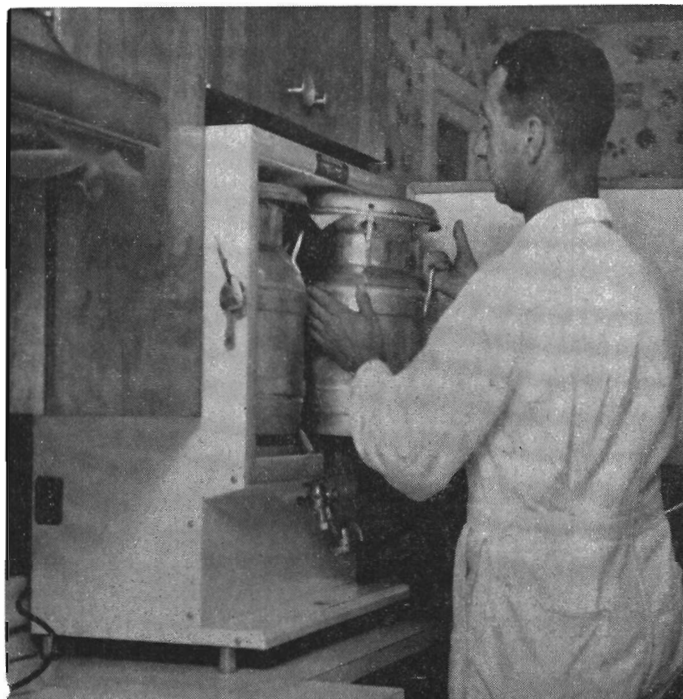


Economics of . . .
Bulk Milk Dispensers
For Home Use

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Economics of **Bulk Milk Dispensers** *For Home Use*

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Summary and Conclusions

This study was undertaken to determine effects of bulk home milk dispensers on (1) consumption of milk, (2) costs of processing and packaging milk in bulk cans versus paper containers, and (3) costs of distributing milk on retail routes in the two types of containers.

The 87 dispenser-using households interviewed in the Portland, Oregon, market reported an average increase in milk consumption of about 24% following installation of bulk dispensers. The average household consumption before installation was over 20 quarts of milk a week. Sixty-five percent of the users were new accounts for the dairies handling home dispensers. One-third of these new accounts formerly purchased milk at grocery stores. Installation of home dispensers negligibly reduced purchases of milk from stores as a supplement to normal delivery.

The home dispenser appeared best adapted to large families in higher income levels. Seventy percent of the households interviewed had gross incomes of over \$6,000 a year, compared to the national average of 33%. The average size of family interviewed was 6.3 members compared to the national average of 3.5. Educational level of

the homemakers was high, 43% having college training compared to a national average of 13%.

Homemakers were well pleased with the home dispenser. Main advantages, in order of importance, were: convenience, saving of refrigerator space, and better quality milk. Major disadvantages cited were: kitchen space requirement, cost of increased consumption, milk spillage, and spout drippage. Over 96% of the households did not object to having the delivery man enter the house to service the dispenser.

Thirty-eight households which formerly had dispensers were interviewed and gave space requirements as the main reason for having dispensers removed. Second most frequently mentioned reason for removal was the cost of increased consumption. Milk spillage and spout drippage ranked third. Consumption per household dropped nearly 15% after dispenser removal.

The only important difference in family characteristics between dispenser users and former users was income. Former users had a lower average income than families keeping dispensers.

The synthetic or budgetary analysis procedure was used to determine the

unit cost for processing and packaging milk in paper containers and dispenser cans. Under conditions specified in the model plant the cost per quart equivalent (including container costs) for milk packaged in half-gallon paper containers was 1.96 cents as compared to 2.15 cents for milk packaged in paper quarts and 2.37 cents for milk packaged in 3-gallon dispenser cans.

When the model plant was modified to increase volume of milk processed and packaged in bulk cans from 13 to 20% of plant volume, relative costs for paper and bulk cans tended to equalize. Cost per quart for paper quarts increased from 2.15 cents to 2.17 cents, and paper half-gallon containers increased from 1.95 to 1.97. Cost per quart equivalent for the home dispenser can declined from 2.37 to 2.14 cents.

