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Surviving or Thriving? Key Profitability Drivers in the Dairy Industry

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EXECUTIVE SUMMARY

- Similar to most agricultural sectors, the dairy industry has been consolidating, in terms of the number of producers, for many years.
- In competitive industries, such as dairy, price equals cost in the long run, on average. Thus, it is critical to continuously strive to be better than average (recognizing the average is a moving target).
- A decision rule for profit maximization (or loss minimization) is to produce where marginal revenue is greater than marginal cost.
- When comparing historical returns from different regions of the country and different sources (accounting firms, Universities, government agency) the following observations can be made:
  - Top producers (e.g., top 20 - 33 %) were considerably more profitable than the average, as measured by $/cow/y.
  - Top producers had similar year-to-year variability in returns as the average of all producers (i.e., they had higher returns, but experienced similar risk).
  - On average, top producers had larger operations.
  - On average, top producers were more productive, in terms of milk produced per cow per year.
  - On average, top producers had lower total costs ($/cow/y), but similar feed costs per cow.
  - Average herd turnover rate or herd replacement rate was not a strong indicator of profitability.
  - High profit groups received slightly higher milk price, on average; but the impact is small, indicating other factors are more important in explaining profitability differences.
- In a commodity market, being a low cost *per unit of production* (which is not the same as lowest cost per cow) is critical to business survival. This is typically accomplished by minimizing fixed costs via cows milked through facilities and milk produced per cow.
- Historically a business strategy of maximizing cows through facilities was a very effective strategy; however, as larger operations have become the norm in the industry, it will become increasingly important to also focus on high production per cow as a means to reduce costs per unit of production.

ECONOMIC PRINCIPLES

Most sectors of agriculture, both crops and livestock, have seen tremendous increases in price volatility in the last 10 - 15 years. Large swings in both input and output prices have resulted in corresponding large swings in year-to-year profitability. A natural concern for dairy owners and managers is to think about, and focus on, ways to manage this risk. However, predicting where prices might go in real time is challenging and managing price risk is difficult for numerous reasons (e.g., marketing tools/options available, basis risk, time frame, etc.). Thus, for many dairy

owners and managers, it is more important to focus on things they have more control over. That is, making decisions based on sound economic principles and focusing on producing at the lowest cost/unit of production is important for long-term business survival. The number of dairy operations in the U.S. has been declining year-over-year for at least the last 50 years. That is, consolidation has been occurring long before the increase in price volatility, reinforcing the need to focus on much more than price risk.

The following are some economic principles/concepts that are important for managers to understand to ensure they are making sound economic business decisions.

1) Variable vs. fixed costs
2) Cash costs vs. economic costs
3) Price = cost
4) Marginal revenue vs. marginal cost

These principles are interrelated and help explain both the behavior of decision makers and trends that we observe in the industry. Following is a short explanation of each of the concepts.

Variable vs. fixed costs – Variable costs are defined as those costs that vary with additional production and fixed costs are those that are constant regardless of production. Fixed costs are directly related to the concept of economies of scale (scale). This relationship between fixed costs and economies of scale has been one of the major drivers of consolidation in the industry. We often use the term *dilution of fixed costs*, which means we can lower fixed costs *per unit of production* by increasing production. Classic examples of fixed costs are things such as facilities, management, overhead, etc. Variable costs are those costs that increase proportionately to production. For example, feed and supplies will increase as cows are added to an operation or as cows are milked more frequently. While fixed costs clearly affect the profitability of an operation, in the short run they can often be ignored when making decisions as to what is optimal (i.e., making decisions focusing on variable costs will lead to profit maximization or loss minimization).

