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B756: Factors Affecting the Unit Costs of Milk Distribution

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FACTORS AFFECTING THE UNIT COSTS OF MILK DISTRIBUTION

by

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INTRODUCTION

Large variation in unit costs among firms performing essentially the same functions is characteristic of the milk distribution industry. This is so despite their operating under economic conditions which provide generally similar prices for goods and services needed for processing and delivery operations. Presumably the special character of the firms in terms of size, management, age of facilities, and equipment may account for cost differences. What the factors may be is important to understanding the ability of firms to operate profitably under a pricing system in which prices received for products sold are largely determined by the lowest cost at which milk can be distributed to consumers. It was the objectives of the analysis reported herein to 1) examine the variation in financial and physical factors thought to affect unit distribution costs and 2) determine the combination of factors which largely explain the differences in unit costs.

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METHOD AND SCOPE

Unit costs of milk distribution (processing, delivery and container) for 21 Maine dealers, for the calendar year 1977, were used in the analysis. These costs were determined for, and reported to the Maine Milk Commission in a previous report. [2/] Information was compiled and reported by individual dealers for five predominate milk packages - gallon plastic, half gallon plastic, half gallon paper, quart paper, and half pint paper. The costs were exclusive of raw product expense and any allowance for profit.

Milk processing and distribution costs were compiled by first allocating annual operating expenses to three plant functions - processing, packaging, and storing, and two delivery functions - wholesaling and retailing. These functional costs were then allocated to the units handled in each function; i.e. pounds of milk processed, half gallon labor equivalents in filling packages, and cases stored in cold rooms and transported on route trucks. Processing and delivery costs per package were determined by allocating the appropriate amount of functional costs to the particular size and type of package. To these costs a container expense was added to obtain a total processing and distribution cost. In obtaining delivery costs, operating expenses first were allocated under two route systems - wholesale and mixed (wholesale-retail). Unit costs for wholesaling were then compiled

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2/ Metzger, H.B., Costs and Efficiency in Fluid Milk Processing and Distribution in Maine Year 1977, LSA Experiment Station, University of Maine, Orono, Misc. Report No. 204, July, 1978.

by weighting the costs under each system by the volume of milk handled under that system.

Physical and financial data for individual dealers, used in the previous report primarily for allocating costs among processing and distribution functions, were used in the present analysis to develop independent variables. Costs of distributing (processing, delivery and container) a half gallon package of milk were used as the dependent variable.

The analyses consisted of cross tabulations to assess differences in various characteristics among groups of dealers having low, medium, or high cost per unit. It also involved correlation and multiple regression analyses. The statistical package for the social sciences (SPSS) was employed for statistical analyses using the computer at the University of Maine at Orono.

COST PER UNIT BY FUNCTION AND PACKAGE

Simple average costs were compiled by functions for each package. For example, for 20 dealers delivering milk in a half gallon paper container, the costs averaged 3.0 cents for processing, 2.5 cents for packaging and 1.7 cents for storage, Table 1. Wholesale delivery costs amounted to 11.2 cents and container costs 4.7 cents. The average total cost per half gallon was 23.1 cents for 20 dealers handling the package.

Similar costs for processing - delivery and container were compiled for four other principal containers - quart and half pint paper;

gallon and half gallon plastic, Table 1. The costs varied for the various container types and sizes among functions due to differences in time and space factors and among containers due to cost of materials, which were different for paper and plastic and not proportional to volume. Combined processing, delivery and container costs for milk in quart paper containers totaled 13.2 cents, while these costs for milk in half pint paper containers were 5.6 cents. Milk distributed in gallon plastic containers had total unit costs per package of 53.8 cents, while those in half gallon plastic containers had costs of 27.3 cents.

Variation among processors in the total unit cost of a given package was substantial. The high cost dealers incurred unit costs about twice that of the low cost dealer. The range in costs for each of the five packages was as follows:

	Minimum	Maximum
Half gallon, paper	$.154	$.313
Quart, paper	.090	.181
Half pint, paper	.044	.086
Gallon, plastic	.367	.746
Half gallon, plastic	.236	.362

TABLE 1

AVERAGE* TOTAL COST PER UNIT FOR MILK SOLD TO WHOLESALE OUTLETS BY CONTAINER TYPE AND SIZE AND BY COST FUNCTION, 21 MAINE MILK DEALERS CALENDAR YEAR 1977

Container Type & Size	Receive Process	Fill Pack	Store Ship	Deliver Whlse	Container	Total	No. Firms
Paper							
Half Gallon	$.030	$.025	$.017	$.112	$.047	$.231	20
Quart	.015	.017	.009	.062	.028	.132	21
Half Pint	.004	.015	.003	.021	.013	.056	21
Plastic							
Gallon	.061	.072	.038	.244	.123	.538	19
Half Gallon	.032	.032	.017	.112	.079	.273	17

* All costs are simple averages of individual firm costs of handling the packages.

VARIATION IN TOTAL COSTS OF DISTRIBUTION PER HALF GALLON PAPER CONTAINER

The half gallon paper container was selected for analysis of factors affecting costs because of its wide use and the large number of units handled per dealer. During 1977, more milk was delivered in gallon containers, but more half gallon packages were processed and handled than gallon packages. Of 21 dealers for whom costs were analyzed, 20 handled half gallon paper, 19 handled gallon plastic, and 17 handled half gallon plastic. Only quart and half pint paper containers were handled by all dealers; however the volume of milk packaged in each of these units was only about 10-12 percent of the total volume handled by the processors.

