Effects of Low Milk Prices on U.S. Dairy Farms in 2000

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Abstract

Effects of low milk prices on U.S. dairy farms are assessed using a survey of U.S. dairy operations. Although small dairy operations were particularly vulnerable to the decline in milk prices in 2000, 41 percent of these operations were able to produce milk at a cost that was competitive with larger operations. This suggests that the managerial ability of individual dairy producers is likely to be as important as size economies to lowering the costs of milk production.

Keywords: dairy farms, milk prices, milk production costs and returns, size economies, management.

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In 2000, milk prices slipped below $13 per hundredweight (cwt) for the first time since 1995 and were more than $3 lower than the 1998 record (figure 1). Although the financial position of dairy farms hinges on many factors in addition to the price of milk (Short and McBride; El-Osta and Johnson; Short), the decline in milk prices adversely affected the financial position of many dairy farms, and forced some to exit the industry. Particularly vulnerable were small operations with low production efficiency. Larger dairy operations with high rates of production were likely to continue to operate profitably (Fallert, et. al.).

Technological advances in genetics, milking systems, feed, and herd management have paved the way for more efficient, profitable, larger dairy operations (Perez; El-Osta and Morehart; Matulich). Larger dairy operations benefit from economies of scale that increase labor productivity and reduce production costs over larger volumes of production (Collins; Johnson and Grabanski). These larger operations have a better chance at staying competitive and financially solvent as milk prices fluctuate. According to government statistics, more than 60 percent of dairy operations exiting the industry between 2000 and 2001 had less than 50 milk cows (table 1). During this same period, 120 new dairy operations with 500 or more milk cows entered the industry.

The objectives of this paper are to present information about the relationship between milk production costs and size of operation, and to examine what this implies for the structure of milk production during a period of low milk prices. Whereas a number of studies have examined the relationship between milk production costs and size for individual milk-producing states (Matulich; Grisley and Gitu; Grisley and Mascarenhas; Frank, 2001; Frank and Vanderlin;

Smith; Casler; Johnson), this study differs in that it uses representative and probability-based data from a national survey of major milk-producing states.

Production Costs and Business Decisions

Business decisions, such as how much or whether or not to produce, are based on the relationship between production costs and expected product price, and the length of the planning period. In a short-term planning period where decisions are made about the mix of feed fed, decisions are based only on the level of operating costs. Operating costs include major inputs such as feed, veterinary and medicine, bedding and litter, marketing, customs operations, fuel, lube, electricity, repairs, interest on operating inputs, and hired labor. During a short-term span, ownership costs are fixed regardless of these decisions.

As the length of the planning period increases and decisions about replacing capital assets are faced, the level of total costs (operating plus asset ownership costs) needs to be considered. Ownership costs include the annualized cost of maintaining the capital investment (depreciation and interest) in dairy facilities and equipment, and costs for non-real-estate property taxes and insurance. Because of the substantial investment period required in replacing dairy production facilities, this is the time that most dairy producers must decide whether or not to stay in business. Among dairy producers, longer-term decisions are made every 10-20 years, as facilities need to be replaced.

Data and Methods

Data for the analysis came from a detailed survey of U.S. dairy operations conducted in 2000 as part of the USDA's annual Agricultural Resource Management Survey (ARMS). Each farm sampled in the ARMS represented a known number of farms with similar attributes so that weighting the data for each farm by the number it represents provides a basis for calculating estimates for the target population. The target population in the dairy survey was operations milking 10 or more cows at any time during 2000. The survey collected information about dairy production practices and performance, milk costs of production, farm financial status, and operator human capital and demographic characteristics. The data included 872 dairy operations in 22 states (figure 2) and covered about 90 percent of U.S. milk production in 2000 (NASS, April 2002).

Official USDA dairy production costs and returns estimates are presented on a per cwt of milk sold basis. These estimates include all the costs and returns associated with the products produced on the dairy enterprise, including those for milk, cattle sales, manure production, and other sources. As a result, the costs associated with the production of 100 pounds of milk cannot be directly compared to the milk price.