Cash costs vs. economic costs – Managers easily can relate to cash costs, i.e., those costs that require a direct cash outlay (e.g., feed bill, vet bill, loan payment); whereas, economic costs are more difficult for many people to grasp. Put another way, cash costs are those things that show up on a cash flow statement with a lender. Cash and economic costs can be equal (and in many cases they are similar), but they can also vary considerably. Economic costs reflect the fact that all inputs (feed, supplies, labor, facilities, capital, etc.) need to be repaid or earn a competitive rate of return or else they will shift to another use in the long run. Cash and economic costs tend to differ for those things typically considered *fixed*. Economic costs incorporate the concept of *opportunity cost*, which may be different from what is actually paid (i.e., cash cost). Economic costs also incorporate the useful life of an asset as opposed to loan payments (or lack thereof), which is another reason economic costs can vary considerably from cash costs.

Price = cost – This economic principle implies that profits are equal to $0. It is important to recognize that the definition of profit here is *economic profit*, which means that all costs have been accounted for. A couple of additional qualifiers are needed regarding this statement -- profit equals zero, on average, in the long run, in a competitive industry. While many people get frustrated with this statement, i.e., “Why

am I in business if I'm not making any profit?" it is important to recognize the main result of this statement – over time the below average producer will go out of business. More importantly, it points to the need to constantly strive to be better than average, recognizing this is a moving target, for long-term business survival (either that or accept below average rates of returns to some inputs – typically labor and capital).

Marginal revenue vs. marginal cost – This concept is a key rule for profit maximization and simply suggests that something should be done if the revenue from making that change (i.e., marginal revenue) is greater than the cost of making the change (i.e., marginal cost). This concept generally would assume that some costs are variable and some are fixed, but that is not a requirement. Assuming some costs are fixed, making decisions to where *the last unit of output* (marginal revenue) is equal or slightly greater than the *last unit of input* (marginal cost) ensures fixed costs are being diluted as much as possible. While the concept is fairly straightforward, identifying the marginal revenue and marginal costs associated with various decisions can become quite complex in some situations for dairy operations.

It is important when thinking about marginal cost to focus on cost per unit of production rather than cost per cow. For example, if some management intervention (e.g., reduce heat stress) is incorporated that improves production, the cost per cow likely will increase, but the cost per pound of milk produced most likely decreases. Thus, an intervention such as this would be profitable even though it increased total costs per cow. The optimal level of production will depend on how much it costs to add incremental milk and that will vary between operations and management abilities. That is, at some point adding incremental milk will not be profitable as the marginal cost will be greater than the marginal revenue. However, most dairies likely are not at this point and thus increasing milk production per cow will be profitable.

EFFICIENCY IS KEY TO PROFITABILITY

The preceding discussion about economic principles generally point to one thing – efficiency is key to profitability. Efficient use of resources is a common attribute of highly profitable operations across business sectors. When considering efficiency in the dairy business, there are three main areas to consider:

1) Efficient use of current facilities,
2) Economies of scale, and
3) Efficient use of the cows.

These concepts may increase or decrease costs per cow, but almost always decrease cost per unit of milk produced, which is the key to profitability in a commodity market.

Maximize the use of current facilities – The concept of making the most efficient use of current facilities is generally well understood and implemented across the industry. For example, dairies attempt to maximize parlor efficiency (one of the big fixed costs of a dairy) by milking the most cows possible through the parlor in a 24-hour period. However, this parlor efficiency is only realized if there are sufficient cows available on the farm to be milked. Herds that have low reproduction often see swings in cow numbers that result in inefficient use of facilities (e.g., parlor use not maximized, open stalls and/or stalls filled with low producing cows). In the last 10 years, we have seen a significant improvement in reproductive efficiencies and these improvements have helped to not only

ensure that all cow slots on the dairy are full, but also that they are filled with a productive cow. As reproductive efficiencies increase, the ability to make voluntary culls (replace the least efficient cows) also increases. As top producers approach pregnancy rates > 25 %, the ability to maximize the use of current facilities is greater than most people ever thought possible.

