Sub Theme: Production (Internal Process Perspective)

WHAT FINANCIAL CHARACTERISTICS ARE ASSOCIATED WITH FARMS THAT DO WELL DURING CYCLICAL LOWS?

Abstract

Production agriculture is a cyclical business, the primary driver often being prices. During times of low prices and profitability, capital asset values often moderate or even decrease below trends, thus providing opportunities. The question posed in this research is what financial characteristics appear to be associated with those farms that do well during cyclical lows. That is, where are these farms significantly different coming out of a cyclical high that may be associated with their ability to do well during the cyclical low and thus potentially take advantage of opportunities?

Data from 178 Wisconsin dairy farms from 2014 to 2018 were used. The year 2014 was the last of a cyclical high in profitability and 2018 was the last year of a cyclical low. The farms were split into two groups, high and low profit farms, by their Return on Assets at the end of 2018. Financial characteristics were then compared for the same two groups at the conclusion of 2014.

Significant differences resulted for costs of production per sales unit, operating profit margin ratio, production, and herd size. The level of debt and working capital was not significantly different, but there was evidence of differing uses of debt.

Keywords

Cycles, Production, Costs of Production, Use of debt financing, Profitability, Thriving

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Paper

Applied

Purpose

It is well documented that commodity agriculture is a cyclical business. Figure 1 shows Class III monthly milk prices since January 1996. The red dots are cyclical, often record, highs and the yellow dots show the following low price. Historically, on average it took 14 months from cycle high to low and an average price drop of $9.10. For a 200-cow dairy selling 4,166 hundredweights per month that is a cash inflow drop of $37,911 for that one month. Each low in a cycle often results in exit from the industry due to loss of profitability. Yet, many farms continue profitable operations in the downward phase of a cycle and use that profitability to take advantage of opportunities to expand and/or make more efficient business operations.

The question addressed in this research is if farm managers know that profits are cyclical then what do their financial characteristics need to look like at the end of the cyclical high to not only survive, but thrive during the cyclical low? The management insight is what farm businesses should focus on when times are good to give the business the best chance to thrive and take advantage of opportunities when times are not as favorable.

Background

The Virginia Tech Gap Report Initiative stated that "lower prices pose challenges for producers and requires them to adopt a productivity-centered business model to cut costs, as well as seek new markets and focus on improving the quality of their products to gain a price advantage (Virginia Tech Gap Initiative 2021: Case Studies). Dhuyvetter stated that "while macroeconomic factors are important, producers' individual management skills are more important for long-term business survival (Dhuyvetter 2011: 11).

Commodity producers are price-takers so getting a higher price from the market is not in their control[1]. "However, individual producers do have some control of profitability at the farm level relative to other producers. That is, while numerous factors beyond the producer's control impact the absolute level of profitability, producers' management abilities impact their relative profitability. In a competitive, consolidating, industry such as agriculture, relative profitability dictates which producers remain in business in the long run" (Dhuyvetter and Ward 2014: 2).

[1] Producers can use price risk management tools to secure a price, but they cannot change the price the market itself offers.

Determining what characteristics are associated with high profit farms has been the subject of many studies. Dhuyvetter and Ward divided grain farms in Kansas from 2011-2013 into three profitability groups. Their research showed "extremely large differences in profitability across producers" (cf Dhuyvetter and Ward 2014: 10). One of their finding was that high profit farms had the most acres providing some evidence that larger operations are more profitable (cf Dhuyvetter and Ward 2014: 10). Not surprisingly, price was found not to be different between high and low profit farms, but higher yields played a much larger role in explaining income differences (cf Dhuyvetter and Ward 2014: 10).

In another study, Dhuyvetter noted that dairy "producers that are significantly more profitable average more production per cow while having similar to slightly lower costs on a per cow basis (cf Dhuyvetter 2011: 11). If production (hundredweight) is higher per cow and costs per cow are maintained, then costs of production per hundredweight will be lower.

Finally, Morris et.al. found that "farm size, share of rented acres, workers per acre, government payments, crop specialization, planting intensity, machine costs, yield management, and price management were all significantly related to farm performance (cf Morris et. al. 2016: 17-18).

Methods

This study involved two statistical analyses. The first was a regression of Return on Assets on financial variables to identify characteristics important in determining the difference in Return on Assets. The second analyses, and primary goal of the work, was to first, identify farms that were doing comparatively well financially at the end of a cyclically low period (hereafter referred to as high profit farms). Second, determine for the same farms what their financial characteristics looked like coming out of the cyclically high year that preceded the cyclical low. The farm management implication is what a producer should focus on when times are good to do well during the following cyclical low. Especially important were determination of financial characteristics that were significantly different than all other farms (hereafter referred to as low profit farms).

