Determinants of Farm Size and Structure

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MANAGERIAL FACTORS THAT AFFECT NEW YORK DAIRY FARM PROFITABILITY

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Managerial factors that affect the profitability of farming have been studied for decades. This paper uses data from 424 farms that were included in the 1987 New York dairy farm business summary (DFBS) to assess the relationship between several factors over which farm operators have some degree of managerial control and profitability as measured by labor and management income per operator (L&MI). In the New York (Cornell) system, L&MI is calculated by subtracting accrual expenses including non-operator family labor and interest paid, from accrual receipts and then deducting a 5 percent real interest charge on the owners equity. The 424 farms are those on which the operator owns at least some of the real estate (full renters are excluded) and on which crop sales are less than 10% of milk sales.

A later section will study the relationship between management factors and cost of producing milk. Finally, comparisons will be made between the results of this study and another study of similar data.

The reader should be aware of some of the problems with the use of farm record data from voluntary cooperators. The major problem is that the data are non-random and there is no practical way of knowing how much the non-randomness affects the results. The New York data are known to come from, on the average, larger than average dairy farms and it is quite likely that the farms are also, on average, above average in profitability. In addition, the use of only one year's data could be misleading because of year to year variability in items such as prices and yields. The year 1987 was one of the more profitable for New York dairy farmers in recent years.

A longer series of data such as 10 years on identical farms would alleviate some of the variability problems. However, this introduces other problems such as lower numbers of farms and the possibility of bias because the less profitable farm operations may have discontinued farming or discontinued cooperation with the record system. Later in the paper some comparisons with data from a 10 year period will be made.

Each year the DFBS data are sorted by variables such as herd size and pounds of milk sold per cow and reported in publications distributed to cooperators, other farmers and agribusiness persons.

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Table 1 shows the 1987 sort on cow numbers along with labor and management income and other data. This table differs slightly from the one in Smith, et al. because two farms were deleted because this author believed they were not appropriate to include.

This table suggests that there is a rather strong relationship between herd size and L&MI. However, there are other factors that may be correlated with herd size that may contribute to the relationship (see the discussion about Table 2 below).

The relationship between herd size and Net Farm Income (NFI) appears to be stronger than the relationship with L&MI. However, this is misleading because the larger farms are more likely to have multiple operators sharing the NFI which is calculated on a per farm rather than per operator basis.

The data are also sorted into 10 groups by pounds of milk sold per cow (Table 2). This table shows a rather strong relationship between milk sold per cow and L&MI. However, the farms with higher milk per cow also tend to have larger herds so the relationship between milk per cow and L&MI is partly due to herd size.

When the data are sorted by measures of labor efficiency such as cows per worker or milk produced per worker the farms with higher labor efficiency tend to be more profitable. Again, this is partly due to other factors; the larger farms tend to have higher labor efficiency. These sorts are not shown in this paper.

In an effort to sort out the fact that there is some relationship between herd size, milk production per cow and labor efficiency, a multiple regression was performed on the data. Several variables were chosen which were known from previous studies to be related to farm profitability as measured by L&MI. These variables were measures of size of business (number of cows), yields (pounds of milk sold per cow) and labor efficiency (cows per worker). Cows per worker was used rather than milk produced per worker because it was less highly correlated with herd size.

Several other measures (barn type, that is free stall vs. stanchion, haylage dry matter as a proportion of all dry matter) that had been used by Kauffman and Tauer in an earlier multi-year study of DFBS data were also included in other regressions but were found to have "incorrect" signs and also to have non-significant coefficients. In addition, several other variables that had been identified in previous studies to be related to profitability were included in other regressions but were found to be non- significant. These were total forage dry matter yield per acre (similar to hay yield per acre used in Kauffman and Tauer) and corn silage dry matter as a percentage of total dry matter produced.

The results of the regression analysis are shown in Table 3. The coefficients for number of cows, pounds of milk sold per cow and cows per worker are all highly significant. However, the R^2 is rather low. Clearly, factors not included in the regression are responsible for much of the variation in L&MI. This author is more confident in the effect of the three factors on L&MI when looking at the tabular results than when studying the regression results.