Economies of scale – Similar to the importance of making sure that facilities are kept full at all times, the concept that larger dairies benefit dramatically from economies of scale has been behind many trends in the industry. Dairies in the Western US, particularly CA, benefitted from the benefits of milking a lot of cows on one facility. In fact, as early as 1997, the *average* cow in CA was found on a dairy with over 1000 cows, with many dairies milking over 2000 cows on a single site. At this same point in time, an *average* cow in Wisconsin would have been part of a dairy with just over 100 cows. CA and WI, the #1 and #2 dairy states in the country, are used to demonstrate a concept that helped to make the West very competitive in the dairy industry for a long time. However, in the last decade or so, this advantage for the West has essentially vanished as dairies in the Upper Midwest and Northeast have expanded and now are able to take advantage of similar economies of scale that the West has been doing for over 20 years. From 1997 to 2012, the size of the typical dairy in CA doubled (1159 to 2412 cows); however, the size of the typical dairy in WI increased almost 6X (113 to 639 cows; USDA and author calculations).

Milk production per cow – One of the key economic concepts discussed earlier was the idea that in a competitive market, price = cost. If this is true, that for the industry the price of milk is equal to the cost to produce it, on-average in the long run, then to survive in the industry one needs to be better than average. The two previous concepts highlight how efficient use of resources (e.g., cows through the parlor) and economies of scale have been used in the past to be competitive and be better than average. However, they also highlight the very important point that if you are not taking advantage of these concepts today, you are most certainly below average. With these two economic concepts becoming essentially table stakes, the final concept that can still be used to be better than average is to maximize production per cow, which will help dilute out maintenance cost on both a cow basis as well as a facilities basis over more pounds of milk.

The following section highlights multiple data sources looking at historical returns of dairy operations in different regions of the country. These data, from actual dairy operations, support the three concepts outlined above – efficient, farm size, productive – are key drivers of profitability differences between operations.

HISTORICAL DAIRY COSTS AND RETURNS

A common question often asked is "What are the primary factors that drive profitability differences across dairy operations?" One approach to gain insight into this question is to examine average historical returns from dairies (aggregated data) versus averages from a subgroup of dairies to determine what factors are related to higher or lower profitability. It is important to point out that this approach simply identifies factors that tend to be associated with higher profitability as opposed to a more rigorous approach that could identify statistically significant relationships. However, analyzing data from multiple sources and/or time periods with

Table 1. Data sources for analyses

Source	Type of Entity	Time period	Region	Subgroups
Karszes, J., W.A Knoblauch, and C. Dymond	University	1999-13	NY	Avg vs Top 20%
Nietzke & Faupel, P.C.	Accounting firm	2001-16	MI area	Avg vs Top 30%
California Department of Food and Agriculture	State agency	2006-16	CA	Herd size
Dhuyvetter[1]	University	2005-10	KS	Avg vs Top 33%
Genske, Mulder and Co., LLP	Accounting firm	2001-16	CA, ID, TX	Avg vs Top 25%

[1] Data for this analysis were from individual dairies by year and thus dairy averages reflected a multi-year average. All other data sources were annual comparisons (i.e., dairies included in the top percentile could vary from year to year).

this approach provides evidence as to how robust these results are.

Sources of data analyzed – Historical costs, returns, and limited production data were obtained from five different sources covering a range of geographies and analyses methodologies (Table 1). It can be seen that the various data sources cover a broad geographical region – i.e., Northeast, Midwest, Southern Plains, and West. The type of entity analyzing the data also varied, indicating the method of analysis is probably not consistent across data sources. Thus, while comparisons of groups within a data source are appropriate, comparing absolute values across data sources is less appropriate. The subgroups compared and the time periods vary slightly, but in all cases except one there were at least 10 years of historical data analyzed (and typically 16). The one study with less data (Dhuyvetter) used multi-year averages from individual dairies for comparison, which is preferred to year-by-year comparisons where the dairies included in the top percentile can vary. It is also important to point out that one study did not compare profitability subgroups (California Department of Food and Agriculture – CDFA). Rather than sort data based on profitability each year, these data were sorted based upon herd size. Thus, by definition, the difference in profitability between groups for CDFA is expected to be less than for the other data sources where groupings were based directly on profitability.