The database consisted of 178 Wisconsin dairy farms over five years, 2014-2018[2]. 2014 was a cyclical high followed by an unusually long four years of cyclical low that ended in 2018. The years for this analysis, 2014-2018, are shown in red in Figure 1. Milk

[2] One year for one farm was dropped due to errors in data entry that could not be fixed.

prices were assumed to be an indicator of cyclical highs and lows. Return on Assets (ROA) for those years validates this assumption. Average Return on Assets for all farms in the database in 2014 was 7.15% followed by 2.34, .71, 1.02, and .03 percent respectively for years 2015-2018.

Data for 2018 was assessed first to determine the top 25% high profit farms that year based on Return on Assets (45 farms), which was the year that ended four years of cyclical lows. The average Return on Assets for the 45 high profit farms in 2018 was 5.0% compared to -1.7% for the 133 low profit farms. Return on Assets equal to or greater than 5% is also the typical break between what is considered a strong versus weak position according to the Ratio Scorecard (Bau et. al. 2018).

Statistics were then analyzed for the same two groups in 2014, the year coming out of the cyclical high. Student t-tests were used to test for significant differences of various financial and production characteristics between the two groups, thus identifying potential causal characteristics in the high profit group's ability to do well even during cyclical lows.

The cost data used was based on cost per hundredweight equivalent (cwteq). Hundredweight equivalent is a process for transforming the data to accurately represent costs for just the dairy enterprise versus charging the cows for the cost of other enterprises. Milk is sold in hundredweight units and thus costs are often expressed in dollars per hundredweight. However, multiple enterprises are common for Wisconsin dairy farms, thus dividing total costs for say grain and milk production by hundredweights of milk sold will inflate the costs of producing milk. Hundredweight equivalent is total income ($) divided by price of milk ($/cwt). The result is a hundredweight equivalent number, where the equivalent term means that if the same total income was derived from milk only, then hundredweight equivalent amount would need to be produced. The value of the transformation is that dividing costs of production by hundredweight equivalent will provide a number more accurate to the real costs of production for milk only.

Results – Regression Analysis

Table 1 shows Excel results from the regression of Return on Assets on various financial and production characteristics. A stepwise process was used to test variables for

their explanatory power and lack of correlation with other variables. Dummy variables were used for separating year effects and producers who were organic[3].

Price effect was significant but did not contribute a major change in Return on assets (.22% increase in ROA for each dollar increase in price). This was not surprising as milk is a commodity and with exception of gains from marketing, prices are not widely different across farms. However, management decisions leading to volume, milk quality, and components can result in some price differences. Also, the year dummy variables likely picked up some of the price effect.

While production per cow was significant, the impact on Return on Assets was by itself not large. For example, an extra 5 pounds of milk per day, or 1,525 pounds per cow for a 305-day lactation, increased Return on Assets .14 percent. However, this may mask a larger impact as additional production is also captured in the costs of production variables, which are divided by production. Most costs of production variables are significant, with exception of interest, and have large impacts on Return on Assets.

The main takeaway from the regression analysis was the amount of Return on Asset differences contributed to lower costs of production for depreciation, labor and other operating costs (interest costs was the noted exception). The metric is costs of production per hundredweight equivalent. Thus, the value can be lower due to 1) lower costs for the same amount of production, 2) higher production for the same amount of costs, or 3) both. Since production (lbs/cow) is significant, then that gives evidence that 2 and 3 are explaining differences in Return on Assets.

Results – t-Test Comparison of High versus Low Profit Farms

Table 2 shows t-test results for evaluating differences between high and low profit groups. Year 2018 results are shown on the right with corresponding 2014 results shown on the left. Since the study was structured to separate high profit farms in 2018, then one would expect many statistical differences in that year. Most metrics are significantly different, of more interest are the ones that are not. Any metrics involving the level of debt or working capital were not significantly different between high and low profit groups. The exception was debt per hundredweight equivalent, which is likely capturing the greater production per cow of the high profit group versus a difference in debt levels.

[3] Organic producers had much higher prices, but much less production per cow. Inclusion of a dummy variable separated this impact on Return on Assets.

