NO. 479. DECEMBER 1965 INSTITUTE OF AGRICULTURE, UNIVERSITY OF MINNESOTA

Minnesota Farm Business Notes

# Creamery Industry: Structure and Performance

J. W. Gruebele and E. F. Koller

Many market structure or organizational changes occurred in the Minnesota dairy manufacturing industry in the past 25 years. Industry concentration—fewer and larger plants—was the trend.

Table 1 shows that the total number of dairy manufacturing plants declined from 938 in 1938 to 361 in 1963. At the same time, the number of plants making only butter decreased from 867 to 278.

The increased concentration is also indicated by the proportion of butter made by the largest plants. In 1938, the four largest plants manufactured 4.8 percent of the total butter in Minnesota. But by 1963, the four largest plants produced 11.2 percent of the total (table 2). The 20 largest plants produced 32 percent of all the butter in the state in 1963, compared to only 13 percent in 1938.

Various factors were responsible for these changes in plant numbers and size. New technology such as larger equipment, clean-in-place systems, and high-temperature-short-time pasteurization had a significant effect. Plant managers found that bigger and better equipment, when fully utilized, reduced per unit cost of output. Improved trucks and roads, as well as bulk milk handling equipment, also encouraged the trend.

Furthermore, the shift from farm-separated cream to whole milk receipts in creameries in the 1940's and 1950's required added equipment and investments. As a result, many plants closed because they could not afford the changes.

Another important structural change was the trend toward cooperative ownership. Out of 333 Minnesota butter plants in 1963, 297 or 89 percent were cooperatives. In 1938, 634 out of 874 plants, or 72.5 percent, were owned cooperatively.

The proportion of butter manufactured by cooperatively owned plants also increased. In 1938, these plants manufactured 71.8 percent of all the butter in Minnesota; by 1963, they produced 90.9 percent.

The shift toward a butter-powder type of plant operation was also an important structural change in the Minnesota industry. In this system, whole milk is received and butter and nonfat dried milk are manufactured in the same building. In the alternative operation plan, milk is received and processed into butter at the local creamery but the skim milk is transferred to another plant specializing in drying the product. Table 1 shows that the number of butter-powder plants in the state increased from 7 in 1938 to 55 in 1963.

The increasing importance of the butter-powder operation is indicated by the increasing proportion of these prod-

(Continued on page 2)

**Table 1. Number of plants in the Minnesota dairy manufacturing industry by type of plant, 1938 and 1963**

| Type of plant | 1938 Number of plants | 1938 Percent of total | 1963 Number of plants | 1963 Percent of total |
|---|---|---|---|---|
| Specialized butter | 867 | 92.4 | 278 | 77.0 |
| Butter-powder | 7 | 0.8 | 55 | 15.3 |
| Specialized milk drying | 0 | ...... | 12 | 3.3 |
| Cheese | 64 | 6.8 | 16 | 4.4 |
| Total | 938 | 100.0 | 361 | 100.0 |

**Table 2. Proportion of total butter manufactured by 4, 8, and 20 largest plants in Minnesota, 1938 and 1963**

| Number of plants | 1938 Million pounds | 1938 Percent of total | 1963 Million pounds | 1963 Percent of total |
|---|---|---|---|---|
| Largest 4 | 14.4 | 4.8 | 38.0 | 11.2 |
| Largest 8 | 23.5 | 7.8 | 63.5 | 18.8 |
| Largest 20 | 40.5 | 13.4 | 108.3 | 32.0 |

# Fluid Milk Processing Costs in Minnesota

R. D. Knutson and E. F. Koller

The number of fluid milk plants in Minnesota has rapidly declined—from 286 in 1955 to only 155 in 1963. During this period, the number of plants handling less than 1 million pounds of milk per year declined most. Only packaging plants handling over 10 million pounds of milk per year increased in number since 1955.

Can small volume plants compete in the vigorously competitive fluid milk industry? Differences in unit costs among various sizes and types of firms greatly affect the answer to this question. Therefore, we recently studied the costs, profits, and efficiency of 27 Minnesota fluid milk plants for the years 1961-63.

These plants were located in fluid milk markets throughout the state except in the Twin Cities and Duluth. We took all cost data from the plants' income and expense statements for the 3 years and then averaged them for each plant. The 27 plants varied in annual volume from about 3 million to over 20 million pounds.