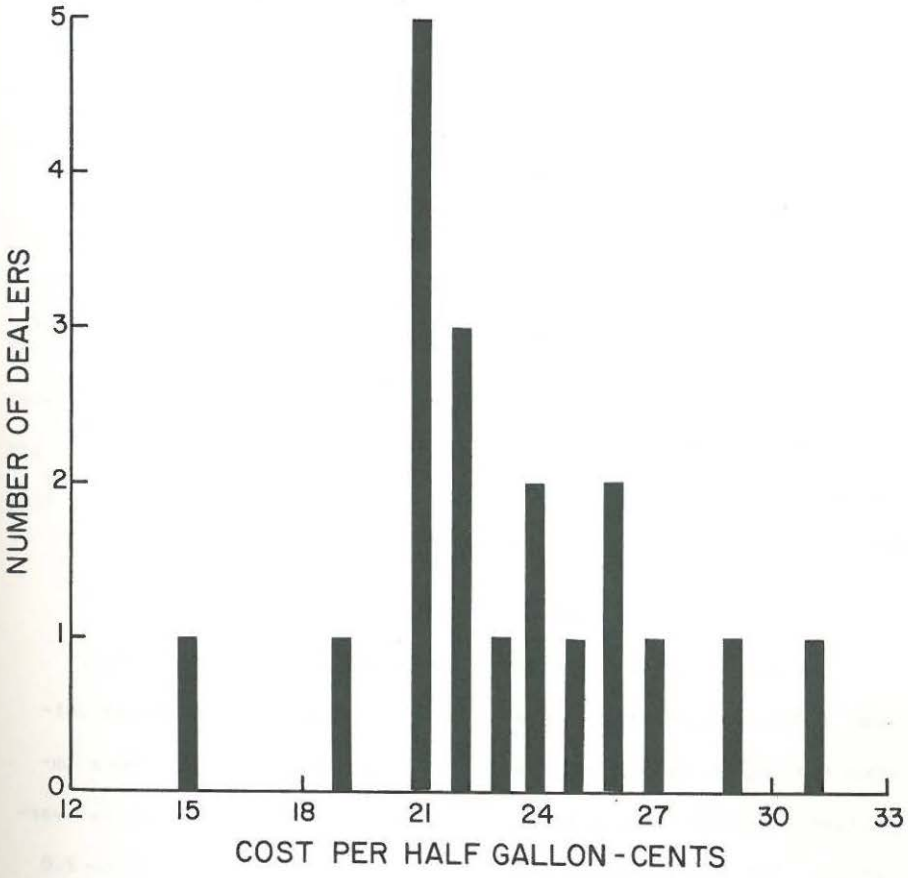
The total cost per unit for processing, delivery and container for distributing a half gallon of milk in paper containers to wholesale customers ranged from 15.4 cents to 31.3 cents. The distribution of the costs of individual dealers is shown in Figure 1. The distribution is skewed rather severely to the right and there is a wide separation of dealer costs per unit in the lowest cost sector. However, there is a strong central tendency of a more or less bimodal nature. Five firms had costs (rounded to nearest cent) of 21 cents per half gallon and three had costs of 22 cents per half gallon. For most other one cent units of additional cost the frequency was one or two dealers per level.

Variation in both the processing costs segment and in the delivery costs segment of total costs was substantial. Also variations were substantial in magnitude for the subprocessing functions -

process, fill and store. Thus causes of variations in these functions explain differences in total costs. The differences among dealers in container costs per unit were nominal, being within a range of one half cent of the mean. Thus container costs explained little of the total cost variation.

Figure 1

FREQUENCY DISTRIBUTION OF TOTAL DISTRIBUTION COSTS PER HALF GALLON, 20 MAINE DEALERS, CALENDAR YEAR 1977



VARIATION IN FACTORS AFFECTING COSTS PER UNIT

Eighteen factors were compiled and used as independent variables to explain variations in unit distribution costs. The variation or deviation in each of these factors provided some insight into the substantial differences that existed among processors with respect to financial and physical efficiency.

Financial Factors

Annual wages paid per employee, including fringe benefits, averaged $11,219. The standard deviation was $2,315. Thus for two-thirds of the dealers a difference in wages of $4,600 was indicated. Among all dealers the difference was substantially more. Wages of routemen which averaged about $12,000 differed by $7,000 among a majority of the dealers.

The net investment (depreciated value) in fixed assets used in operations (building, equipment, vehicles) when measured in terms of milk processed showed substantial differences. The average investment was 2.2 cents per 100 pounds of milk processed per year. For two-thirds of the dealers the range in investment per 100 pounds of milk was from 1.4 cents to 3.0 cents.

Physical Factors

The volume of milk processed per plant (for 21 plants) averaged 16 million pounds per year. Two-thirds of the plants had volumes ranging to 16 million pounds from the mean, Table 2. More importantly perhaps, the milk processed per man showed substantial variation. For two-thirds of the plants the range was from 1.0 to 2.0

million pounds of milk per man per year.

In route operations, several measures of labor efficiency indicated substantial differences among dealers. For example, for all processors an average of 33,900 cases of milk was handled per route per year. For two-thirds of the dealers the cases handled per route per year ranged from 21,600 to 46,200. Using wholesale routes for comparison, the variation among firms in labor efficiency was greater than for all routes, Table 2.

Substantial differences existed in delivery systems. While an average of two-thirds of the milk was delivered on wholesale routes, from less than one-third to 100 percent was delivered on wholesale routes by most dealers.

