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

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EXECUTIVE SUMMARY

The financial bottom line, or net income, is a key factor in determining how successful a dairy has been historically as well as an indicator of the financial ease or struggles the dairy might have in the future. What causes returns to vary from year to year on an industry level or income to vary from one operation to another are key questions for dairy farmers. For example, do direct economic factors like milk price received, feed cost, labor, or 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 looking at annual average Kansas Farm Management Dairy Enterprise data from the 20-year period 1989 to 2008. 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, milk production, and herd size were evaluated. For the 20-year period, producers consistently covered variable costs (average return of $2.75/cwt over variable cost, ranged from $1.51 to $4.66). However, consistently covering fixed costs was more difficult as returns over total costs were negative in 11 of the 20 years (average return of $0.03/cwt over total cost, ranged from -$1.23 to $1.79). If the 20 years were split into thirds based on returns over total cost, the top seven years had an average return over total costs of $212 per cow compared to a loss of $180 per cow for the worst seven years. Thus, there was a difference in returns over total costs of $392 per cow between the "best 1/3 years" and the "worst 1/3 years" over this time period.

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, the past five years of Kansas Farm Management Dairy Enterprise data were evaluated to quantify relationships 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 slightly over $1,000 per cow more than the low-profit operations ($451/cow versus

-$551/cow). High-profit producers had larger operations, slightly greater total costs per head ($62.63/cow), and received slightly lower milk prices ($0.56/cwt) compared with low-profit producers. However, the high-profit group produced significantly more milk per cow (5,268 lbs/cow). In explaining profitability difference across producers at a point in time, milk price received and cost per cow did not affect profit nearly as much as total milk produced per cow.

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 for the past few decades with each decade having its pivotal years of financial hardship. 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. Small to midsize producers have felt a major crunch in their cash flow and net income in the past few years. Net income largely determines how long a farm can survive. A dairy farmer who makes little to no profit during a particular year with no capital saved or cash reserves will likely continue to struggle in future years. In contrast, producers who have capital saved from previous profitable years can survive longer during times of low milk prices and increased costs.

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. In theory, a skilled manager should be able to balance asset utilization, reduce cost, and maximize revenue to increase net income. Many managers, however, are unable to optimize each of these factors.

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 dairy enterprise data were taken from the years 1989-2008; where each year represented the average of all producers participating in the enterprise analysis for that respective year. Data given and evaluated for each year included farm demographics (i.e., herd size, milk production), revenue, and cost factors. The average number of producers enrolled per year was 66 with a range of 33 to 113 for the 20-year period. Farm size for the producers in this data set is on the smaller side with an average of 101 cows and a range of 85 to 120 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. The Kansas producers enrolled in KFMA over the 20-year period produced an average of 64.1 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 20-year period have little meaning for benchmarking current operations.

All farm-level revenue and cost information was normalized by converting it to both a per cow and per hundredweight (cwt) of milk produced basis. 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 were sorted into thirds (top seven years, middle six years, and bottom seven years) as a measure of how much returns vary over time for “good years” versus “bad years” (i.e., top 1/3 versus bottom 1/3).

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

Forty dairy farms from the Kansas Farm Management Association database were selected on the basis of their participation in reporting data during the past five years (2004 to 2008). To be included in the analysis, a farm must have reported data a minimum of three of the five years. The average number of years farms reported data was 4.5 years (6 farms had 3 years, 11 had 4 years, and 23 had 5 years). The farms were sorted from high to low on average returns over total costs (i.e., profit) and then separated into top-, middle-, and bottom-third categories (13, 14, and 13 farms, respectively). The multi-year, multi-farm average number of cows per farm was 115 (range: 35 to 257 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 pounds of milk per cow, culling rate, milk price per hundredweight of milk ($/cwt), and income over feed cost.

To normalize data, results are reported on a per-cow basis. There is debate within the dairy industry regarding whether data should be analyzed on a per-cow or per-cwt basis. The 40 farms were ranked from 1 to 40 (1 = highest profit, 40 = 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 40 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.