In the study, we emphasized those factors which appeared significantly related to variations in costs, profits, and efficiency. In this article, our purpose is to report on factors which result in variation in processing costs only.

Processing costs included costs associated with the handling of milk from the time it reached the plant until it was placed in the cold room. They did not include distribution costs, raw material costs, or overhead costs such as managers' salaries, office expense, or building depreciation.

For the 27 plants, processing costs accounted for nearly 50 percent of total operating costs. Distribution and overhead costs accounted for 34 and 16 percent of total operating costs, respectively.

### Processing Cost Components

We divided total processing costs into five components—labor, containers and plant supplies, repairs, depreciation, and utilities. The cost of containers and plant supplies accounted for 37 percent of processing costs or 71 cents per hundred pounds (cwt.) (table 1).

Container costs averaged 85 cents per cwt. for eight plants packaging milk in paper containers. The average cost was 46 cents per cwt. for five

(Continued on page 3)

## Creamery Industry . . .

(Continued from page 1)

ucts processed by these plants. These organizations manufactured only 1 percent of the state's butter in 1938 but 51 percent in 1963. The proportion of dry milk produced by these firms rose from 60 percent in 1955 to 78 percent in 1963.

Among major factors accounting for the shift to butter-powder operations are the cost savings involved. In the combined operation, milk is received only once and interplant hauling of skim milk is avoided with obvious savings. Other important savings accrue in the heating and cooling of milk when skim milk can be transferred within the same plant rather than to another plant.

### Structure-Performance Relationships

One purpose of this statewide study of the dairy manufacturing industry was to analyze how changes in market structure affected the market performance or economic results of the industry. We obtained information from a sample of 86 Minnesota dairy plants of which 48 were specialized butter plants and 38 were butter-powder plants.

A direct test of the relationship between increasing industry concentration and performance was not possible because benchmark year performance data were not available. However, by comparing the number and size of firms with performance variables, we could make some inferences.

**Table 3. Average operating costs for 41 butter plants and 37 butter-powder plants in Minnesota, by size, 1963**

**Butter Plants**

| Butterfat received a year (1,000 pounds) | Number of plants | Cost per pound of butterfat (cents) |
|---|---|---|
| 100-299 | 3 | 10.07 |
| 300-499 | 3 | 10.50 |
| 500-749 | 6 | 6.89 |
| 750-999 | 5 | 6.26 |
| 1,000-1,499 | 18 | 5.83 |
| 1,500 and over | 6 | 5.47 |
| Total or average | 41 | 6.06 |

**Butter-Powder Plants**

| Total milk solids received a year* (1,000 pounds) | Number of plants | Cost per pound of milk solids (cents) |
|---|---|---|
| Less than 4,000 | 6 | 6.06 |
| 4,000-6,999 | 6 | 4.61 |
| 7,000-10,499 | 8 | 3.85 |
| 10,500-19,999 | 10 | 3.08 |
| 20,000 and over | 7 | 3.01 |
| Total or average | 37 | 3.40 |

* Includes butterfat and nonfat solids.

**Processing Efficiency**—One expected result of increasing concentration was increased processing efficiency. Table 3 shows that as butter plants grew from the 300,000-500,000 pounds of butterfat a year range to 1,500,000 pounds and over, operating costs decreased from 10.5 cents a pound to 5.47 cents.

Likewise, as the annual pounds of total milk solids increased from less than 4 million to over 20 million, plant costs in 37 butter-powder plants declined from 6.06 cents a pound to 3.01 cents. The data indicate that economies of scale exist in the Minnesota dairy manufacturing industry. Furthermore, no plant has fully exploited these economies of size.

**Net Margins**—Another hypothesis of the study was that profitability and plant size were positively related. According to the data, large plants had greater average net margins and net margin to net worth ratios than did small plants.

Dairy plants receiving less than 500,000 pounds of butterfat annually had an average net margin ratio of 5 percent as compared with 11.3 percent in plants receiving over 1,500,000 pounds (see table 4).

We also expected that the type of plant operation (butter-powder or specialized) affected performance. We analyzed results by looking at the price paid to farmers per hundred pounds (cwt.) for No. 1 milk plus patronage refund.

In 1963, butter-powder plants paid producers an average of $3.29 per cwt. for No. 1 milk (including refunds). In contrast, specialized butter plants paid only $3.19. In statistical terms, this difference was highly significant.