Cost of Producing Milk

The DFBS data have been used to relate herd size and milk sold per cow to cost of production per cwt. (Table 4). Costs are calculated using the "whole farm" method whereby all items produced other than milk are assumed to be produced at the value for which they are sold or inventoried. This procedure may give different results from that obtained by enterprise accounting but on the average milk sales are 85 percent of total receipts so on most farms the bias should be small.

There is little difference among herd size groups in operating costs (excluding costs for operator labor, management and equity capital and depreciation of real estate and equipment). However, total production costs, including imputed costs, decline rather steadily as herd size increases.

When the data are sorted by milk sold per cow, there appears to be some decline in operating cost per cwt. as milk per cow increases. However, the difference among groups are small except for the group with the lowest production and the two or three highest groups. Total cost per cwt. declines quite steadily and markedly as milk sold per cow increases.

A sort by milk sold per worker (not shown here) shows a steady decline in total cost per cwt. of milk, from $19.44 with less than 200,000 lbs. per worker to $12.08 with 700,000 lbs. or more per worker. This factor is quite highly correlated with both cows per farm and milk per cow. The sort by cows per worker was not available at the time this paper was written.

A regression was performed on the relationship of cows per farm, milk sold per cow and cows per worker to operating cost and total cost per cwt. of milk sold (Table 5). The three variables have little relationship to operating costs, as expected from inspection of the tabular data. However, the same variables explain somewhat more of the variation in total cost of milk production than they do of the variation in L&MI. It could be argued that a linear relationship between herd size and total cost of production is not entirely logical, that is, at some herd size, cost of production would be zero. This argument may also be valid with respect to the other two variables. Therefore, a regression in logs was performed on the same data and is presented in the last column of Table 5. This regression explains about 32 percent of the variation in the total cost of production per cwt.

One conclusion that might be drawn from the regression results is that these variables may be less important in determining total cost per cwt. of milk than one might conclude from observing the tabular data.

With respect to farm size, it appears to this author that there is enough relationship between herd size and total cost of production that there will be continued incentive for at least some dairy farmers in New York to continue to increase herd size.

Comparison with a Multi-Year Study

Kauffman and Tauer (KT) performed an analysis on 112 farms that cooperated with the DFBS program continuously during the 1974-83 period. First and second degree stochastic dominance were used to separate the farms into successful and less successful groups based on L&MI, L&MI per cow, return on equity capital and return on equity capital excluding appreciation. Logit regression was then used to identify farm characteristics (out of 16) leading to success, which was defined as being in the top half rather than the bottom half by profitability.

KT found milk sold per cow and herd size to be two of the most important variables of the 16 that they considered in explaining the variation in L&MI. They also found that single proprietor farms were more likely to be in the top half. This was attributed to dividing the profit among several operators (or in their words, dilution of earnings by excess labor).

KT also found that barn type (free stall vs. stanchion) was not important in determining profitability. This is a rather curious result when one considers the fact that several thousand New York dairy farms have switched from stanchions to free stalls in the last 25 years and that practically no one has switched in the opposite direction.

In the current study, when a stanchion-free stall zero-one variable was added to the L&MI equation, free stall farms were found to be much less profitable than stanchion farms, but the coefficient was insignificant so it was deleted. However, a sort of the stanchion and free stall farms into two groups resulted in a situation where the larger stanchion farms had a herd size about equal to the smaller free stall farms (88 and 83, respectively). The stanchion farms had a higher average L&MI ($8,414) than the free stall farms ($6,525).

Conclusions

It is clear that this study, like many others, has not identified management factors that account for a high proportion of the variability in profitability among farms. The current study identified three factors, herd size, milk sold per cow and cows per worker that explained about one-fourth of the variability in L&MI and about one-third of the variability in total cost of producing a cwt. of milk. Even so, one could raise the question of what management factors are related to milk sold per cow, which could be considered to be more of a result than a management factor.

Table 1.