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, and percentage of farm labor allocated to livestock.

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 $14.10 per hundredweight (cwt) for their milk (milk receipts plus patronage refunds); annual average price received ranged from $11.82 to $19.71 for the 20-year period from 1989 to 2008. 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. Costs per cwt of production were relatively stable for much of the time period, but in recent years increased significantly (figure 4). Over the 20-year period, variable costs averaged $12.87/cwt (ranged from $11.55 to $17.96) and total costs averaged $15.59/cwt (ranged from $14.00 to $22.02). On the other hand, costs of production per cow have been increasing steadily over the entire time period with fairly large year-to-year increases from 2004 to 2008 (with the exception of 2005) (figure 5). Variable costs per cow averaged $2,526 (range of $2,070 to $3,677) and total costs averaged $3,060/cow (range of $2,500 to $4,509). From 1989 through 2003 costs per cow were increasing steadily, but costs per cwt were relatively stable because of increasing production over this time period (figure 1). However, costs per cwt have also been increasing from 2004 to 2008 (with the exception of 2005) indicating that increases in production have not kept up with increasing cow costs in these years. In addition to variable and total costs, figures 4 and 5 show the annual average gross income. 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 ruturns (profitability) from year to year.

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 on a per cow and per cwt basis. 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 $538

($2.75) and ranged from $293 to $963 ($1.51 to $4.66). Gross income was sufficient to cover variable costs every year over this 20-year period.

Figure 7 shows returns over total costs both on a per cow and per cwt basis. 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 $3/cow ($0.03/cwt) and ranged from a low of -$268 to $371 (-$1.23 to $1.79). Gross income was sufficient to cover total costs only nine of the 20 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 $639 per cow in returns over total cost (-$268 to $371) across the 20-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 20-year returns are sorted from high to low and separated into three categories, high (7 years), middle (6 years), and low (7 years) returns, the average returns per cow over variable costs are $776, $497, and $334, respectively. The average returns over total costs are $212, -$28, and -$180 per cow respectively. On average there is a $392 per cow 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 and variable and total costs. The correlation is a statistical measure of how 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 all of the correlations are relatively low suggesting variability in returns are affected by multiple factors as opposed to one key driver. The exception to this is price and returns over variable cost where the correlations are somewhat stronger (0.66 and 0.59). The correlation is positive as expected, i.e., higher prices are associated with higher returns over variable costs, and is supportive of why many producers feel they need to spend more management time devoted to marketing. The movement of milk price is affected by number of total cows in U.S. inventory, once the number of cows increases beyond a threshold number, the milk market gets overwhelmed with raw milk causing the raw milk price to decline. On the other hand,

when the number of cows is reduced below this threshold, then price goes up as there is insufficient supply to meet the demand. As milk prices increase, producers strive to increase herd size and milk production and thus move towards oversupplying the milk market which causes the price to decline. It is this process of under-supplying the market to over-supplying the market that leads to price volatility. In addition to these supply factors, milk price is heavily influenced by the strength of the economy and other commodity prices. Producers cannot control these 'macro' level factors; as a price taker price received is somewhat uncontrollable and thus one cannot completely reduce the variability of returns.

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

Table 2 reports farm information, income, and cost data for the three profitability groups (high, medium, and low). 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 less 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 30% (5,268 lb per cow). Milk price was similar for all three groups and was actually slightly greater ($0.56/cwt) for the low-profit farms compared with the high-profit farms. Given the greater milk production and comparable price, the high-profit farms generated nearly $800 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 differences existed among the three profitability groups. When all categories were included, the high-profit farms averaged $1,065 more income per cow than the low-profit farms (slightly more than $500 per cow compared with 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 higher total cost per cow (Table 2). 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. Labor costs per cow were slightly 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 and dairy supplies costs were about $140 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 ($49.71 and $30.64, respectively), which likely is a result of spreading costs over more cows (i.e., economies of size). The high-profit farms averaged $62.63 per cow more cost, but when coupled with the significantly greater income ($1,065), net returns were greater. High-profit farms averaged $1,000 more profit than low-profit farms and had a $450 per cow advantage over medium-profit farms. These differences were very significant and almost entirely 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. In the profit analysis, pounds of milk produced per cow per day accounted for the most variation ($P < 0.001$) in profitability, revealing that production is the driving factor behind profitability differences between operations (Table 3). Milk price in relation to profit, with all other variables held constant, was also a key factor ($P < 0.05$). Of the cost factors evaluated, feed as a percentage of total cost and percentage of farm labor devoted to livestock were not significantly related to profit. In addition, variability in culling rates between operations was not related to profitability differences.