**Degree of Progressiveness**—One study hypothesis was that the industry's changing market structure affected performance as measured by the degree of progressiveness. Degree of progressiveness refers to the adoption of new technology. We considered three technologies—the adoption of high-temperature-short-time pasteurization (HTST), clean-in-place systems (CIP), and bulk milk receiving. As expected, large plants were more progressive than small ones (see table 5).

We also found that larger plants had adopted the new technology at an earlier date than had smaller operations. So, they brought their patrons the advantages of new methods sooner.

**Table 4. Average net margins and net margins to net worth ratios for 86 Minnesota dairy plants, by size, 1963**

| Pounds of butterfat received (1,000 pounds) | Number of plants | Net margin per plant (dollars) | Net margin-net worth ratios* (percent) |
|---|---|---|---|
| 0-499 | 7 | 5,849 | 5.0 |
| 500-749 | 7 | 14,937 | 7.4 |
| 750-999 | 9 | 23,279 | 10.3 |
| 1,000-1,499 | 26 | 37,279 | 12.9 |
| 1,500 and over | 37 | 103,259 | 11.3 |
| Total or average | 86 | 59,849 | 11.3 |

* This ratio is calculated by dividing net margin in the firm by net worth or owner capital. It shows the rate of return on owner capital.

**Table 5. Proportion of 59 Minnesota dairy plants that had adopted HTST, CIP, and bulk milk systems, by size, 1965**

| Size of plant | Number of plants | Technology: HTST | CIP | Bulk milk |
|---|---|---|---|---|
| 1,000 pounds butterfat | | percent of plants | | |
| Less than 1,000 | 17 | 6 | 41 | 88 |
| 1,000-1,499 | 16 | 38 | 81 | 94 |
| 1,500 and over | 26 | 88 | 100 | 100 |

We also tested the relationship between plant operation and degree of progressiveness. Results indicated that butter-powder plants were more progressive than butter plants. For example, by 1965, about 83 percent of the butter-powder plants but only 20 percent of the butter plants had adopted the HTST pasteurizer.

### Conclusions

Reduced numbers and increased size of dairy firms apparently have improved the industry's overall performance. With increasing concentration, efficiency and progressiveness should increase and net margins should improve.

Economies to large size are available to the highest dairy plant volume levels. Therefore, managers should consider acquiring more milk for processing by increasing patronage, purchasing from other plants, or merging.

Butter-powder plants have advantages over simple butter operations in the form of increased net margins and higher prices paid for milk. Management should consider possibilities of shifting milk processing to a butter-powder operation. However, a large milk supply is needed for a successful plant of this type. ∎

## Fluid Milk . . .

(Continued from page 1)

**Table 1. Processing costs per cwt. of milk in 27 Minnesota fluid milk plants, 1961-63**

| Cost component | Average cost per cwt. | Proportion of total processing cost |
|---|---|---|
| | dollars | percent |
| Labor | 0.665 | 34.5 |
| Containers and plant supplies | 0.710 | 36.6 |
| Repairs | 0.075 | 4.0 |
| Depreciation* | 0.284 | 14.9 |
| Utilities | 0.190 | 10.0 |
| Total | 1.924 | 100.0 |

* Includes all depreciation on equipment in the plant as well as rental expenses on packaging equipment. Because of problems involved in the allocation of building depreciation between the plant and distribution, all building depreciation was allocated to overhead.

plants packaging milk in multitrip glass containers. Paper container costs were substantially higher for plants using preformed cartons and for small volume plants. Small plants could not take advantage of quantity discounts involved in large volume packaging and purchases.

Labor costs averaged 66 cents per cwt. or 34 percent of processing costs. Among the 27 plants studied, labor costs ranged from virtually no paid labor to $1.16 per cwt. of milk. One principal reason for this wide variation was that seven plants used family labor or proprietors' unpaid labor. For the 20 plants using no family labor, labor costs ranged from $0.36 to $1.16 per cwt. The average was $0.70.

An additional source of variation in labor costs was the relationship existing between the annual volume of milk packaged per plant worker and the annual volume of milk packaged per plant. Annual volume per plant worker varied from less than 200,000 pounds for one small plant to over 2 million pounds for one large plant.

We found that volume per plant worker rose sharply up to plant volumes of about 8 million pounds per year. Then volume per worker tended to level off. This increased volume per worker was possible primarily because larger plants utilized more automatic and bigger capacity equipment than did smaller plants.