The top 25% high orofit Return on Asset farms clearly are financially better off in 2018 after four years of cyclically low profits. The question is, what were their characteristics and how were they different in the cyclically high year of 2014 that enabled them to not only survive, but thrive during the low years?

While significantly higher for the high profit group, both groups had a healthy and profitable Return on Assets in the cyclical high year of 2014, 9.0% and 6.5% respectively for high and low profit groups. Four years later after four straight years of below normal prices and profitability, Return on Assets eroded for both groups, but the high profit group still maintained a healthy 5.0% average Return on Assets compared to -1.7% for all others.

Return on Assets is a product of the Asset Turnover (ATO) ratio, the ability to turn assets into gross revenues, and the Operating Profit Margin (OPM) ratio, the ability to be efficient with expenses. Interestingly, the Asset Turnover ratio was not significant (p-value = .1159), meaning that the two profit groups' ability to turn assets into revenues was not statistically different. However, the Operating Profit Margin ratio was one of only five characteristics tested in 2014 that was significant at the 5% level. While both turning assets into revenues (ATO) and being efficient with expenses (OPM) are partners in determining Return on Assets, in this study, it was efficiency (OPM) that separated those that maintained profitability in later cyclically low years. That is not to say that turning assets into revenues (ATO) is not important, it's just not as different between the two groups. That is, both groups were able to get milk out of cows, but the high profit group did it with less expense.

Efficiency per unit is a function of production, costs of production, and price. Commodity agriculture is a price taker, so not surprisingly prices were not significantly different between the two groups in 2014. However, while at the lower 10% significance level, both costs of production per unit and production were significantly different. Thus, the high profit group produced significantly more on average (1,350 lbs/cow/year) but used less costs per hundredweight equivalent to do so compared to the low profit group. With exception of the depreciation expense ratio, the cost ratios as a percent of total revenues were not significantly less, indicating that higher production was likely more influential in the lower costs of production per unit. This supports the findings by Dhuyvetter (cf Dhuyvetter 2011: 11).

Farm managers, lenders, and consultants often focus on keeping debt at a modest level and maintaining, even building, working capital. As a risk management strategy, this is sound advice, but perhaps not as a strategy for greater profits. The level of debt as a percentage of assets, cows or cwteq was not significantly different between the high

and low profit group. The same was true for working capital as a percent of total revenues, expenses, cwteq, or assets. However, while the level of debt and working capital may not be a defining characteristic between high and low profit groups, how debt is used and how working capital is managed may be important.

Debt financing is a major tool for farm managers to improve efficiency (OPM) and increase profitable units of production (ATO). If the debt financed capital returns greater profits than the interest paid, then greater profitability results, an equity multiplier. However, it is a double-edged sword. If debt is used for purposes that do not return a profit greater than the interest rate (bad investments, covering losses, or restructured loans for capital assets that may no longer be in use), then it reduces profits. The multiplier still works, it's just negative instead of positive.

An indicator of whether debt is being used to positively multiply profitability is whether Return on Equity (ROE) is greater than Return on Assets (ROA). In 2014, 73% of high profit farms had ROE>ROA compared to 56% of low profit farms. After four years of low profitability, the high group fell to 42% (42% decrease), while the low profit group fell to 4% (93% decrease). While it is not known what the debt was used for by either group, these results indicate that the high profit group may have been better at using debt financing to invest in cost-saving, production-enhancing, or expanded economic units, while the low profit group may have been using debt to cover past losses, accounts payable, or restructuring old loans. The former may have prepared those farms well for the cyclical low that followed.

One area that was surprising to the author at least was that working capital, whether measured as a percent of total revenues, expenses, cwteq, or assets was not significantly different between the two groups in 2014. It was hypothesized that greater working capital would be significant in a business thriving well in a cyclical low. However, this was not the case. That said, working capital is a risk management/opportunity strategy and not a profitability strategy. Too much working capital would be better used paying off debt or investing in income-generating investments. Thus, the high profit farms not having significantly higher working capital may be more an indication of better cash management and/or uses of lines of credit as a substitute for standing working capital.

The area that was the most significantly different in 2014 between the high and low profit groups was any variables expressing farm size. High profit farms were significantly higher at the 5% level for total assets, total liabilities, herd size, and acres owned. This may indicate some economies of scale, greater capability to invest in profit-generating technologies, or even more diversity of income sources. While both groups grew

in herd size and acres owned from 2014 to 2018, the increase was greater for the high profit groups. This may indicate greater capacity to take advantage of lower capital asset prices during cyclical lows.