In order to compare the average all milk price received by dairy farmers in 2000 to milk costs of production, the costs estimated from the 2000 dairy ARMS data were allocated to those for milk and those for other products using the 'CWT of Milk Sales Equivalent (CWT EQ)' method advocated by Frank, 1998; where:

CWT EQ = Total Gross Value of Production / U.S. All Milk Price per CWT.

CWT EQ is the cwts of milk the enterprise would have had to sell in order to have had the same total gross value of production it had, without the joint products income (including cattle sales, income from renting or leasing dairy stock to other operations, renting space to other dairy operations, co-op patronage dividends associated with the dairy, assessment rebates, and manure production). The cost items were then divided by the CWT EQ.

Operating plus asset ownership costs were used in the analysis of production costs. These costs indicate the dairy operation's ability to meet short-term debt obligations and to replace capital assets as needed, and thus stay in business. The cumulative distribution of operating and ownership costs per CWT EQ cost was plotted for specified size groups to determine what percent of producers in each size group were able to cover costs at the U.S. all milk prices that prevailed in 2000. Size of operation was specified according to the milk cow numbers on each farm and grouped to match reported farm numbers by size of operation (NASS, February 2002): small farms – less than 50 head; medium farms – 50-199 head; large farms – 200-499 head; industrial-scale farms – 500 head or more.

Results and Conclusions

Small- and medium- sized dairy operations far outnumbered large and industrial-scale operations during 2000 (table 2). Thirty-nine percent of dairy operations were small, but these small

operations accounted for only 10 percent of total milk sales. Only 4 percent of dairy operations were industrial-scale, but these operations accounted for more than one-third of milk sales.

Farm specialization in dairy production increased with size, with the value from dairy ranging from 75 percent of total farm value of production on small operations to 93 percent on industrial-scale operations (table 2). More than 40 percent of dairy operations across the size groups had been in business more than 20 years (table 2). This means that some of these producers were likely at the point at which business decisions about facility replacement were necessary. Of the almost 8,000 dairy operations that exited the dairy industry between 2000 and 2001, more than 60 percent were small dairy operations (table 1). Forty-two percent of small farms reported intentions of exiting dairy production within the next 5 years, compared with very few of the industrial-scale operations (table 2). Production intentions reported in the 2000 ARMS support other data (NASS, February 2002) that indicate more than 7,500 small- and medium-sized operations exited the industry between 2000 and 2001. The data also suggest that many more small- and medium-sized operations will cease production in the next 10 years. By 2010, 65 percent of small producers plan to be out of business, while 84 percent of industrial-scale operations plan to remain in business.

In general, indicators of physical and economic performance improved as size of operation increased. Feed efficiency was significantly higher on industrial-scale dairy operations. Greater feed efficiency on the part of these operations results from both more output per cow, and less feed fed per CWT EQ. Industrial-scale operations fed 162 pounds of feed per CWT EQ, compared with 243 and 252 pounds on small and medium operations, respectively (table 2). The

general ration formulation fed by all dairy producers is much the same. Thus, differences in feed efficiency can likely be attributed to better management of feeding systems and higher performance genetics. Industrial-scale operations were also more labor-efficient, using only 0.11 total labor hours per CWT EQ. Small, medium, and large dairy operations used significantly more labor.

Industrial-scale dairy operations had significantly lower operating and ownership costs than small and medium operations, averaging $10.74 per CWT EQ (table 2). This is indicative of the economies of scale (i.e., spreading costs over more units of production) experienced as the size of the enterprise increases. However, improvements in performance from the small to the industrial-scale operations were not linear, but rather incrementally less with each size group. The largest efficiency gains were made between the small and medium groups. Average costs on medium-sized dairy operations were about 10 percent less than on small operations, while average costs fell about 8 percent between the medium and large groups and almost 9 percent between large and industrial-scale operations. These data suggest that production costs are reduced significantly by increasing the size of operations from relatively small sizes, but that there are still cost-reducing incentives for operations to grow to the industrial-scale.