### Total Processing Costs

Volume of milk processed, family labor, and type of package significantly affected processing costs per cwt.

**Volume**—Variations in unit costs may result from numerous sources. However, utilization of capacity in a given plant and size of plant greatly affect costs. Unit costs can generally be decreased in a given plant if sales can be increased to permit full capacity of volume of milk packaged. These lower unit costs result mainly from spreading fixed operating costs over greater volume.

In addition, larger plants have the potential to achieve lower unit costs than smaller plants. These lower costs result primarily from economies in utilization of plant and labor, as well as economies from large volume equipment. But, if large plants do not operate at or near full capacity, they may incur higher costs than their smaller competitors.

Table 2 indicates that average processing costs generally declined as annual volume increased—whether or not family labor was used. For 20 plants not using family labor, costs declined from $2.50 per cwt. for plants handling under 1 million pounds per year to $1.71 for plants handling over 10 million pounds. These costs were equivalent to about 5.4 cents per quart for the smallest plants to 3.7 cents per quart in the largest group.

Variation existed in processing costs in each volume group. However, especially wide variation existed among the largest volume plants. For example, among the largest volume plants, costs varied from less than $1.25 per cwt. in one plant to over $2.25 per cwt. in another. Both plants handled about 20 million pounds per year.

So size alone does not result in low unit costs. Cost-increasing factors such as low capacity utilization, poor plant layout, high wage rates, inefficient management, and several different packages and products may prevent large plants from achieving their lowest potential costs.

**Family Labor**—In 7 of the 27 plants studied, substantial quantities of unpaid family or proprietors' labor were used in the packaging operation. Use of family labor offset part or all of the diseconomies of operating a small size plant. The average processing cost of $1.73 per cwt. for plants using family labor was nearly equivalent to the average processing cost of $1.71 per cwt. for plants processing over 10 million pounds per year.

Although use of family labor allows small volume plants to compete with large volume plants, these small plants are declining in importance with the general trend toward fewer plants.

**Table 2. Processing costs per cwt. of milk by annual volume of milk processed and type of labor used, 27 Minnesota plants, 1961-63**

| Annual volume of milk (1,000 pounds) | Cost (dollars) per cwt for plants: Using family labor | Not using family labor |
|---|---|---|
| 999 and under | 1.840 | 2.508 |
| 1,000-2,499 | 1.842 | 2.215 |
| 2,500-4,999 | 1.440 | 2.010 |
| 5.000-9,999 | ...... | 1.875 |
| 10,000 and over | ...... | 1.712 |
| All plants | 1.726 | 2.035 |

**Package**—When total processing costs were considered, the lower container costs for glass tended to be largely offset by higher labor, depreciation, and utility costs associated with it.

Combination glass and paper operations tended to have higher unit costs than did all-glass or all-paper operations. For example, in three combination plants processing from 2.5 to 10 million pounds per year, the average processing cost was $2.09 per cwt. For four similar size all-paper operations, the average cost was $1.87 per cwt.

We expected glass-paper packaging operations to have high unit costs because both glass and paper packaging equipment must be maintained. Often, neither line of equipment can be maintained at sufficient volume to reduce costs to as low a level as all-glass or all-paper packaging operations. Many small volume plants found it more profitable to buy milk packaged in paper from other plants while packaging glass product lines themselves.

### In Conclusion

Indications are that large volume plants generally have a cost advantage in packaging fluid milk. Nevertheless, considerable variation in unit costs exist, even among large volume plants. Plant size must be suited to the market size so that a given plant may operate near full capacity and take advantage of existing economies. ■

Minnesota Farm Business Notes

**Prepared by the Department of Agricultural Economics and the Agricultural Extension Service.**

**Published by the University of Minnesota, Agricultural Extension Service, Institute of Agriculture, St. Paul, Minnesota 55101.**

# the outlook corner

Jerome Hammond

The balance between production and consumption of milk products responds to various economic forces. Changes in these balances since 1940 are illustrated in the figure. This figure shows the estimated amounts by which regional production of all milk products, manufactured dairy products, and fluid milk products (all in whole milk equivalent) exceeded or fell short of regional consumption. Balances indicate the level and trend in net movement of product between regions.

The north-central region, a residual supplier of at least some milk products to all other U. S. regions, supplied about 26 billion pounds in 1960. However, little indication of increasing or decreasing trend during the period studied is apparent.