All herds versus top percentile groups – Table 2 reports average values of all herds versus the average of the top percentile groups for select variables. The difference in profitability ($/cow/y), remember the definition of profit varies by source, ranged from $154 to $523. The data source with the lowest difference (CDFA) is not surprising given that these data were sorted on herd size as discussed above. The key take home from this is that there are large differences between the average producers' returns and those of the top producers (keep in mind that

the average group includes the top producers). The variability of returns across time (Range) is generally quite similar for all herds compared to the top percentile group indicating that while the most profitable dairies have considerably higher profit they have similar year-to-year variability in their returns. This is not surprising given that much of the year-to-year variability is due to milk and feed price changes that are generally out of the producers' control.

Across all data sources, the top percentile group averaged larger herd sizes compared to the all herds' average. It is important to point out that while this result holds on average across the time periods and for most individual years, it is not true for every year (data not shown). That is, there have been several years where the average herd size for the most profitable group is smaller than for the all herd average. This reinforces that *being big does not guarantee success* (i.e., it is more important to be *good* than to be *big*). This is particularly true when you consider that the typical dairy is getting larger and larger and therefore most dairies are already capturing the benefits of economies of scale. However, it also reinforces that economies of scale exist where there are benefits to diluting fixed costs across more cows, on average. On average, milk production (Milk/cow) was greater for the most profitable farms across all data sources. As with herd size, this result does not necessarily hold every individual year across all data sources. This result also reinforces that there are benefits to diluting fixed costs (both associated with the dairy and the individual cow) across higher production per cow. These two factors indicate that the most profitable farms use their resources more efficiently than the average dairy by milking more cows and getting more milk per cow.

The total cost on a per cow basis (cost/cow) was lower for the top percentile dairies compared to the all herds in all cases and ranged from -$16 to -$249. The CDFA data that were sorted on herd size, as opposed to profitability, showed a slightly higher cost/cow for the large herds compared to the small/medium herds average. This lower cost is once again indicative of spreading fixed costs over more cows, with the obvious exception of the CDFA data. Similar to total costs per cow, feed costs per cow (Feed/cow) are generally slightly lower for the most profitable dairies; however, this difference is fairly small. Thus a general conclusion might be that the most profitable dairies have lower total costs, but roughly the same feed costs as other dairies – yet those similar feed costs per cow are associated with slightly higher milk production.

Given that total costs per cow were lower for the top percentile dairies and milk production was higher, total costs per hundredweight of production (Cost/cwt) were also lower, ranging from $0.70 to $2.18 less/cwt. On average across the studies, the total cost/cwt of milk produced was $1.21 lower for the top percentile dairies compared to the average for all herds. In times of extremely volatile markets, as the dairy industry has experienced in the last decade, this lower cost *per unit of production* can be an important part of risk management against lower prices. Even though feed costs per cow were similar, when that is combined with slightly higher milk production, feed costs/cwt of milk produced are lower for the top percentile dairies compared to the all herds average. This suggests that feed cost per cow is not a good indicator of profitability. Rather, feed cost per unit of production should be used.