Less variation existed among dealers in the proportion of milk processed in various size packages than in most other aspects of their operations. An average of 39 percent of the milk was packaged in gallon containers. The standard deviation from this mean was eight percent. Similar computations for half gallons and half pints indicated that the variation in the proportion of milk handled was greatest for half pints, Table. 2

Table 2

AVERAGES AND STANDARD DEVIATIONS IN COSTS PER UNIT AND IN VARIOUS FACTORS AFFECTING COSTS PER UNIT IN MILK DISTRIBUTION, 21 MAINE DEALERS, CALENDAR YEAR 1977

Item	Mean	Standard Deviation
Cost Per Half Gallon		
Processing	$.072	.025
Delivery	.111	.028
Container	.047	.002
Total	.230	.036
Financial Factors		
1977 Wages plus fringe benefits per employee	$11,219	$2,315
Wages per routeman	11,985	3,512
Wages per plantman	9,424	2,678
Expenses per 100 lbs. milk processed per year:		
Total expenses	.055	.011
Wages	.022	.006
Wages plus fringe	.026	.006
Net fixed asset value per 100 lbs. milk processed per year	.022	.008
Physical Factors		
Million pounds milk processed:		
Per plant per year	15.6	16.4
Per plantman per year	1.5	0.5
Hundred cases all products stored:		
Per plantman per year	466	175
Hundred cases delivered:		
Per routeman per year	299	107

Table 2 - Con't.

Item	Mean	Standard Deviation
Physical Factors (con't.)		
Per route per year		
all routes	339	123
whlse routes	372	214
mixed routes	147	128
Percent Milk Delivered on Wholesale Routes	67	35
Percent Milk Processed as:		
Gallons	39	08
Half Gallons	29	06
Half Pints	11	05

CHARACTERISTICS OF DISTRIBUTORS IN LOW, MEDIUM AND HIGH COST GROUPS

When dealers were grouped as low, medium or high cost, based upon cost of distribution per half gallon paper container, the average cost per unit for the low cost group was 19.6 cents compared with 22.7 cents and 27.2 cents for the medium and high cost groups, respectively. Of the 7.6 cents difference between low and high cost group averages, 2.7 cents was in processing costs, 4.4 cents in delivery, and 0.2 cents in container. Tabulations of average characteristics for each of the cost groups pointed toward some reasons for the cost differences.

Size of Operation

Large size as measured by number of cases delivered on routes,

was associated with low unit costs. However, size as measured by pounds of milk received showed no definite relationship to level of unit costs. Number of employees, on the other hand, was substantially lower for low cost dealers, especially in the number of administrative employees, Table 3.

Financial Efficiency

A high wage paid per employee was not associated with high cost. The tendency was for dealers paying lower wages to have higher costs, Table 3.

The low cost group was characterized by low investment per 100 pounds of milk processed with medium and high cost groups having the same, but substantially higher investment. Total operating expenses divided by the amount of milk processed increased almost consistently from the low to the high cost group. Only for investment per 100 pounds were differences statistically significant. These characteristics generally reflected the low or high capacity use of the facilities as well as differences in ages of facilities.

Physical Efficiency

A consistent inverse relationship was indicated between the amount of milk received and processed per plantman and cost per unit of distribution. The low cost group average 18,460 hundredweight per man per year compared with 14,808 hundredweight for the medium cost and 12,486 hundredweight for the high cost groups. The same strong relationship existed in cases stored per plantman, Table 3. There were less than 10 chances in 100 that the differences could be

due to chance alone.

Table 3.

COMPARISON OF LOW, MEDIUM AND HIGH COST GROUPS OF DEALERS IN COSTS PER UNIT AND PHYSICAL AND FINANCIAL FACTORS AFFECTING COSTS, 20 MAINE DEALERS, CALENDAR YEAR 1977

Item	Cost Group			
	Low	Medium	High	All
Number of Dealers	7	7	6	20
Costs Per Half Gallon				
Process	$.054	$.078	$.087	$.072
Deliver	.096	.103	.140	.111
Container	.046	.046	.048	.047
Total	.196	.227	.272	.230
Cases Delivered on All Routes - 1977:				
Wholesale Rts. (100)	4479	4417	3809	4256
Mixed Rts. (100)	1113	653	520	774
Number of Employees:				
Total	27	36	36	33
Administration	3	8	7	6
Number Routes:				
Wholesale	8.5	9.1	8.5	8.7
Mixed	5.1	2.3	3.7	3.7
Total	13.6	11.4	12.2	12.4
Million Pounds Milk Received in 1977:	14	17	16	16
Wages Per Employee - 1977:				
Plantman	$ 9,754	$10,363	$7,944	$ 9,424
Routeman	11,541	11,463	13,110	11,985
All Employees	9,531	9,625	9,106	9,438
Fixed Assets Per 100 Pounds Milk Processed:	$.016	$.025	$.025	$.022