Direct delivery time per quart of milk in paper containers for the average 4-quart customer was .14 minute and for a 12-quart delivery was .07 minute. Average delivery time per quart equivalent for bulk home dispenser customers was about .20 min-

ute. All dispenser-using families took one 3-gallon can per delivery, although some had three deliveries per week while others had two.

Difference in delivery time was accounted for mainly by time spent inside the home on bulk delivery, which averaged .10 minute per quart equivalent. As bulk delivery generally was through the back door, it involved an average of 46 additional feet and eight additional steps over paper delivery.

Conditions under which this study was made indicated no cost savings from processing, packaging, and distributing milk in bulk cans as compared to paper containers. Advantages to a dairy would have to accrue from increased sales of milk per household, from new customers, and from increased sales of by-products. Opportunity for increased sales of by-products comes with more frequent contact with household members when the bulk cans are placed in the dispenser in the kitchen. However, in this study no increases in by-product sales to dispenser users were observed.

Introduction

In the last 15 to 20 years there has been a rapid shift toward the selling of fluid milk through stores at the expense of retail routes. This has occurred largely because of the relatively lower costs (and resulting lower prices) of distributing milk through stores. Cash-carry selling, large volume, and nondeposit paper cartons, have all helped to hold wholesale and store distribution costs down.

On the other hand, several developments have tended to increase relative costs of retail home delivery. With

growth of cities, traffic congestion has increased, resulting in costly increases in delivery time. This problem has been intensified because many city ordinances and/or union contracts prevent delivery of milk prior to 7 a.m., thus forcing delivery during periods when traffic is most congested. Some union contracts limit the amount a driver may deliver in an 8-hour day. In general, union contracts have tended towards flat salary payment plans and away from plans based mainly on commissions. Taken together, these de-

velopments have eliminated many incentives for greater retail sales.

With lower prices available at stores, many large volume customers have switched to this source for their milk supply. This leaves retail routes servicing a disproportionate share of small volume customers. Cost per quart of delivering milk to small volume customers becomes excessively high.

Because of differences in volume of milk handled on a retail and wholesale route, each increase in cost adds to the unit cost disadvantage of retail distribution. For example, the union wage contract in Portland, Oregon, signed September, 1959, calls for an increase of 17 cents per hour for all drivers—wholesale and retail. This is equivalent to \$1.36 per 8-hour day, or .27 cents per quart, assuming a large retail route of 500 units per day. On a small wholesale route, delivering only 2,000 units, the increased cost per unit would amount to only .068 cents—just one-fourth of the cost increase on retail routes.

During the period of rapid shift from retail route to store sales, per

capita consumption of fluid milk declined about 13.5% despite a consumer income increase of 67%.

It is argued that home delivery encourages consumption because milk is made more readily available. Consequently, a shift away from home delivery is offered as a possible explanation for the apparent nonresponse of consumption to increased consumer incomes. Recently completed studies appear to support this claim. Assuming home delivery does encourage increased consumption and that it will be beneficial to the industry, ways must be found to reduce relative costs of this method of distribution if it is to remain in existence.

A high percentage of home delivery expense is associated with labor and truck costs. Since there is little opportunity to reduce wage rates or total overhead truck costs, other ways must be found to reduce unit delivery costs.

This can be achieved by increasing number of units delivered per stop. Bulk home dispensers have been suggested as a possible answer to this problem.

Results

Consumption Habits and Family Characteristics

A number of brands and models of home milk dispensers are available. However, all households interviewed in this study were using the Norris Home Dispenser. The Norris Home Dispenser holds two 3-gallon cans and has a stainless steel interior and a white enamel exterior. The unit has a self-contained refrigeration unit, including a thermostat which permits adjusting the temperature of the ma-

chine. It has the same lift-type dispensing valve found on most commercial restaurant machines. This particular model sold for \$135 in 1959.