Conclusion and Remarks

Agricultural profitability is cyclical. Cyclical lows often result in farm losses and exit from the industry along with the trauma and stress that comes with it. However, cyclical lows are also times when capital assets are lower priced providing good opportunities for those with ability to invest. The primary question of this analysis was what financial and production characteristics a manager should strive for when times are good, to be best prepared for when times turn bad.

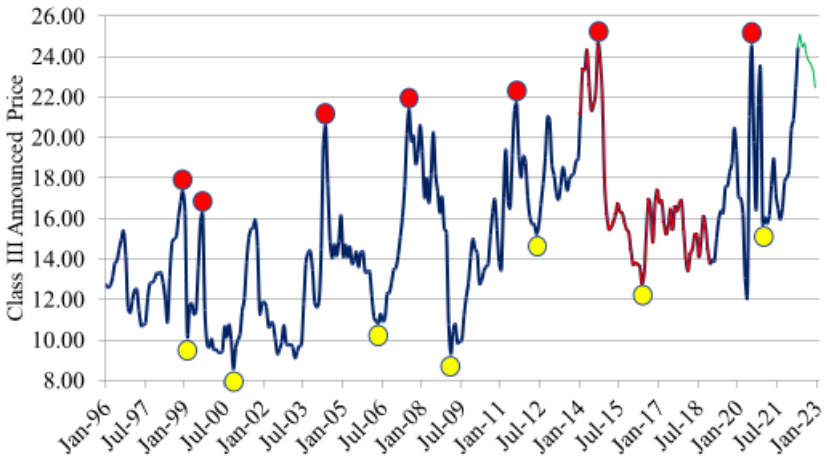
This study indicates that focus on cost efficiencies while maintaining and even improving production are key components. In addition, using debt capital on investments that improve efficiency and size (with efficiency) such that the gain in returns is greater than the interest rate paid may be key for preparing for a cyclical low. Extrapolating that theme, it may also be a wise management move to pay down as quickly as feasible deadweight debt, that is, debt that is not returning a profit greater than interest paid.

Further, success during cyclical lows enables a business to take advantage of lower capital asset price opportunities. The data shows this in that herd size was not only significant, but the herd size difference between the high and low profit farms grew by 19% during the cyclical low and the difference in acres owned grew by 86 percent.

Virtually everyone can make money during cyclical highs. Emotionally, it can create a euphoric optimism for the future and perhaps some generosity in spending. Afterall, many investments and family living activities were on hold during the previous cyclical low and now that cash is in hand, it may be time to "catch up," and often for good reasons.

That said, the cyclical high is also the best time to prepare the business for the cyclical low that is sure to follow. Updating plant and equipment, investing in efficiency gaining technologies, investing in right-sizing the operation for the future, paying down deadweight debt, and building at least modest working capital are a few potential strategies to pursue. Especially important are those strategies, investments, and technologies that will increase production per unit while maintaining or even hopefully lowering costs per unit. Price per unit will fall in the cyclical low, but if prior preparation has lowered the businesses costs of production per unit by more than the price drop, then profits are still being made.

Figure 1: Class III Monthly Milk Prices



Red line is years of study, 2014-2018
Green line is futures as of May 23, 2022

Cycle High	Cycle Low	Price Difference from Cylcical High to Low			Months from Cyclical High to Low
Dec-98	Feb-99	17.34	10.27	7.07	2
Sep-99	Nov-00	16.26	8.57	7.69	14
May-04	May-06	20.58	10.83	9.75	24
Jul-07	Feb-09	21.38	9.31	12.07	19
Aug-11	May-12	21.67	15.23	6.44	9
Sep-14	May-16	24.6	12.76	11.84	20
Jul-20	Dec-20	24.54	15.72	8.82	5

Avg + 1 Stdev	11.17	21
Avg + .5 Stdev	10.13	17
Average	9.10	14
Avg - .5 Stdev	8.06	10
Avg - 1 Stdev	7.03	6
Stdev	2.0706777	7.731691123

75%	75th %tile	10.80	20
50%	50th %tile	8.82	14
25%	25th %tile	7.38	7

Table 1: Regression Results, Dependent Variable: Return on Assets

SUMMARY OUTPUT

Regression Statistics	
Multiple R	83.82%
R Square	70.25%
Adjusted R Square	69.81%
Standard Error	2.9192
Observations	889