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 3). Percentage of labor allocated to livestock was positively associated with costs per cow and tended ($P < 0.10$) to account for a significant proportion of the variation associated with cost per cow. 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. In contrast, feed cost as a percentage of total costs was not related to costs per cow.

Two other factors evaluated in the regression were culling rate and mean year of reported data. Culling rate, which was not statistically related to profitability, was positive and affected ($P < 0.05$) total cost. In other words, selling cull cows did not affect profit, but greater culling rates were associated with higher total costs per cow. In addition, the mean year of reported data tended ($P < 0.10$) to be significant in explaining profit and was related ($P < 0.05$) to explaining costs per cow. These trends in year differences may slightly skew the results reported in Table 2 because the year effect is not accounted for. However, because the regression results account for year differences and because data used in the analyses represent 4.5 of the 5 years for all reporting farms, one can be

confident the results are accurate and can conclude that increasing milk production is key 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, they 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 only slightly higher costs. Furthermore, it was found that the variability in returns across producers at a point in time are much larger than the variability in average 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.). Additionally these data are not necessarily representative of the Kansas dairy industry as larger operations (greater that 500 cows), such as are more common in western Kansas, are not included in the KFMA data base.

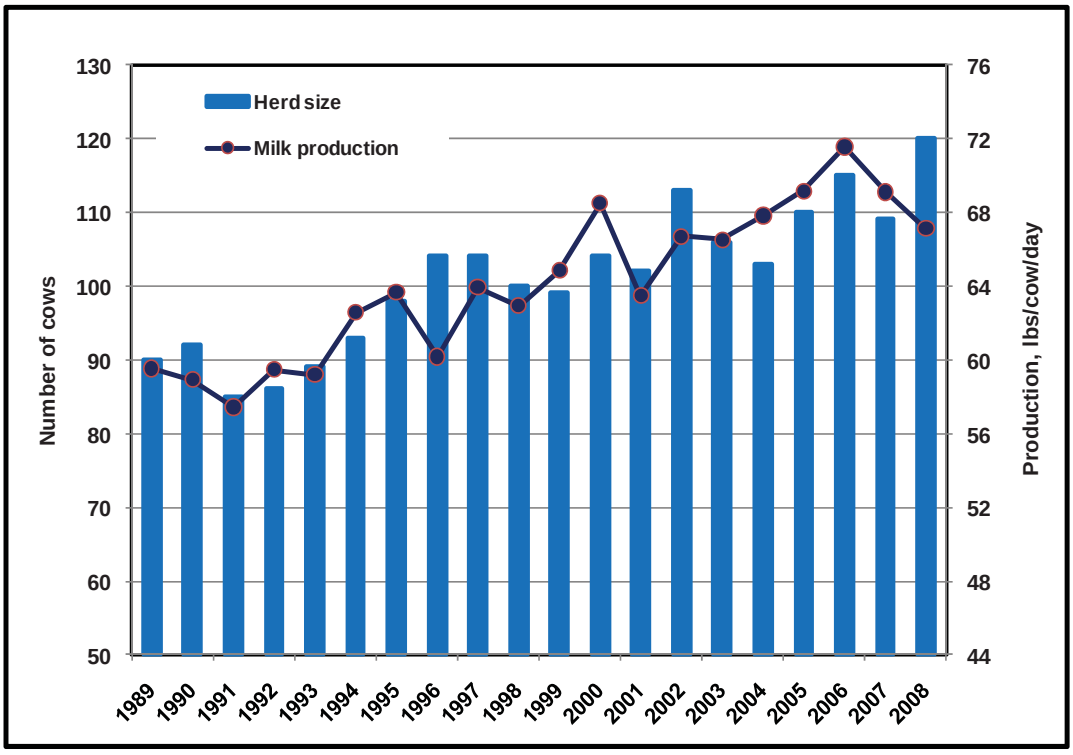

Figure 1. Average Herd Size and Milk Production per Cow

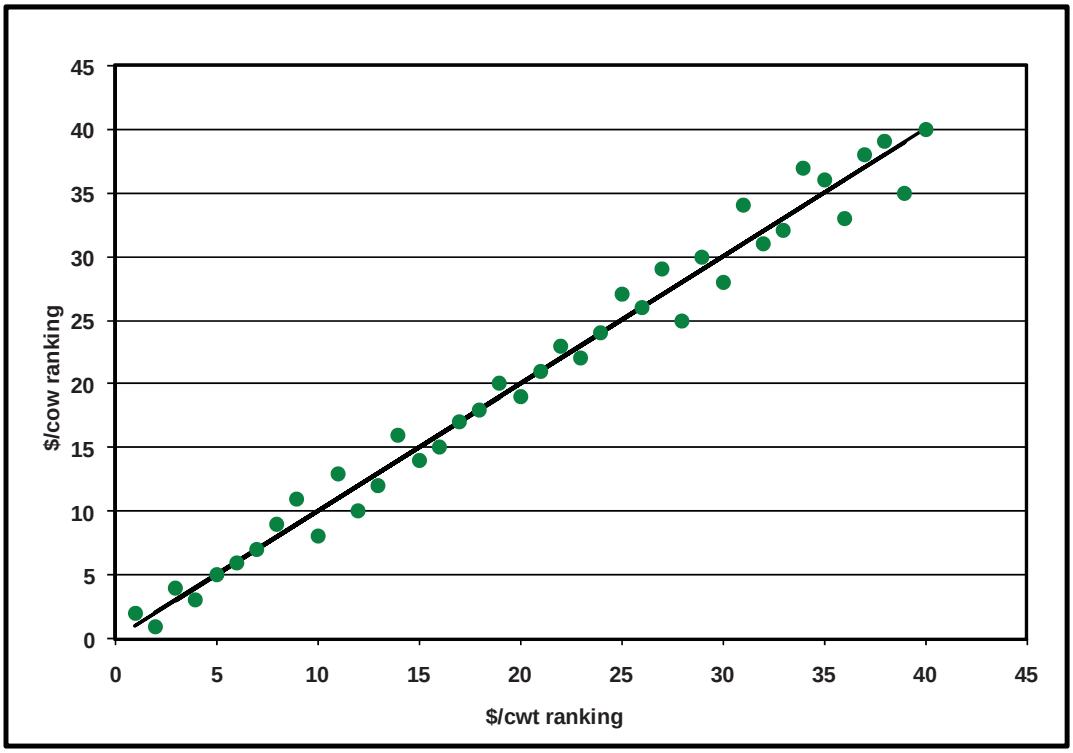

Figure 2. Ranking of Return over Total Costs (i.e., profit) on a Per Cow versus Per Cwt Basis (correlation = 0.99).