Table 3 - Con'd

Item	Cost Group			
	Low	Medium	High	All
Operating Expenses Per 100 Pounds Milk Processed				
Wages	$ .021	.021	.024	.022
Wages Plus Fringe Benefits	.024	.025	.029	.026
All Expenses	.048	.055	.062	.055
Hundred Cases Delivered Per Route - 1977:				
Wholesale	405	343	366	372
Mixed	149	178	107	147
All	329	406	271	339
Cases Delivered Per Routeman - 1977:				
All Routes - 100 Cases	308	330	251	299
Cases Stored Per Plantman - 1977				
All Products-100 Cases	576	448	357	466
Hundred Pounds Milk Received Per Plantman	18,460	14,808	12,486	15,389
Percent of Deliveries on Wholesale Routes	69	66	66	67
Percent of Whole & Low Fat Milk Processed in:				
Gallon Containers	34	42	42	39
Half Gallon Cont.	33	26	28	29
Half Pint Cont.	13	10	10	11
Percent Whole Milk Processed in:				
Half Pint, PA*	13	10	10	11
Quart, PA	8	6	7	7
Half Gallon, PA	19	17	13	16
Half Gallon, PL	6	4	8	6
Gallon, PL	25	23	27	25

* PA, paper, PL, plastic

In route operations changes in physical efficiency were not consistently associated with changes in cost, although more cases of milk were handled per route by dealers having low cost than by dealers having high cost. The same situation prevailed with respect to cases delivered per routeman.

Proportion of Volume in Packages of Various Size and Type

The proportion of whole milk processed in five major package sizes and types indicated that a higher percentage of milk packaged in paper half gallon containers was directly associated with a lower cost per unit. Low cost dealers processed an average of 19 percent of whole milk in half gallon paper containers compared with 13 percent for the high cost group. However, these differences were not statistically significant. There was no consistent relationship between the proportion packaged in other containers and cost level, Table 3.

When both whole milk and low fat milk volume was included in the proportion of volume packaged in gallon, half gallon, and half pint containers there was no consistent relationship between the proportions and cost level for any package. However, a relatively low percentage of volume in gallon containers and a relatively high percentage in half pints characterized the low cost group as compared with the high cost group.

FACTORS FOR ESTIMATING UNIT COSTS

Graphic and statistical techniques were used to develop the degree of correlation between various physical and financial characteristics of milk distributors and unit costs. Multiple regression was employed to develop the importance of various factors in explaining cost differences and to provide a basis for estimating unit costs. Those eighteen characteristics previously discussed were the basis for the analysis.

Factor-Cost Correlations

Physical Factors

The quantity of milk processed per year was negatively correlated with the cost per half gallon. The correlation coefficient -0.26 indicated a relatively low correlation (1.0 equal perfect correlation).[3/] Since relatively low costs per unit were achieved by several small volume dealers and since two large volume dealers had relatively higher costs, their situations substantiallly affected the correlation, Figure 2.

The quantity of milk stored annually per plantman was negatively correlated with the cost per half gallon. A relatively high correlation existed, with a coefficient of -0.67. Apparently the level of plant labor efficiency in terms of cases handled per plantman is a good indicator of total unit costs of distribution, Figure 3.

The quantity of milk delivered annually per route was negatively correlated with the total cost of distributing a half gallon of

3/ Correlation coefficients of 0.43 or more were considered significant.

milk. The correlation coefficient of -0.47 indicated the more volume handled per route the lower the unit cost. The correlation was not high but sufficient to consider this characteristic as an important variable affecting cost. The plot of quantity delivered and cost per unit for each dealer is shown in Figure 4.

Financial Factors

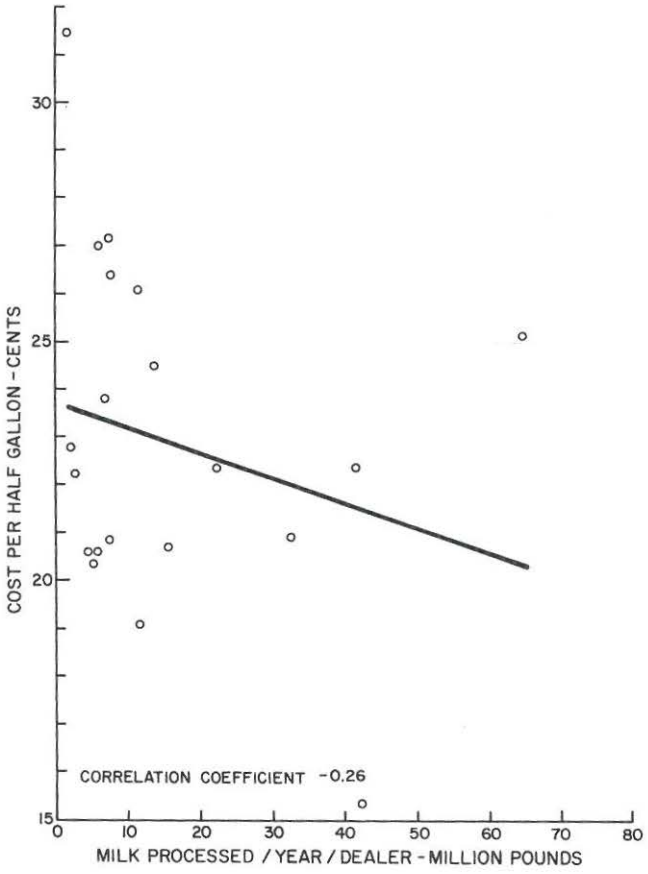
Annual wages paid per employee (for all employees) was negatively correlated with unit cost per half gallon. As wages increased cost per unit decreased. However, the correlation coefficient was relatively small at -0.27. Apparently the higher wages which were being paid reflected the efficiency of the personnel or the profits of the dealer, and were not a factor raising the unit cost. However, some firms with low wage rates were among the firms with the lowest costs, Figure 5.

Wages paid per plantman were also negatively correlated with unit costs, Figure 6. The correlation was somewhat higher than that for all employees as the correlation coefficient was -.44 for wages per plantman compared with -0.27 for wage per employee for all employees.