While mean costs by size of operation reveal information about the relative competitiveness of various sized operations, they mask the underlying variation in costs. Cost variation among dairy operations in each size group is illustrated in figures 3-6. The variation in cost was greatest among the small dairy operations, and least among the large and industrial-scale operations. The cost distributions also show that despite higher average costs among the small- and medium-

sized groups, many of these operations produce at a cost that is competitive with larger operations. For example, at an all milk price of $12.40 per cwt, 41 percent of small producers covered production costs in 2000, compared with 85 percent of the industrial-scale producers. However, this 41 percent corresponded to about 11,000 small operations, compared with about 2,400 industrial-scale operations (table 2). Therefore, there is substantial variation in production costs that cannot be attributed to size of operation. This suggests that the managerial ability of individual dairy producers is likely to be as important as size economies to lowering the costs of dairy production.

Well-managed small- and medium-sized operations able to cover total costs at an all milk price of $12.40 per cwt manifested production efficiencies similar to larger operations. Feed efficiency was significantly higher on small- and medium-sized operations covering total costs than on those operations not covering total costs. Greater feed efficiency resulted from both significantly higher output per cow, and less feed fed per CWT EQ (tables 3 and 4). Small- and medium sized operations covering total costs were also more labor efficiently, using significantly less labor hours per CWT EQ than small- and medium-sized operations not able to cover total costs.

Well-managed small- and medium-sized operations covering total costs had significantly lower operating and ownership costs than small- and medium-sized operations not covering total costs (tables 3 and 4). These result suggest that, in the long run, these small- and medium-sized dairy operations can withstand the negatives effects of fluctuating milk prices and continue to operate profitably.

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Table 1. Number of dairy operations

Size of operation (number of cows)	Number of operations 2000	2001	Change
Small (1-49)	52,920	48,020	-4,900
Medium (50-199)	44,225	41,550	-2,675
Large (200-499)	5,350	5,195	-155
Industrial-scale (500+)	2,675	2,795	+120

Source: NASS, Milk Production, February 2002.

Table 2.—Characteristics and performance of dairy farms, by enterprise size, 2000

Item	Enterprise size (number of milk cows)			
	Small (a)	Medium (b)	Large (c)	Industrial-scale (d)
	Less than 50	50-199	200-499	500 or more
Number of farms	27,917	37,171	3,396	2,848
Dairy cattle inventory (*number*)	946,030	3,312,139	1,074,616	2,751,722
Share of ARMS (*percent*)				
Dairy farms	39	52	5	4
Milk sales	10	41	14	35
Milk cows (average number per farm)	33 b c d	88 a c d	313 a b d	955 a b c
Farm production value from dairy (percent)	75 d	83 d	88	93 a b
Operator age (percent less than 55 years)	74	68	61	71
Farm debt-to-asset ratio	0.16 d	0.19 d	0.23 d	0.36 a b c
Farms exiting industry in 5 years or less (percent)	42 b c d	29 a c d	17 a b d	3 a b c
Farms exiting industry in 6 to 10 years (percent)	23	25 d	22	13 b
Farms in industry 20 years or more (percent)	48 d	55	64	*42 a
Output per cow (pounds)	14,932 b c	16,157 a	17,420 a	17,326
Labor efficiency (hours per CWT EQ)	0.66 b c d	0.37 a c d	0.17 a b d	0.11 a b c
Feed efficiency (pounds per CWT EQ)	243 d	252 d	#317	162 a b
Production costs (dollars per CWT EQ):				
Feed costs	6.42	5.52	5.14	5.71
Operating costs	9.39	9.09	8.77	9.28
Ownership costs	4.77 b c d	3.72 a d	2.99 a d	1.46 a b c
Total operating and ownership costs	14.16 c d	12.81 d	11.76 a	10.74 a b

Coefficient of **V**ariation = (Standard Error/Estimate)*100. * indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75.

a, b, c, d indicate that estimates are significantly different from the indicated enterprise size above the 90 percent or better level using the t-statistic.

Source: 2000 USDA Agricultural Resource Management Survey.