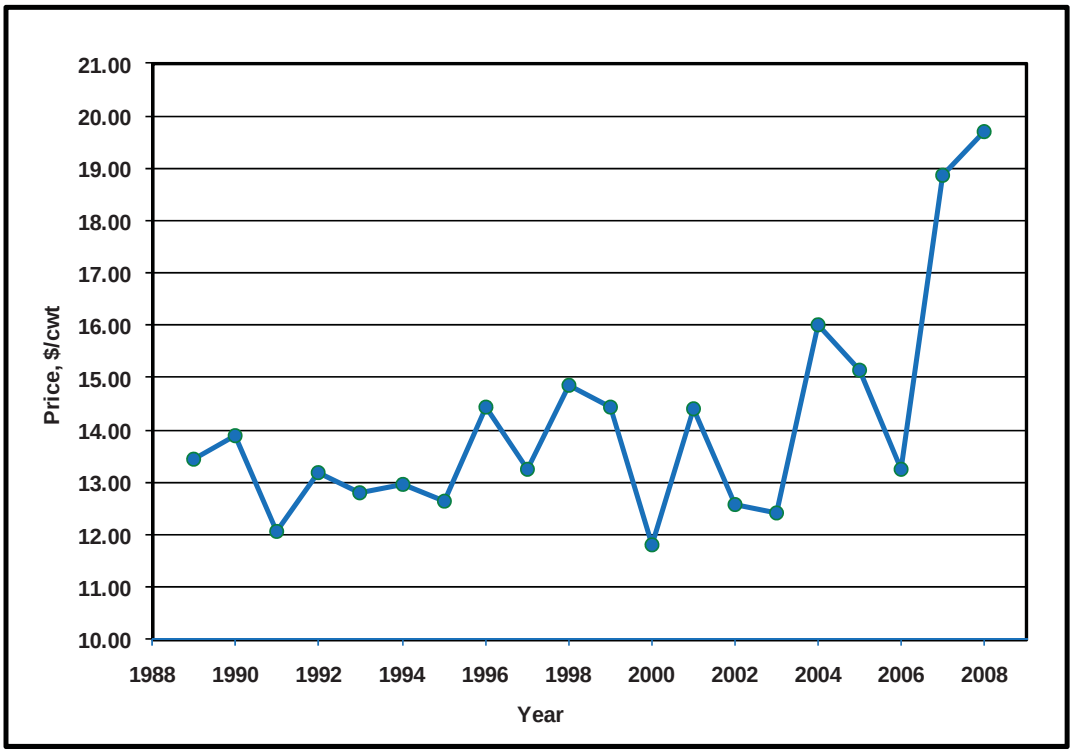

Figure 3. Annual Average Milk Price Received

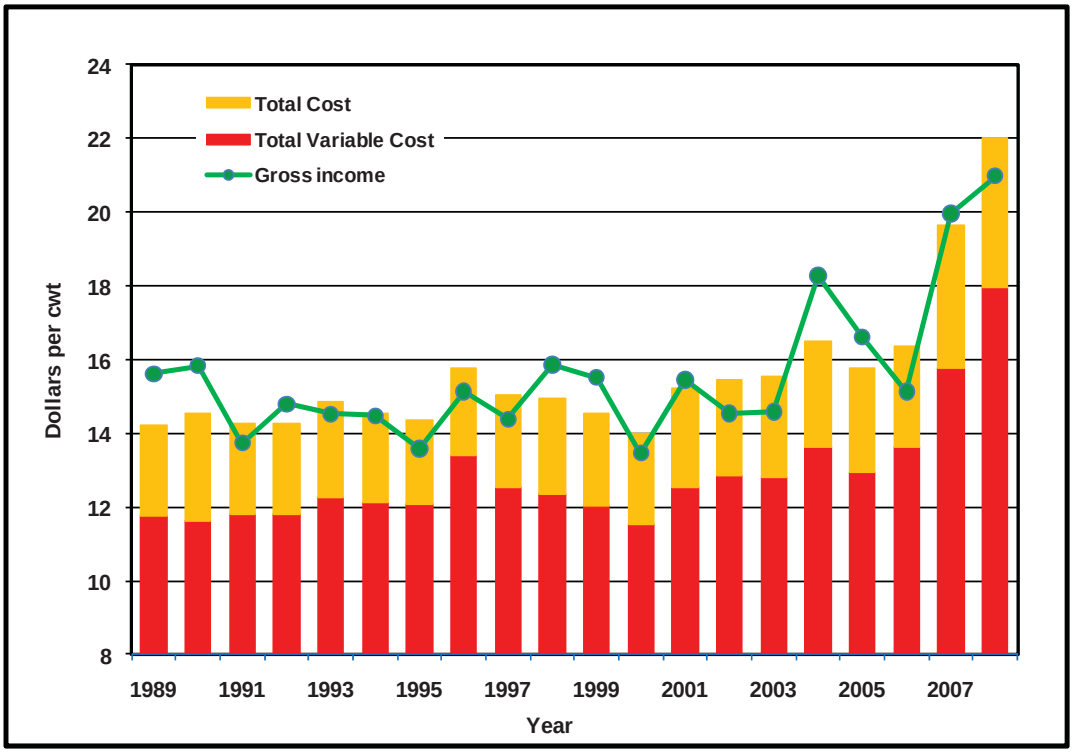

Figure 4. Annual Variable and Total Costs versus Gross Income per Hundredweight of Milk Produced