The net value of fixed assets per 100 pounds of milk was directly correlated with the cost per half gallon. Thus the higher the investment the higher the unit cost. The correlation coefficient was +0.43 indicating a modest correlation, but sufficient to consider this factor an important variable affecting unit cost. Apparently the increased investments with their accompanying higher depreciation charges did not offset increased efficiency which new investment

Figure 2

Relation of Quantity of Milk Processed and Distribution Cost Per Half Gallon (Processing, Delivery to Wholesale Accounts, and Paper Container)



Regression $C = .238 - .000557(Q)$
$(.03525)(.00000)$

Where: C = Cost per half gallon

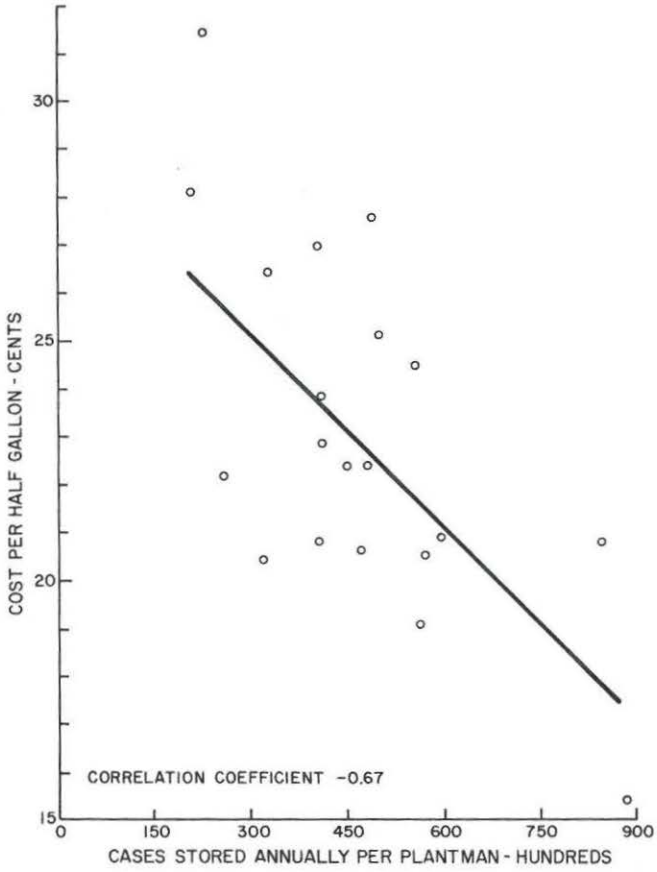
Q = Million pounds milk processed per year

$r^2 = .07$

F = 1.28

Figure 3

Relation of Quantity of Milk Stored Per Plantman and Distribution Cost Per Half Gallon (Processing, Delivery to Wholesale Accounts, and Paper Container)



Regression $C = .293 - .0001353(Q)$

$(.02718)\ (.00004)$

Where: C = Cost per half gallon

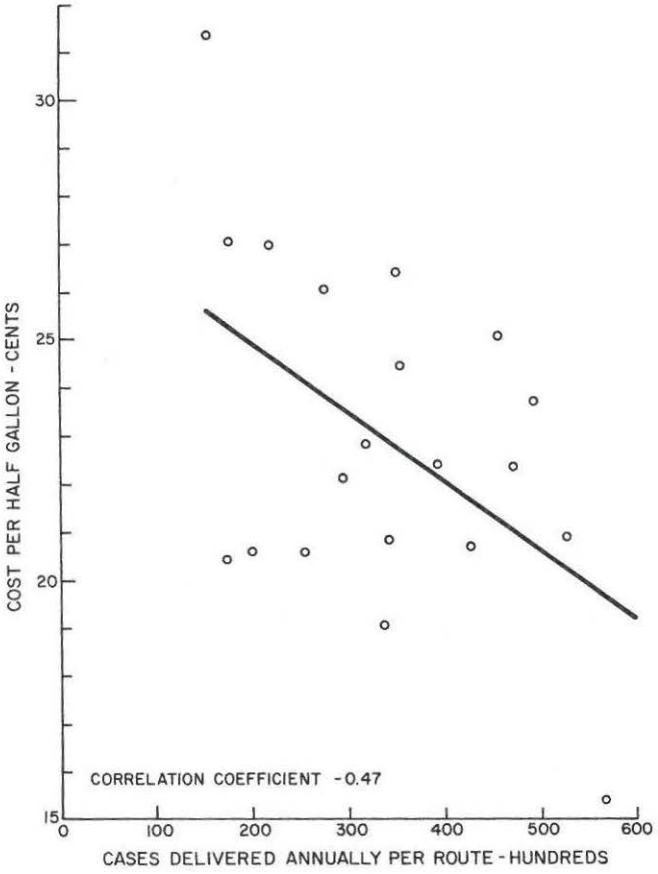
Q = Hundred cases stored

$r^2 = .44$

F = 14.42

Figure 4

Relationship of Quantity of Milk Delivered Per Route and Distribution Cost Per Half Gallon (Processing, Delivery to Wholesale Accounts, and Paper Containers)