In an effort to determine effects of bulk home dispensers on consumption, homemakers were asked how much milk they had used in a 7-day period before having a dispenser, including milk delivered and quantity bought from other sources. Dispenser users

also were asked how much bulk milk they had purchased, how much extra milk they had bought from the milk route man, and how much milk they had purchased from other sources in the past seven days. Of the 87 households interviewed, 79 reported usable data on milk consumption before and after installation of bulk dispensers. The average increase in consumption, accompanying installation of the bulk dispenser, was about 24%. The F test on the consumption difference before and after the installation of the home dispenser for all family characteristics with over five observations, indicated these consumption changes were significant.

Family size

The majority of the households studied had from 5 to 8 family members, the average size family being 6.3. This is almost double the 3.5 average for the United States, as reported by the United States Department of Commerce for 1959. Only about 9% of all United States families had over 4 members in 1959.

As expected, family size has an important influence on milk consumption

per household, (Table 1). Average consumption for all households, before installation of a dispenser, was over 20 quarts per week. Increases in consumption were found in each family size classification. They ranged from about 17% for families with 4 to 5 members to 39% for families with 7 members. Households with more than 7 members increased about 26%.

Income

Increases in milk consumption resulting from installation of the bulk dispenser did not differ greatly for various income groups, (Table 2). The most significant fact revealed by this table was that a high percentage of the households studied were in the upper income groups. Nearly 18% of the households were in the \$10,000 and over income group. Households grossing \$6,000 and over accounted for almost 70% of those studied.

Occupation

Sales workers made up the occupational group showing the greatest relative consumption increase after dispenser installation, reporting an increase of about 42% (Table 3). Al-

Table 1. Household Consumption of Fluid Milk Before and After Installation of Bulk Home Milk Dispenser by Size of Family, Portland Market, 1959.

Household members	Average weekly consumption			
	Households studied	Before dispenser	After dispenser	Increase
<i>Number</i>	<i>Number</i>	<i>Quarts</i>	<i>Quarts</i>	<i>Percent</i>
3	1	7.0	12.0	.....
4	6	21.0	26.3	25.4
5	16	21.5	25.2	17.4
6	28	26.8	31.5	17.3
7	12	23.2	32.4	39.4
8	9	31.0	38.9	25.4
9 or more	7	34.7	44.6	28.4
Total	79	25.7	31.7	23.5

Table 2. Household Consumption of Fluid Milk Before and After Installation of Bulk Home Milk Dispenser by Income Groups, Portland Market, 1959.

Income groups	Average weekly consumption			
	Households studied	Before dispenser	After dispenser	Change
<i>Gross dollars</i>	<i>Number</i>	<i>Quarts</i>	<i>Quarts</i>	<i>Percent</i>
Under 4,000	1	23.0	36.0	.....
4,000-5,999	23	23.1	28.4	22.6
6,000-7,999	27	25.9	32.2	24.3
8,000-9,999	9	28.1	36.0	28.1
10,000 or more	14	27.1	32.9	21.3
No reply	5	28.4	32.8	15.5
Total	79	25.7	31.7	23.5

Table 3. Household Consumption of Fluid Milk Before and After Installation of Bulk Home Milk Dispenser by Occupation of Head of Household, Portland Market, 1959.

Occupational group	Households studied	Average weekly consumption		Change
		Before dispenser	After dispenser	
	<i>Number</i>	<i>Quarts</i>	<i>Quarts</i>	<i>Percent</i>
Professional and technical	5	33.8	38.0	12.4
Managers, officials, and proprietors	30	25.8	32.4	25.6
Clerical and kindred workers	2	14.0	20.0	.....
Craftsmen, foremen, and operatives	23	24.8	29.1	17.4
Common labor	6	27.5	33.5	21.8
Service workers	5	28.0	33.0	17.9
Sales workers	7	23.1	32.9	42.0
No reply	1	20.0	38.0	.....
Total	79	25.7	31.7	23.5

though the professional and technical occupational group had the lowest consumption increase, it had the highest consumption rate per household before dispensers were installed.

Education

Households were segregated into three groups according to education of homemakers. Little difference in average household consumption is shown

among the three educational levels. The difference was somewhat greater before installation of dispensers.