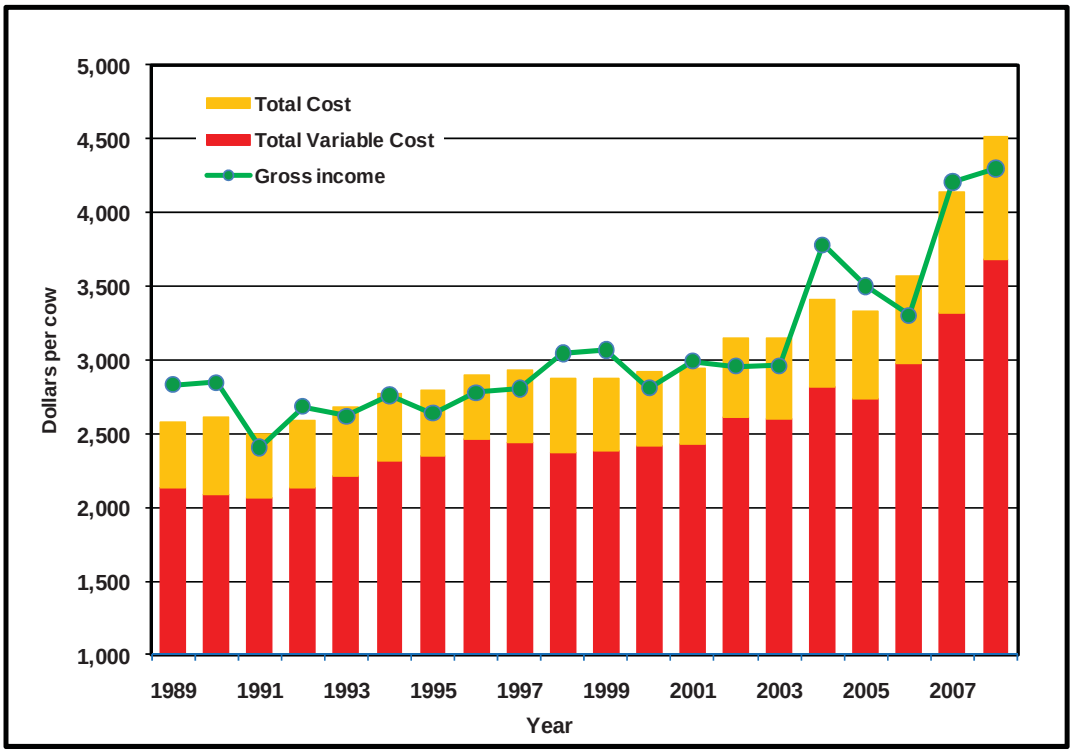

Figure 5. Annual Variable and Total Costs versus Gross Income per Cow

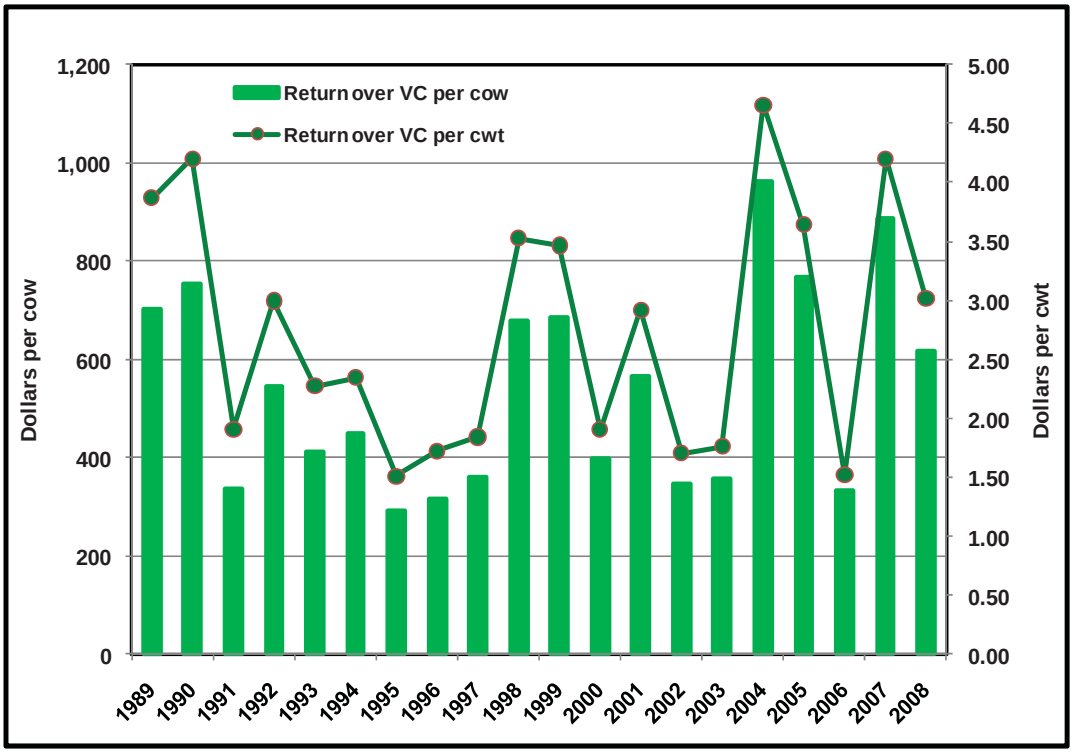

Figure 6. Returns Over Variable Costs

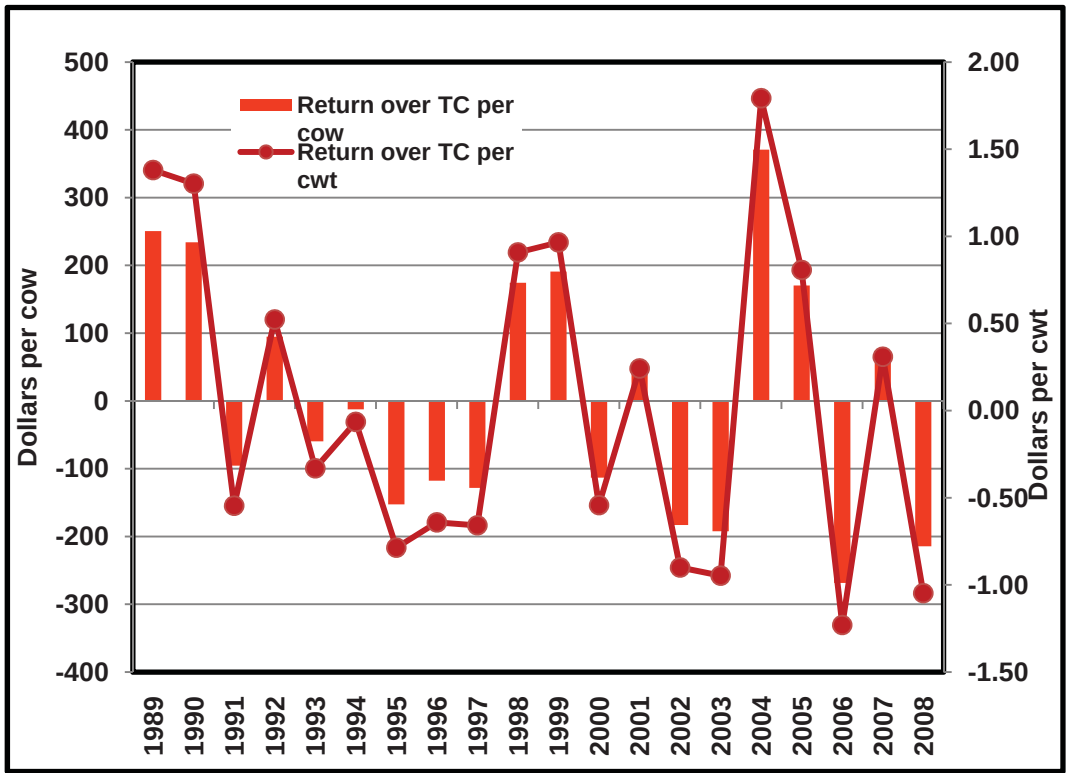

Figure 7. Returns Over Total Costs

Table 1. Correlations of Price and Costs with Profitability Measures

Profitability measure	Milk price ($/cwt)	Variable cost ($/cow)	Total cost ($/cow)
Returns over VC, $/cow	0.66	0.28	0.32
Returns over TC, $/cow	0.22	-0.26	-0.22
Returns over VC, $/cwt	0.59	0.14	0.19
Returns over TC, $/cwt	0.21	-0.27	-0.23

Table 2. Dairy enterprise measures among high, medium, and low profit groups[1]

Item[2]	All farms	Profit category			High minus low	
		High	Middle	Low	Absolute	%
Number of farms	40	13	14	13		