Regression $C = .276 - .000136.5(Q)$

$(.03214)\ (.00006)$

Where: C = Cost per half gallon

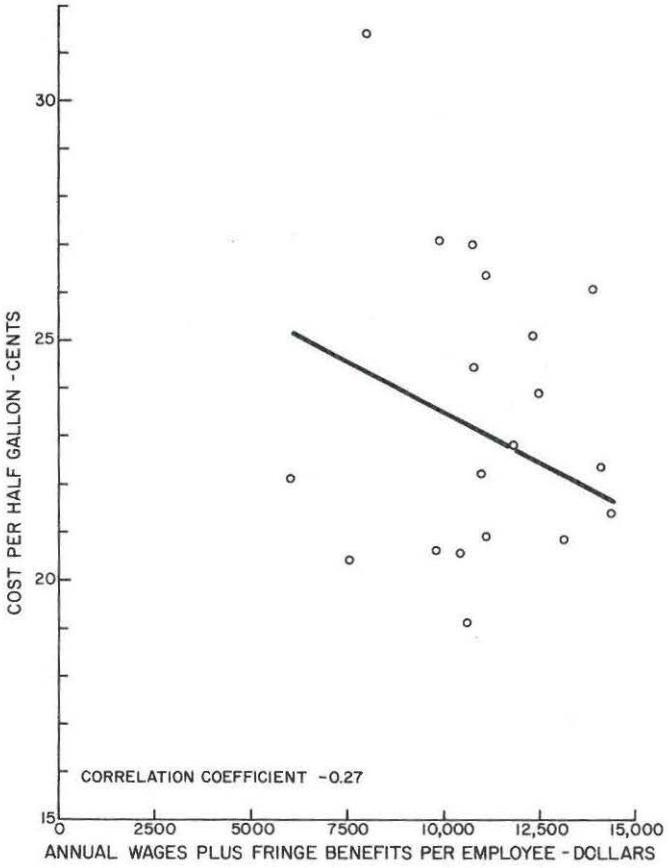
Q = Hundred cases delivered

$r^2 = .22$

F = 5.19

Figure 5

Relation of Wages Per Employee to Distribution Cost Per Half Gallon (Processing, Delivery to Wholesale Accounts, and Paper Container)

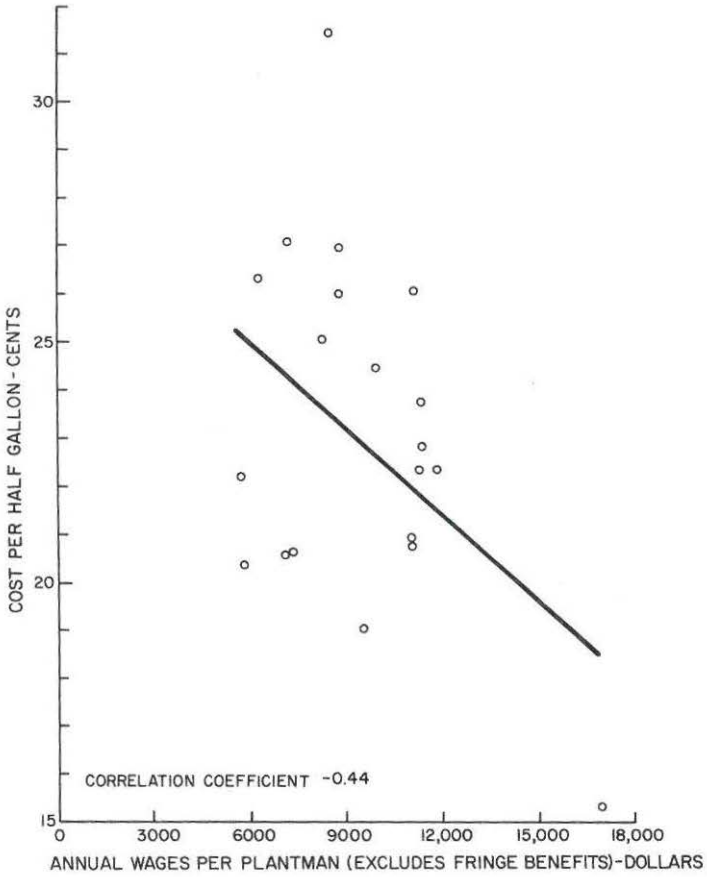


Regression $C = .276 - .004126(W)$
$(.035) \quad (.0035)$

Where: C = Cost per half gallon
W = Annual wages in thousand dollars
$r^2 = .07$
F = 1.40

Figure 6

Relationship of Annual Wages Per Plantman to Distribution Cost Per Half Gallon (Processing, Delivery to Wholesale Accounts, and Paper Container)



Regression $C = .284 - .005782(W)$

$(.033)\ (.0028)$

Where: C = Cost Per Half Gallon

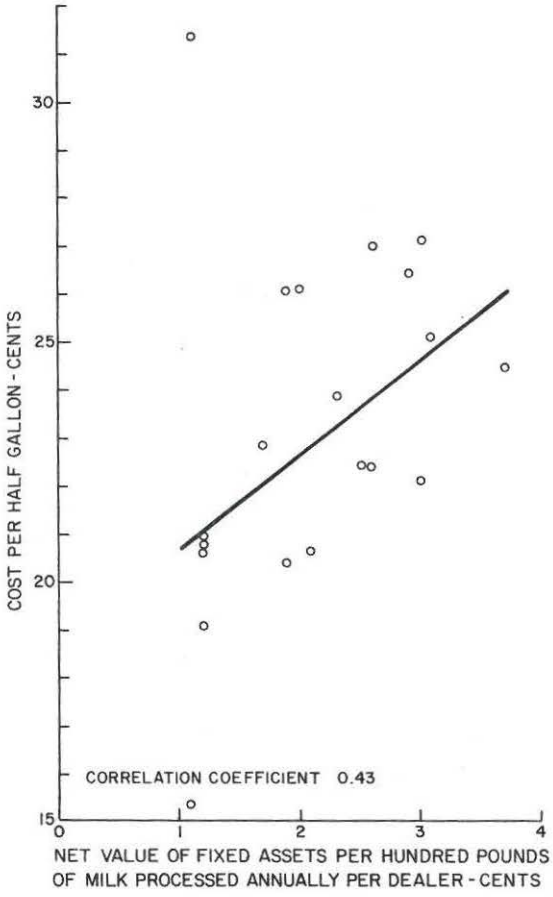
W = Annual wages in thousand dollars

$r^2 = .19$

F = 4.23

Figure 7

Relation of Investment in Plant and Equipment to Distribution Cost Per Half Gallon