Table 3.—Characteristics and performance of small dairy farms, 2000

Item	Small farms (less than 50 milk cows)	
	Covering total costs (a)	Not covering total costs (b)
Number of farms	10,908	17,009
Dairy cattle inventory (*number*)	390,310	555,720
Share of ARMS (*percent*)		
Dairy farms	41	59
Milk sales	48	52
Milk cows (average number per farm)	35 b	32 a
Farm production value from dairy (percent)	76	75
Operator age (percent less than 55 years)	83 b	67 a
Farm debt-to-asset ratio	0.15	0.17
Farms exiting industry in 5 years or less (percent)	44	40
Farms exiting industry in 6 to 10 years (percent)	na	30
Farms in industry 20 years or more (percent)	52	45
Output per cow (pounds)	16,908 b	13,539 a
Labor efficiency (hours per CWT EQ)	0.55 b	0.77 a
Feed efficiency (pounds per CWT EQ)	102 b	283 a
Production costs (dollars per CWT EQ)		
Feed costs	3.54 b	9.35 a
Operating costs	5.97 b	12.87 a
Ownership costs	3.17 b	6.41 a
Total operating and ownership costs	9.14 b	19.28 a

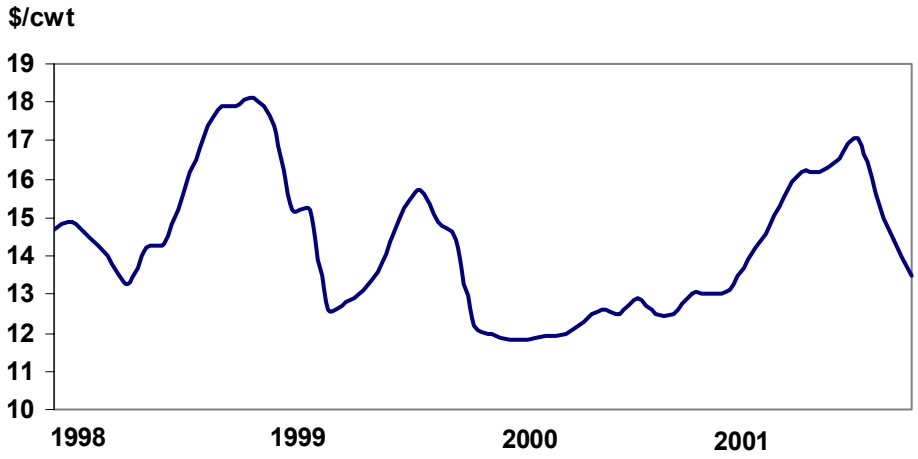
Coefficient of **V**ariation = (Standard Error/Estimate)*100. * indicates that CV is greater than 25 and less than or equal to 50.
na indicates value is not available due to no observations, an undefined statistic, or reliability concerns.
a, b indicate that estimates are significantly different above the 90 percent or better level using the t-statistic.
Source: 2000 USDA Agricultural Resource Management Survey.

Table 4.—Characteristics and performance of medium dairy farms, 2000

Item	Medium farms (50-199 milk cows)	
	Covering total costs (a)	Not covering total costs (b)
Number of farms	18,231	18,940
Dairy cattle inventory (*number*)	1,652,350	1,659,788
Share of ARMS (*percent*)		
Dairy farms	49	51
Milk sales	57	43
Milk cows (average number per farm)	90	87
Farm production value from dairy (percent)	84	83
Operator age (percent less than 55 years)	73	63
Farm debt-to-asset ratio	0.17	0.20
Farms exiting industry in 5 years or less (percent)	27	31
Farms exiting industry in 6 to 10 years (percent)	23	26
Farms in industry 20 years or more (percent)	49 b	62 a
Output per cow (pounds)	18,204 b	14,118 a
Labor efficiency (hours per CWT EQ)	0.31 b	0.46 a
Feed efficiency (pounds per CWT EQ)	133 b	*320 a
Production costs (dollars per CWT EQ)		
Feed costs	4.05 b	7.48 a
Operating costs	6.95 b	11.92 a
Ownership costs	2.95 b	4.73 a
Total operating and ownership costs	9.90 b	16.65 a