Table 2. Summary of key indicators from various dairy data sources

Source/Group	Region	Years	$/cow/yr	Range	Herd size	Milk/cow	Cost/cow	Feed/cow	Cost/cwt	Feed/cwt	Milk price	Cull
Cornell[1]												
Avg	NY	1999-13	$510	$1,498	763	65.8	$3,221	$1,464	$13.34	$6.04	$16.74	33.8%
Top 20%	NY	1999-13	$932	$1,602	802	67.2	$2,972	$1,426	$12.04	$5.75	$16.89	32.2%
Difference			$422	$104	39	1.4	-$249	-$38	-$1.30	-$0.29	$0.15	-1.6%
N&F, P.C.[2]												
Avg	MI area	2001-16	$306	$2,018	1,380	63.9	$4,088	$1,749	$17.51	$7.48	$17.05	37.0%
Top 30%	MI area	2001-16	$637	$1,946	1,914	66.0	$3,928	$1,732	$16.31	$7.19	$17.15	37.1%
Difference			$331	-$72	534	2.1	-$160	-$17	-$1.20	-$0.29	$0.10	0.1%
CDFA[3]												
Small	CA	2006-16	$76	$1,826	359	69.4	$3,589	$2,152	$16.27	$9.75	$16.61	$279
Medium	CA	2006-16	$111	$1,902	887	71.3	$3,563	$2,132	$15.73	$9.40	$16.21	$310
Sm/Med avg	CA	2006-16	$94	$1,864	623	70.4	$3,576	$2,142	$16.00	$9.58	$16.41	$295
Large	CA	2006-16	$247	$2,175	2,218	75.1	$3,624	$2,192	$15.13	$9.14	$16.14	$327
Difference			$154	$311	1,595	4.8	$48	$50	-$0.87	-$0.43	-$0.27	$33
KSU[4]												
Avg	KS	2005-10	-$351	n/a	114	55.7	$3,964	$1,888	$19.50	$9.29	$16.29	26.0%
Top 33%	KS	2005-10	$172	n/a	133	62.4	$3,948	$1,956	$17.32	$8.58	$16.36	24.3%
Difference			$523	n/a	19	6.7	-$16	$68	-$2.18	-$0.71	$0.07	-1.7%
G, M and Co[5]												
Avg	CA	2001-16	$146	$1,501	1,822	69.6	$3,317	$1,817	$15.32	$8.36	$15.42	37.6%
Top 25%	CA	2001-16	$413	$1,577	2,661	70.3	$3,170	$1,742	$14.39	$7.89	$15.56	37.3%
Difference			$267	$76	840	0.7	-$147	-$75	-$0.94	-$0.47	$0.14	-0.3%

Table 2. Summary of key indicators from various dairy data sources (continued)

Source/Group	Region	Years	$/cow/yr	Range	Herd size	Milk/cow	Cost/cow	Feed/cow	Cost/cwt	Feed/cwt	Milk price	Cull
G, M and Co[5]												
Avg	ID	2001-16	$105	$1,553	1,898	69.6	$3,428	$1,807	$15.67	$8.22	$15.80	34.1%
Top 25%	ID	2001-16	$338	$1,970	2,172	70.8	$3,336	$1,761	$14.97	$7.88	$15.98	33.2%
Difference			$233	$417	274	1.2	-$92	-$46	-$0.70	-$0.34	$0.18	-0.9%
G, M and Co[5]												
Avg	TX	2001-16	$201	$1,877	1,928	66.0	$3,344	$1,658	$16.50	$8.13	$16.91	35.0%
Top 25%	TX	2001-16	$496	$1,824	2,371	68.1	$3,201	$1,610	$15.24	$7.63	$16.98	33.7%
Difference			$296	-$52	442	2.1	-$143	-$48	-$1.26	-$0.50	$0.07	-1.3%

[1] Karszes, et al., 2014
[2] Nietzke & Faupel, P.C., 2016
[3] California Department of Food and Agriculture, 2015
[4] Dhuyvetter, 2011
[5] Genske, Mulder and Co., LLP, 2017

Dairies in the top percentile groups averaged slightly higher milk prices, with the exception of the CDFA data, but the difference was relatively small ($0.12/cwt, excluding CDFA). Without knowing more information, it is impossible to tell what this slightly higher price is attributed to. Based on data regarding futures gains/losses (when available), it does not appear to be related to market timing/strategies (data not shown). Rather, it likely is due to volume and/or quality premiums. Regardless of what is driving the price difference, the impact is relatively small (e.g., $0.12/cwt on 70 lb/d is about $30/cow/y) compared to the total difference in profit indicating other factors are more important.