Regression $C = .188 + 1.924(I)$

$(.033) \quad (.9645)$

Where: C = Cost per half gallon

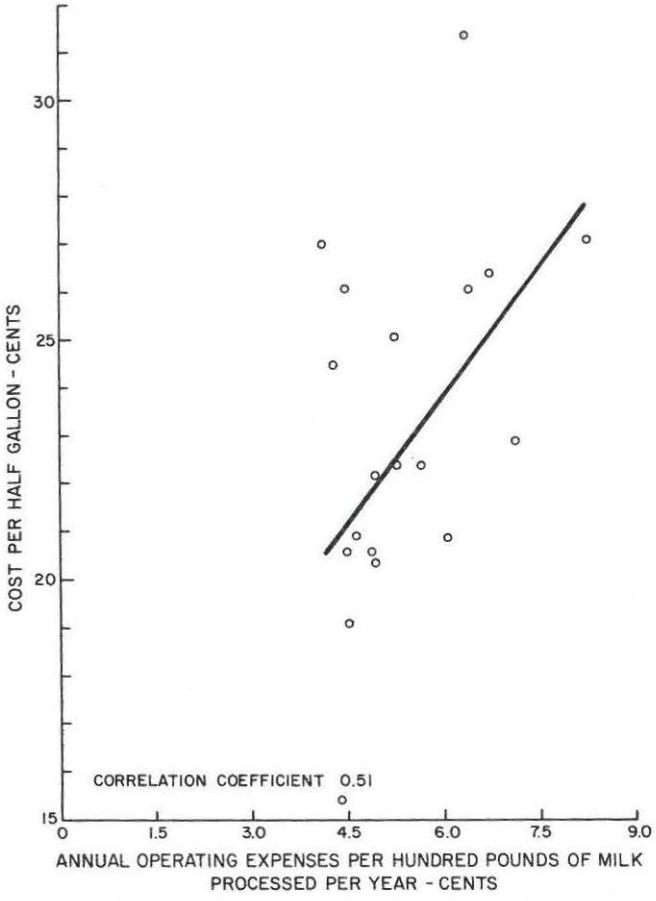
I = Value fixed assets in dollars per hundred pounds of milk

$r^2 = .18$

F = 3.98

Figure 8

Relation of Operating Expenses Per Hundred Pounds of Milk to Distribution Cost Per Half Gallon



Regression $C = .141 + 1.624\ (E)$

$(.031)\quad (.6376)$

Where: C = Cost per half gallon

E = Annual operating expenses in dollars per hundred pounds of milk

$r^2 = .22$

$F = 5.19$

should provide. The extent to which some plants have fully depreciated or partially depreciated plant equipment affects depreciation costs and this influences the unit cost comparisons. The percent of plant and truck capacity being utilized is also reflected in this factor. Figure 7 indicates the variability among firms in investment per 100 pounds of milk processed.

Annual operating expenses, which combine wage, non-wage, and all overhead expenses, were directly correlated with unit costs. The correlation coefficient was +.51 indicating a modestly strong relationship, Figure 8. Operating expenses per 100 pounds of milk processed may be considered as another measure of unit costs which substitutes for a half gallon unit cost. The correlation does not support this, however. While costs per 100 pounds of milk are a major component of unit cost per package, other factors, such as management decisions, route organization, and product mix, have substantial additional influences on the unit cost of a package. The operating expense factor, is an indicator of plant capacity, as a plant not utilized to capacity will show high costs per 100 pounds of milk handled.

Multiple Regression

Seventeen factors were used in a regression equation as a beginning step in determining those primary factors which explain the variation in costs per half gallon. These seventeen factors accounted for 99 percent of the variation in unit costs of 20 dealers included in the analysis. The factors and their combined contribution in explaining the cost variation were as follows:

Factor	R-Square Change*	R-Square**	Order of Entry Into Equation
Cases stored per plantman	.445	.445	1
Cases delivered per route-mixed routes	.092	.537	2
Percent whole and low fat milk processed in half gallon containers	.074	.611	3
Wages and fringe benefits expense per employee	.028	.638	4
Cases delivered per route-all routes	.037	.675	5
Fixed assets per 100 lbs of milk	.024	.699	6
Cases delivered per route-wholesale route	.038	.737	7
Wages per plantman	.014	.751	8
Percent whole and low fat milk processed in half pint containers	.012	.763	9
Percent volume delivered on wholesale routes	.010	.774	10
Wages expense per 100 lbs. milk	.013	.787	11
Operating expense per 100 lbs. milk	.037	.824	12
Wages plus fringe benefits expense per 100 lbs. milk	.046	.870	13
Percent whole and low fat milk processed in gallon containers	.038	.908	14
Wages per routeman	.071	.979	15
Cases delivered per routeman	.002	.981	16
Pounds received per plantman	.007	.989	17

* Percent of remaining cost variation explained by each variable
** Percent of cost variation explained by variables in the regression equation

The important variables as explainers of unit cost variation were cases stored per plantman which accounted for 44.5 percent of the variation, cases delivered on mixed routes which explained 9.2 percent of the variation, and percent of milk processed in half

gallon containers which explained 7.4 percent of the variation. Several other variables each explained 3 to 4 percent of the variation. The variation explained by each variable is influenced by the combination of variables with which it is associated, therefore, the percentages hold only for the previously indicated variable combination.