On a product classification, the north-central region showed a major change. During the 1940's, this region was a major supplier of fluid milk to other areas. The balance of fluid milk production in excess of fluid use has decreased to practically nothing in recent years. This region also supplies manufactured products to all other regions because none are self-sufficient.

The northeastern region has undergone the greatest adjustment in production-consumption balances for milk products. It has moved from a deficit production area to a surplus production area of fluid products. It is still a deficit production area of manufactured dairy products, although it is tending toward increased self-sufficiency.

The 11 western states are now less self-sufficient in the production of both manufactured and fluid milk products than they were. In 1940, this region produced all its fluid milk requirements and nearly all of its manufactured dairy product requirements.

Since 1945, the South has tended toward self-sufficiency in production of fluid milk products. But production of manufactured products has continued below regional needs.

A review of some causes of these trends and their inter-relationships provides clues to future expectations. During the period studied, much of the eastern and southern areas came under administered milk pricing through federal and state legislation. This regulation may have distorted economically determined price relationships.

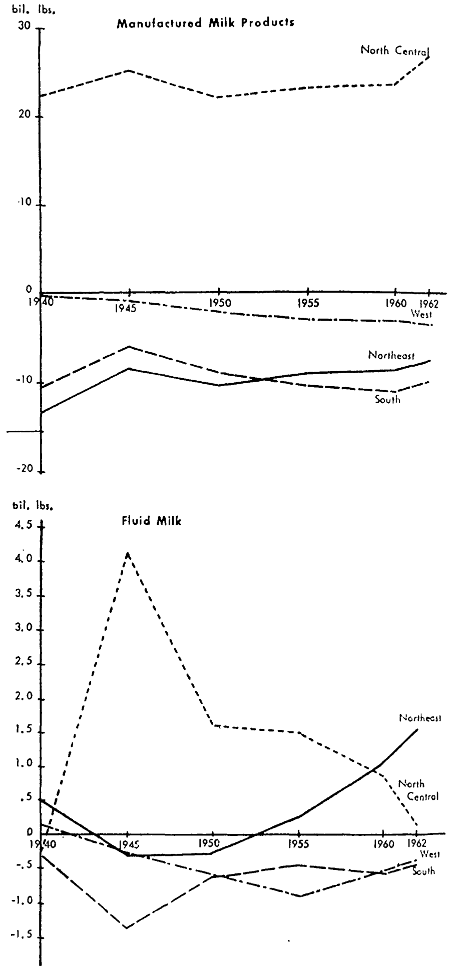
Resulting prices may have encouraged uneconomic local production. Supplementary regulatory provisions may have discouraged and prevented entry of milk from other regions. There is little evidence of reduction in milk regulation. Therefore, these regions may become more self-sufficient in milk product production.

Increased requirements of both fluid and manufactured products in excess of production in the West probably result mainly from demand effects of a rapid population growth rate. Between 1940-50, its population grew 41 percent; between 1950-60, it grew 39 percent. The maximum growth rate for any other region for these periods was 16 percent.

More than 15 percent of the nation's population was in the western region in 1960 as compared to only 10.5 percent in 1940. The growth rate shows no tendency to slacken, so milk product needs from other regions will expand.

Improved road systems and techniques of transporting fluid milk encourage increased movement of milk and milk products from low-cost to high-cost production areas. The north-central region, a low-cost production area, apparently has not benefited from these developments. Evidently, restrictions on movements of milk and/or reduced production costs in other areas are offsetting the increased mobility of milk.

In summary, the greatest potential outside market for milk products from the north-central region lies in the West. Unless factors affecting inter-regional product movement to the Northeast and South greatly change, these markets will continue to decline in importance for the north-central region. ■




**Estimated amount by which milk product production exceeded or fell short of total milk product use, by U.S. regions, selected years.**

Estimates do not add up to zero because of the problem of obtaining regional per capita consumption figures. Source: USDA statistics.

Agricultural Extension Service
Institute of Agriculture
University of Minnesota
St. Paul, Minnesota 55101
Luther J. Pickrel, Director
Cooperative Agricultural Extension Work
Acts of May 8 and June 30, 1914
OFFICIAL BUSINESS
11-65 2,885

PENALTY FOR PRIVATE USE TO AVOID PAYMENT OF POSTAGE, $300