Housewives with high school training showed the largest consumption increase percentage after installation, while housewives with a grade school education showed the smallest increase (Table 4).

As with income and family size, educational level of homemakers in the

Table 4. Household Consumption of Fluid Milk Before and After Installation of Bulk Home Milk Dispenser by Education of Homemaker, Portland Market, 1959.

Education of homemaker	Average weekly consumption			
	Households studied	Before dispenser	After dispenser	Change
	<i>Number</i>	<i>Quarts</i>	<i>Quarts</i>	<i>Percent</i>
Grade school	6	27.7	32.8	18.7
High school	39	24.7	31.2	26.5
College	34	26.5	32.1	21.2
Total	79	25.7	31.7	23.5

Table 5. Household Consumption of Fluid Milk Before and After Installation of Bulk Home Milk Dispenser by Age of Homemaker, Portland Market, 1959.

Age of homemaker	Average weekly consumption			
	Households studied	Before dispenser	After dispenser	Change
<i>Years</i>	<i>Number</i>	<i>Quarts</i>	<i>Quarts</i>	<i>Percent</i>
19-30	27	23.3	27.4	17.5
31-50	52	26.9	34.0	26.2
Total	79	25.7	31.7	23.5

study was well above the national average. Over 92% had a minimum of high school training, compared to the national average of 68%, according to census reports. Over 43% of the homemakers had college training, compared to a national average of 13%.

Age of homemaker

All 79 housewives fell within the age groups, 19 to 30 and 31 to 50 (Table 5). The 31 to 50 age group

had the greater consumption increase, amounting to about 26% as compared to only about 18% for those 19 to 30. The older age group also had the higher average consumption per household.

Length of time dispenser used

The average milk consumption increase was greatest the first month or less after a dispenser was installed (Table 6). Homemakers stated con-

Table 6. Weekly Household Consumption Increases by Period of Time Home Bulk Dispenser Used, Portland Market, 1959.

Item	Months dispenser used				
	1	2	3-6	7-12	Over 12
Number of households	13	10	24	14	18
Average weekly increase (quarts)	8.2	5.1	5.4	5.9	6.0
Percent increase	29.7	20.6	21.0	24.7	22.7

sumption increased sharply the first few weeks, mainly because of the dispenser's novelty to children. After this initial period, consumption tended to decrease somewhat, then stabilized at a level about 20 to 24% above previous consumption.

Milk purchasing habits

Purchases from sources other than the regular route man, before dispensers were installed, amounted to 585 quarts a week. Purchases from other sources, after installation, totaled 118 quarts. However, of 79 dispenser users, 19 formerly had purchased all their milk from stores. Weekly purchases of these 19 families were 454 quarts. This meant a reduction of only 13 quarts in milk purchased from outside sources, since obtaining dispensers, for the remaining 60 families.

Twelve dispenser users reported extra purchases of whole milk from other sources in the past seven days. Nine reported purchasing extra whole milk because they ran out during the week.

Twenty-two dispenser users were purchasing extra milk besides whole

milk, consisting mainly of skim, powdered, and canned milk. These products were used mainly for cooking and dietary reasons.

Source of initial knowledge

Most homemakers learned about the home dispenser through their friends and relatives. While this may substantiate the cliché that "one's best advertisement is a satisfied customer," the fact that there has been limited promotional advertising on home dispensers in the Portland area must be taken into consideration.

Over 27% of the households first heard about the home dispenser through a solicitor. Solicitors contacted only large consumer units of higher income standing.

Twenty-four percent of the dispenser users first learned about the dispenser through an exhibit at a city trade fair and through several nonadvertising articles on home dispensers in the local newspaper.

The regular route milk man ranked fourth as a source of initial knowledge about dispensers.

Opinions of Consumers Using Dispensers

Advantages

Homemakers were enthusiastic about the home dispenser, many commenting that they would not be without one again. This enthusiasm was more clearly demonstrated recently in Denver, Colorado, where dispenser accounts refused to shift back to conventional containers even when offered milk by a competing company at 15 cents a gallon below what they were currently paying.