While the seventeen variables explained almost all of the variation in unit costs, the similarities in some of the variables and the close correlation between two or more variables raised serious questions about the meaning and importance of these variables.[4/] Thus an effort was made to remove as much multicolinearity as possible and to preserve those variables which explained most of the cost variation. Two procedures were followed. First the correlation coefficient of $\pm.50$ was used as a basis for eliminating independent variables because of multicolinearity. Second, those variables were selected which had 1) a high correlation with the dependent variable, and 2) little multicolinearity with one another. In the first situation seven independent variables were selected as follows:

Wages plus fringe benefits per enmployee
Cases stored per plantman
Cases delivered per route - wholesale routes
Percent of volume delivered on wholesale routes
Percent of wholesale and low fat milk processed in gallon containers
Fixed assets per 100 pounds milk processed
Operating expenses per 100 pounds milk processed.

In the second situation five independent variables were selected as follows:

Wages per plantman
Cases stored per plantman

4/ The regression equation would be useful as a cost predictor.

Cases delivered per route - all routes
Fixed assets per 100 pounds milk processed
Operating expenses per 100 pounds milk processed.

Results of the multiple regression analysis indicated these two sets of variables were about equal in explaining the variation in costs. They accounted for 63 percent and 62 percent of variation, respectively.

Because of the wider representation of physical and financial characteristics, the variables in the first situation were selected for further examination for prediction of unit cost. The independent variables and their combined contribution in explaining cost variation were as follows:

Factor	R-Square Change	R-Square
b_1 - Cases stored per plantman per year	.445	.445
b_2 - Annual wages plus fringe expenses per employee	.057	.502
b_3 - Dollar value of fixed assets per 100 lbs. milk processed	.046	.548
b_4 - 100 Cases delivered for route - wholesale route	.056	.604
b_5 - Percent of volume delivered on whole routes	.006	.610
b_6 - Dollar value of operating expenses per 100 lbs. milk processed	.016	.627
b_7 - Percent of whole and low fat milk in gallon containers	.005	.631

The regression equation incorporating these factors was as follows:

$$C = \underset{(.027)}{\$.16} - \underset{(.00008)}{.000123b_1} + \underset{(.00054)}{.000547b_2} + \underset{(.99)}{.99b_3} - \underset{(.00005)}{.000079b_4}$$

$$+ \underset{(.0317)}{.0264b_5} + \underset{(.989)}{.687b_6} + \underset{(.097)}{.0386b_7}$$

Where: C = unit cost per half gallon

b_1---b_7 = independent variables, as specified above

( ) standard error of coefficient

r^2 = .63

The regression indicated that cost per unit declined as cases stored per plantman and cases delivered per wholesale route increased, and that cost per unit increased with increases in wages per employee, increases in the value of assets and the amount of operating expenses per 100 pounds of milk processed, and with increases in the percentage of volume delivered on wholesale routes and packaged in gallon containers.

The coefficient for each of the factors was not significantly different from zero. Only the coefficients for cases stored per plantman and cases delivered per route were greater than one standard error, but less than two standard errors. While the factors contribute to an explanation of the unit cost variability they can not be used as reliable predictors of unit costs because of their variability.

SUMMARY

Explanations were sought for the variations among individual milk processors in unit costs of distributing milk in a half gallon paper container in 1977. Costs per dealer ranged from 15.4 cents to 31.3 cents per half gallon with a simple average of 23.1 cents. The modal cost was 21 cents per half gallon. Financial and physical factors affecting costs varied substantially among dealers. Wages per employee differed by more than $5,000 and volume handled by more than 16 million pounds annually. Labor efficiency showed wide variation with milk handled per plantman differing by more than 100 percent.

One third of the processors included in a group of low cost processors had significantly lower net investments per 100 pounds of milk (1.6¢) than processors in higher cost groups (2.5¢). Low cost processors also handled a larger volume of milk per plantman (57,600), handled a larger amount of milk per wholesale route (40,500 cases) and per mixed route (14,900 cases) than the high cost processors whose volumes were 35,700, 36,600, and 10,700 cases respectively.

Factor - cost correlations resulted in correlation coefficients of -0.67 for cases stored per plantman, -0.26 for pounds of milk processed, -0.47 for cases delivered per route, -0.27 for wages paid per employee, -0.44 for wages paid per plantman. Other correlation coefficients were: +0.43 for net value of fixed assets per 100 pounds of milk processed and +0.51 for annual operating expenses per 100 pounds of milk processed . Correlation coefficients of .43 were considered to be significant.

Seventeen variables included in a multiple regression equation

accounted for 99 percent of the variation in cost per half-gallon. The coefficients of two factors in a seven factor equation - cases stored per plantman and cases delivered per route on wholesale routes - approached but did not reach a level of statistical significance that differed from zero. This regression equation was not considered a reliable predictor of unit costs.

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