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	13	17607.105	1354.393	158.936	7.83 E-220
Residual	875	7456.413	8.522		
Total	888	25063.519			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	25.7783	2.4473	10.5335	1.65 E-24	20.9751	30.5815
2015 Dummy Variable	-8.2003	0.5922	-13.8470	1.43 E-39	-9.3626	-7.0379
2016 Dummy Variable	-9.9019	0.6876	-14.4013	2.35 E-42	-11.2513	-8.5524
2017 Dummy Variable	-7.8398	0.5699	-13.7562	4.01 E-39	-8.9583	-6.7212
2018 Dummy Variable	-9.3292	0.6734	-13.8533	1.33 E-39	-10.6509	-8.0075
Organic Dummy Variable	-0.6970	1.2327	-0.5654	0.5719	-3.1163	1.7223
Price, $/cwt	0.2190	0.0742	2.9503	0.0033	0.0733	0.3647
Production, lbs/cow/year	9.18 E-05	3.59 E-05	2.5584	0.0107	2.14 E-05	0.0002
COP before depr, int, & labor, $/cwteq	-1.1190	0.0472	-23.7083	2.31 E-96	-1.2116	-1.0263
Depreciation, $/cwteq	-1.5889	0.0882	-18.0200	5.55 E-62	-1.7620	-1.4158
Interest, $/cwteq	-0.1989	0.1802	-1.1040	0.2699	-0.5526	0.1547
Labor, $/cwteq	-1.4585	0.1704	-8.5588	5.07 E-17	-1.7929	-1.1240
Non-milk revenue:Total Revenue	-0.0237	0.0088	-2.6784	0.0075	-0.0410	-0.0063
Herd size	0.0015	0.0003	4.8239	1.66 E-06	0.0009	0.0022

Table 2: Farm Characteristics and Significance Tests of High versus Low Profit Farms

	2014, Cyclical High			2018, Cyclical Low		
	High Profit	Low Profit	P-Value	High Profit	Low Profit	P-Value
N	45	133		45	133	
Return on Assets, %	9.0	6.5	.0047**	5.0	-1.7	.0000**
Return on Equity, %	11.9	8.7	.0255**	5.9	-9.5	.0000**
Price, $/cwt	24.47	24.31	.2679	17.40	16.60	.0459**
Production, lbs/cow/year	23,678	22,328	.0517*	24,344	22,467	.0095**
Operating COP[1], $/cwteq[2]	13.80	14.54	.0703*	10.00	12.16	.0000**
Depreciation COP, $/cwteq	1.95	2.23	.0509*	1.66	2.01	.0083**
Interest COP, $/cwteq	.67	.68	.4766	.68	.84	.0430**
Labor COP, $/cwteq	3.16	3.40	.0901*	2.62	3.28	.0000**
Non-Milk Revenue:TR[3]	20.3%	17.0%	.0668*	22.7%	17.0%	.0198**
Total Assets, mil.	5.723	3.788	.0066**	6.291	4.012	.0066**
Total Liabilities, mil.	1.755	1.191	.0462**	2.078	1.698	.1808
Debt to Asset Ratio, %	27.9	25.6	.2289	30.4%	32.7%	.2698
Debt per Cow	4,816	4,383	.2030	5,246	5,298	.4689
Debt per cwteq	16.39	16.34	.4891	15.34	18.79	.0419**
Herd Size, head	361	232	.0154**	423	270	.0171**
Acres Owned	359	271	.0467**	449	286	.0035**
Working Capital to TR, %	25.6%	25.8%	.4821	24.9%	28.4%	.1722
Operating Profit Margin, %	20.9	16.1	.0077**	14.3	-6.4	.0000**
Asset Turnover Ratio, %	43.6%	39.1%	.1159	35.6%	28.4%	.0115**
Operating Expense Ratio, %	69.1%	70.1%	.3022	73.9%	82.6%	.0000**
Depreciation Expense Ratio	8.1%	9.2%	.0509*	10.3%	12.5%	.0083**
Interest Expense Ratio, %	2.8%	2.8%	.4766	4.2%	5.3%	.0430**

[1] COP = Costs of Production before depreciation, interest, and labor.

[2] cwteq = Hundredweight Equivalent. Hundredweight equivalent is a means to adjust costs of production per sales unit to just the primary product, in this case, milk. The cwteq is total farm income divided by milk price. Dividing costs by the cwteq is more reflective of the cost of producing just milk versus charging the cows for corn and other enterprise production costs.

[3] TR = Total Revenue from all sources.

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