COWS PER FARM AND FARM INCOME MEASURES
424 New York Dairy Farms, 1987

Number of Cows	Average Number of Cows	Number of Farms	Net Farm Income (w/o apprec.)	Labor & Management Income Per Operator
Under 40	33	32	$11,140	$1,228
40 to 54	47	69	15,546	4,429
55 to 69	62	74	17,099	1,362
70 to 84	77	71	26,024	6,573
85 to 99	90	41	34,773	12,999
100 to 149	119	70	41,411	10,501
150 to 199	170	30	56,906	15,288
200 to 299	241	27	81,414	27,968
300 & over	370	10	159,643	67,047

Table 2.

MILK SOLD PER COW AND FARM INCOME MEASURES
424 New York Dairy Farms, 1987

Pounds of Milk Sold Per Cow	Number of Farms	Average Number of Cows	Net Farm Income w/o Apprec.	Net Farm Income Per Cow	Labor & Management Income/Oper.
Under 12,000	27	75	$7,326	$98	$-3,980
12,000 to 13,999	47	80	21,361	267	4,442
14,000 to 14,999	48	81	19,092	236	877
15,000 to 15,999	77	103	33,063	321	8,493
16,000 to 16,999	90	102	36,452	350	13,084
17,000 to 17,999	67	105	39,798	379	12,757
18,000 to 19,999	52	102	44,409	435	16,173
20,000 & over	15	174	94,409	574	36,106

Table 3.

REGRESSION RESULTS FOR THE RELATIONSHIP BETWEEN SEVERAL MANAGEMENT FACTORS AND LABOR AND MANAGEMENT INCOME PER OPERATOR, CORNELL, DFBS, 1987

Independent Variable	Coefficient	Means
No. of cows	99.6188 (19.1117)[a]	98.46
Milk sold per cow, lbs.	2.9385 (0.4699)	15,911
Cows per worker	492.0652 (144.1650)	30.6
Intercept	-62,075	
R^2	.266	

[a]Standard errors of the coefficients are shown in parentheses.

Table 4.

FARM COST OF PRODUCING MILK BY HERD SIZE AND MILK SOLD PER COW
424 New York Dairy Farms, 1987

By Herd Size				By Milk Sold Per Cow			
	Cost per Hundredweight				Cost per Hundredweight		
Number of Cows	Operating	Excluding Op's Labor, Mgt. & Cap.	Total	Pounds Milk Sold Per Cow	Operating	Excluding Op's Labor, Mgt. & Cap.	Total
Under 40	$9.30	$10.98	$16.08	Under 12,000	$11.05	$12.96	$17.22
40 to 54	9.31	10.94	14.74	12,000 to 13,999	9.26	11.05	14.55
55 to 69	9.49	11.18	15.05	14,000 to 14,999	9.69	11.37	14.79
70 to 84	9.22	10.90	14.04	15,000 to 15,999	9.49	11.02	13.82
85 to 99	8.97	10.49	13.30	16,000 to 16,999	9.39	10.85	13.39
100 to 149	9.25	10.88	13.83	17,000 to 17,999	9.23	10.83	13.50
150 to 199	9.45	11.03	13.41	18,000 to 18,999	9.00	10.56	13.19
200 to 299	9.61	10.95	12.74	20,000 & over	8.72	9.95	11.76
300 & over	9.27	10.55	12.01				

Table 5.
REGRESSION RESULTS FOR THE RELATIONSHIP BETWEEN SEVERAL MANAGEMENT FACTORS AND COST PER CWT. OF MILK SOLD, CORNELL DFBS, 1987

Variable	Operating Costs (Linear) Coefficients	Total Costs (Linear) Coefficients	Total Costs (Logs)
No. of cows	.002286 (.001745)[a]	-0.00286 (0.00186)	-.03976 (0.014502)
Milk sold per cow, lbs.	-0.00017 (0.000042)	-0.00044 (0.000045)	-.41356 (0.041979)
Cows per worker	-0.00664 (0.013169)	-0.07135 (0.014033)	-0.13949
Intercept	12.01 (1.95)	23.89 (2.09)	7.293715 (0.131184)
R^2	0.038	.28	.318

[a]Standard errors of the coefficients are shown in parentheses.

References

Kauffman, Jonas B., and Loren W. Tauer. "Successful Dairy Farm Management Strategies Identified by Stochastic Dominance Analyses of Farm Records." Northeastern Journal of Agricultural and Resource Economics, Vol. 15, No. 2, pp. 169-177.

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