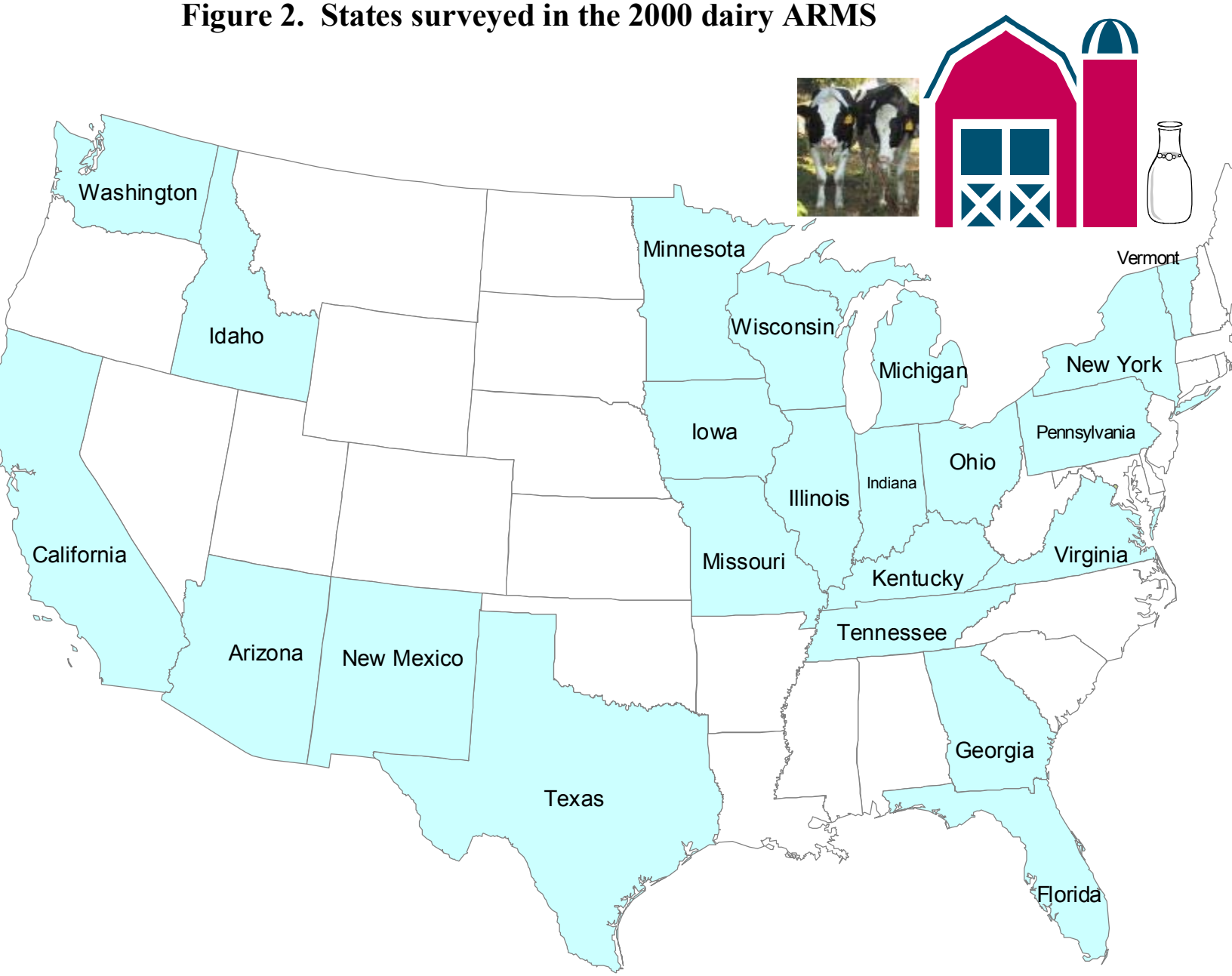
Coefficient of **V**ariation = (Standard Error/Estimate)*100. * indicates that CV is greater than 25 and less than or equal to 50.
a, b indicate that estimates are significantly different above the 90 percent or better level using the t-statistic.
Source: 2000 USDA Agricultural Resource Management Survey.

Figure 1. Monthly U.S. average all milk price, 1998-2001



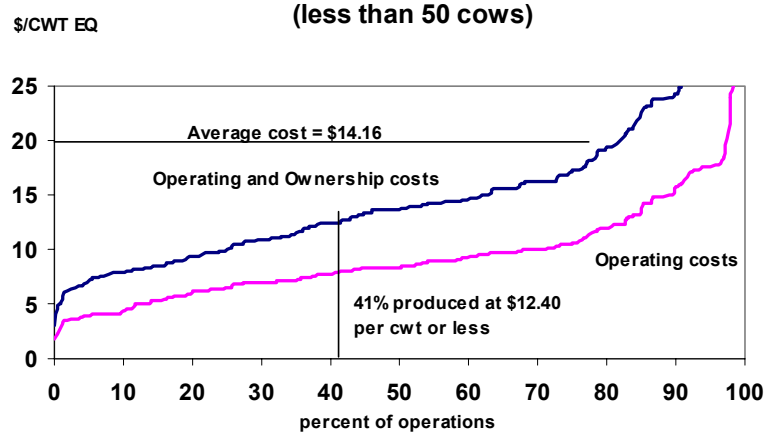
Source: NASS, Agricultural Prices Annual Summary, July 2002.