The final variable considered was a measure of herd turnover rate or annual culling. This variable is reported differently for each of the entities and thus cannot be compared across data sources. For example, the CDFA study reports an annual replacement cost ($/cow/y); whereas, all other studies report a turnover or culling rate (percent). The more profitable herds had a lower culling rate for five of the seven data sets, but two actually had a slightly higher culling rate or cost for the more profitable herds. Lower culling rates/lower herd turnover is preferred *all else equal*; however, it has been shown that a higher culling rate can be more profitable if it results in higher production (Dhuyvetter et al., 2007). In other words, without knowing why animals are leaving the herd (voluntary vs. involuntary) it is hard to determine if it is a good thing or a bad thing. Thus, these mixed results regarding the relationship between culling and profit grouping are not unexpected.

CONCLUSION

Currently many sectors in agriculture are facing tough margins due to market prices and thus it is easy and/or tempting to let these prices influence decisions that may not be optimal. As a general rule, in a commodity market being a low cost producer – *on a per unit of production basis* -- is critical for long-term business survival. Having an understanding of several key basic economic principles is important for both producers and their advisors to help them make sound economic decisions. While the need to make sound economic decisions is always important, it becomes even more critical in times of tight margins. Additionally, as operations get larger, the need to manage them more *business like* will also likely increase (i.e., base decisions more upon data and analyses and less on *gut feel*).

The profitability for dairy operations (and most all other agricultural enterprises) varies tremendously over time due to market cycles. While this variability can cause significant financial pain and hardship, it is important for producers and their advisors to focus on things they can control and manage. More importantly, profitability of dairy operations is extremely variable *across* operations indicating that management and how resources are used is important; thus, making well-informed management decisions related to production can make the difference between profit and loss and hence long-term business survival. Two factors that are consistent in explaining more profitable operations are greater herd size and production per cow – both of these are methods of spreading large fixed costs associated with running a dairy across more production (i.e., dilution of fixed costs).

REFERENCES

California Department of Food and Agriculture. 2015. California Cost of Milk Production, 2015 Annual. Accessed 12/28/2016 at: http://www.cdfa.ca.gov/dairy/dairycop_annual.html. (Similar reports from earlier years.)

Dhuyvetter, K. 2011. Factors Impacting Dairy Profitability: An Analysis of Kansas Farm Management Association Dairy Enterprise Data. Department of Agricultural Economics, Kansas State University, Manhattan. Accessed 12/28/2016 at: http://www.agmanager.info/node/7139.

Dhuyvetter, K.C., T.L. Kastens, M. Overton, and J. Smith. 2007. Cow Culling Decisions: Costs or Economic Opportunity? Proc. 8th Western Dairy Management Conference, Reno, NV. Pp 173-187.

Genske, Mulder and Company, LLP. 2016. Cost Studies for the Year Ended December 31, 2015. http://www.genskemulder.com/industries/dairy/. Actual reports are proprietary and not publicly available on website. (Similar reports from earlier years.)

Kansas Farm Management Association. 2016. 2015 Enterprise Summary Dairy Cows State. Accessed 12/28/2016 at: http://www.agmanager.info/kfma/enterprise-reports. (Similar reports from earlier years.)

Karszes, J., W.A. Knoblauch, and C. Dymond. 2014. Dairy Farm Business Summary – New York Large Herd Farms, 300 Cows or Larger, 2013. E.B. 2014-05. Department of Agricultural, Resource, and Managerial Economics, College of Agriculture and Life Sciences, Cornell University, Ithaca, New York. Accessed 12/28/2016 at: http://www.dairychallenge.org/pdfs/2014_Northeast/DFBSlargeherd2013EB2014-05.pdf). (Similar reports from earlier years.)

Nietzke and Faupel, PC. 2016. Dairy Advantage Accounting and Benchmarks 2015 Annual Report. http://www.nfcpa.com/agriculture/dairy-advantage-accounting-and-benchmarks/. Actual reports are proprietary and not publicly available on website. (Similar reports from earlier years.)

USDA NASS, Quick Stats. https://quickstats.nass.usda.gov/. Census data of inventories and operations with milk cows by state. Accessed 2/9/2018 at: https://quickstats.nass.usda.gov/.