1,864 | \$92 | 5% |
| Labor | 652 | 555 | 636 | 765 | -210 | -27% |
| Vet | 110 | 129 | 93 | 108 | 20 | 19% |
| Dairy supplies | 292 | 320 | 265 | 288 | 32 | 11% |
| Marketing / breeding | 88 | 111 | 80 | 72 | 39 | 54% |
| Machinery | 347 | 325 | 350 | 367 | -43 | -12% |
| Utilities and fuel | 171 | 153 | 153 | 207 | -54 | -26% |
| Interest | 333 | 319 | 318 | 360 | -42 | -12% |
| Other | 83 | 81 | 56 | 110 | -29 | -26% |
| Total Cost | \$3,964 | \$3,948 | \$3,790 | \$4,142 | -\$194 | -5% |
| Net Return to Management | -\$351 | \$172 | -\$300 | -\$922 | \$1,094 | |

¹ Sorted by Net Return to Management (Returns over Total Costs) per Cow

Table 2b. Dairy enterprise measures among high, medium, and low profit groups (\$/cwt)¹

| Item | All Farms | Profit Category | | | Diff. between High 1/3 & Low 1/3 | |
|---------------------------------|----------------|-----------------|----------------|----------------|----------------------------------|-------------|
| | | High 1/3 | Mid 1/3 | Low 1/3 | Absolute | % |
| Number of Farms | 38 | 13 | 12 | 13 | | |
| Number of Cows in Herd | 114 | 133 | 126 | 84 | 49 | 58% |
| Cull rate, % | 26.0 | 24.27 | 28.51 | 25.53 | -1.27 | -5% |
| Pounds of milk/cow | 20,326 | 22,788 | 20,445 | 17,753 | 5,036 | 28% |
| Milk price, \$/cwt | \$16.29 | \$16.36 | \$16.37 | \$16.16 | \$0.19 | 1% |
| Milk sales, \$/cwt | 16.29 | 16.36 | 16.37 | 16.16 | 0.19 | 1% |
| Net cattle sales, \$/cwt | 1.08 | 1.31 | 1.09 | 0.84 | 0.47 | 56% |
| Other income, \$/cwt | -0.58 | -0.86 | -0.60 | -0.28 | -0.58 | 210% |
| Gross Income | \$17.87 | \$18.11 | \$17.94 | \$17.57 | \$0.55 | 3% |
| Feed | \$9.49 | \$8.61 | \$9.48 | \$10.37 | -\$1.76 | -17% |
| Labor | 3.40 | 2.44 | 3.13 | 4.60 | -2.15 | -47% |
| Vet | 0.53 | 0.57 | 0.52 | 0.51 | 0.06 | 12% |
| Dairy supplies | 1.44 | 1.40 | 1.28 | 1.62 | -0.23 | -14% |
| Marketing / breeding | 0.44 | 0.50 | 0.41 | 0.42 | 0.08 | 19% |
| Machinery | 1.72 | 1.44 | 1.83 | 1.89 | -0.45 | -24% |
| Utilities and fuel | 0.88 | 0.67 | 0.78 | 1.18 | -0.51 | -43% |
| Interest | 1.68 | 1.41 | 1.65 | 1.99 | -0.57 | -29% |
| Other | 0.42 | 0.36 | 0.35 | 0.56 | -0.20 | -36% |
| Total Cost | \$20.00 | \$17.40 | \$19.42 | \$23.13 | -\$5.73 | -25% |
| Net Return to Management | -\$2.13 | \$0.71 | -\$1.48 | -\$5.56 | \$6.28 | |

¹ Sorted by Net Return to Management (Returns over Total Costs) per Cwt

Table 3a. Regression analysis for profit and cost models (\$/cow)

| Variable | Profit Model (\$/cow) | | Cost Model (\$/cow) | |
|------------------------------|-----------------------|----------------------|---------------------|----------------------|
| | Coefficient | p-value ¹ | Coefficient | p-value ¹ |
| Intercept | 5,584 | 0.802 | -9,681 | 0.620 |
| Cows, number of head | 1.916 | 0.156 | -1.605 | 0.196 |
| Milk production, lbs/cow/day | 19.892 | 0.004 | 34.579 | <.0001 |
| Milk price, \$/cwt | 182.345 | 0.023 | | |
| Cull rate, percent | -6.830 | 0.267 | 12.070 | 0.038 |
| Feed percent of total cost | 30.128 | 0.054 | -29.165 | 0.040 |
| Livestock labor percent | -8.480 | 0.209 | 12.541 | 0.043 |
| Years in average | -103.181 | 0.615 | 108.668 | 0.553 |
| R-square ² | 0.4773 | | 0.6490 | |

¹ 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).

² R-square represents the proportion of variability in the dependent variable (*Profit* and *Cost*) that is explained by variation in the independent variables.

Table 3b. Regression analysis for profit and cost models (\$/cwt)

| Variable | Profit Model (\$/cwt) | | Cost Model (\$/cwt) | |
|------------------------------|-----------------------|----------------------|---------------------|----------------------|
| | Coefficient | p-value ¹ | Coefficient | p-value ¹ |
| Intercept | -3.7943 | 0.974 | 17.9226 | 0.856 |
| Cows, number of head | 0.0119 | 0.089 | -0.0102 | 0.107 |
| Milk production, lbs/cow/day | 0.1469 | <.0001 | -0.1539 | <.0001 |
| Milk price, \$/cwt | 0.8554 | 0.036 | | |
| Cull rate, percent | -0.0177 | 0.572 | 0.0438 | 0.131 |
| Feed percent of total cost | 0.1796 | 0.027 | -0.1860 | 0.012 |
| Livestock labor percent | -0.0516 | 0.138 | 0.0772 | 0.016 |
| Years in average | -0.2578 | 0.806 | 0.1443 | 0.876 |
| R-square ² | 0.5975 | | 0.6776 | |

¹ 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).

² R-square represents the proportion of variability in the dependent variable (*Profit* and *Cost*) that is explained by variation in the independent variables.