Figure 2. States surveyed in the 2000 dairy ARMS



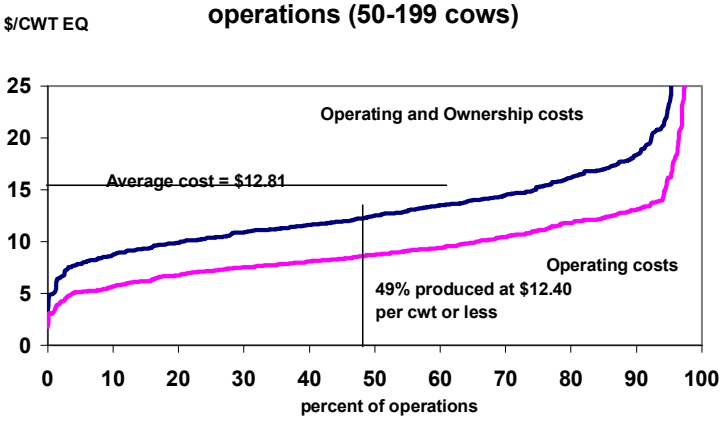
Source: 2000 USDA Agricultural Resource Management Survey.

Figure 3. Cost distributions, small dairy operations (less than 50 cows)



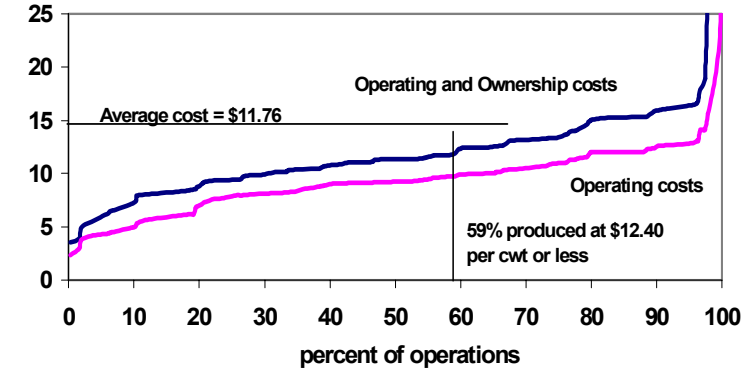
Source: 2000 dairy Arms survey.

Figure 4. Cost distributions, medium dairy operations (50-199 cows)



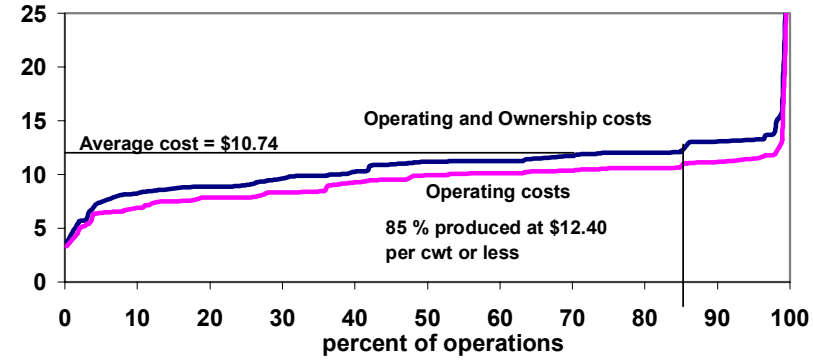
Source: 2000 dairy ARMS survey.

Figure 5. Cost distributions, large dairy operations (200-499 cows)



Source: 2000 dairy Arms survey.

Figure 6. Cost distributions, industrial-scale dairy operations (500 cows or more)



Source: 2000 dairy Arms survey.