Number of cows per herd	115	135	130	79	57	72
Culling rate, %	25.6	28.1	21.0	28.0	0.13	0
Pounds of milk	20,610	22,966	21,129	17,697	5,268	30
Milk price, per 100 lb of milk	$16.48	$16.32	$16.25	$16.88	–$0.56	–3
Milk sales	$3,369	$3,731	$3,420	$2,951	$780	26
Net cattle sales	$267	$440	$209	$156	$284	183
Other income	$59	$59	$60	$58	$0.89	2
Gross income	$3,695	$4,230	$3,689	$3,165	$1,065	34
Feed	$1,749	$1,763	$1,807	$1,672	$90.91	5
Labor	$596	$594	$528	$672	–$78.19	–12
Vet	$115	$113	$128	$102	$10.47	10
Dairy supplies	$300	$354	$321	$224	$130.32	58
Marketing/breeding	$93	$86	$111	$82	$4.05	5
Machinery	$323	$308	$304	$358	–$49.71	–14
Utilities/fuel	$158	$151	$143	$182	–$30.64	–17
Interest	$319	$335	$291	$332	$3.00	1
Other	$76	$76	$60	$93	–$17.59	–19
Total cost	$3,729	$3,779	$3,694	$3,716	$62.63	2
Net return to management	–$34.34	$451.06	–$5.04	–$551.31	$1,002	

[1] Sorted by net return to management (returns over total costs) per cow.
[2] All items are on a per-cow basis unless indicated otherwise.

Table 3. Regression analysis for profit and cost models

	Profit ($/cow)		Cost ($/cow)	
Variable	Coefficient	*P* value	Coefficient	*P* value
Intercept	36,901	0.113	–42,958	0.025
Cows, number of head	1.00	0.385	–0.26	0.798
Milk production, lb/cow/day	25.48	0.000	29.52	0.000
Milk price, $/100 lb of milk	176.82	0.024		
Culling rate, %	1.14	0.793	9.64	0.038
Feed percent of total cost	17.07	0.175	–15.27	0.157
Livestock labor percentage	–3.64	0.464	7.68	0.079
Years	–398.91	0.080	421.27	0.021
R-square	0.4547		0.6217	