Homemakers giving more than one advantage of dispensers were asked to

rank them in order of importance. Convenience was the advantage ranked first most frequently (Table 7). Children being able to serve themselves, not having to open the refrigerator each time milk is wanted, the convenient availability of milk, no cartons or bottles to handle, and no bottle breakage were the most frequently mentioned convenience factors.

The second most common reason given was saving of refrigerator space. Homemakers in many cases reported that a dispenser was just like having

Table 7. Advantages of Bulk Home Milk Dispenser Given by Dispenser Users, Portland Market, 1959.

Advantage	Order of importance				
	1	2	3	4	5
Convenience	49	46	28	9	1
Save refrigerator space	16	10	5	3	5
Better quality and colder milk	12	12	18	8	5
Encourage to use more milk....	4	10	13	4	2
Less spoilage and spillage	3	6	6	6	2
Cheaper per quart	3	3	1	....	....
Total	87	87	76	30	15

Table 8. Disadvantages of Bulk Home Milk Dispenser Given by Dispenser Users, Portland Market, 1959.

Disadvantage	Order of importance		
	1	2	mentioned
Space requirement	12	2	....
More expensive	10	1	1
Spillage and dripping	9	2	10
Inconvenience of handling cans	2	2	....
Inconvenience to clean	2	....	1
Dislike dispenser color	1	....	1
Notice milk bill more	1	1	....
Can't tell quantity remaining in can..	1	....	4
Other .....	....	....	5*
Total	38	8	22

* Includes "run out of milk in middle of meal," "can't take bulk on outings," "can't put other dairy products in dispenser," "coil frosts up and drips," and "dislike dairy's name on dispenser."

another refrigerator, since it gave them much more refrigerator space.

Better quality and colder milk was the third most frequently mentioned advantage. Milk could be kept as cold as desired. Most households kept their thermostats set around 35° F., keeping milk colder, and generally more palatable, than in a refrigerator.

Other advantages given less frequently for home dispensers included: "encourage increased consumption," "less spoilage and spillage," and "cheaper per quart." Homemakers on twice-a-week delivery commented that they were well pleased with this arrangement.

Disadvantages

Of the 87 households having dispensers, only 38 cited disadvantages or needs for improvement (Table 8). Eight of the 38 gave a second disadvantage, while 22 mentioned, but did not rank, factors they disliked.

Kitchen space requirement was listed as number one disadvantage by dispenser customers. These homemakers frequently mentioned that, if they were to build new houses, they would provide kitchen space just for the dispenser. Several homes had dispensers in their garages or on nearby porches, as no kitchen space was available.

Increased expense was the com-

plaint mentioned second most often—caused by rent paid for the machine and increased consumption. Because they were now buying more milk in larger units, half of this group thought they should not be charged for the dispenser, while the other half thought there should be a reduction in milk price.

The complaint mentioned third most often was that spillage and spout drip-page occurred in using the machine. Homemakers particularly did not like drippage that occurred frequently when the hose of a new can was cut. Spillage caused by lifting the milk spout by younger children and neighbor children was also a source of irri-

tation. Spillage caused by younger children occurred most frequently when dispensers were new.

Other answers given included: "inconvenience of handling cans," "inconvenience of cleaning," "dislike dispenser color," and "can't tell quantity remaining in the can." These answers accounted for about 19% of the complaints.

More than 95% reported they did not object to having a milk delivery man enter their homes to service dispensers. Pleasant consumer-driver relationships were indicated by favorable comments homemakers often made about delivery men when this question was asked.

Opinions of Former Dispenser Users

Portland dairies supplied a list of families who had had their home dispensers removed. These people were interviewed about family characteristics, attitudes towards the home dispenser, and consumption habits.

From a list of over 60, it was possible to contact only 38 because many of these families had moved and could not be located.

Thirty-six of the 38 gave usable consumption data. Milk consumption per week with the dispenser totaled 1,146 quarts while consumption per week after the removal of the dispenser dropped to 976 quarts or about 15%, for the 36 households.

Consumption was not broken down according to family characteristics because of the small sample size. However, a breakdown by family characteristics was made, similar to that made for households using the dispenser.

In general there was little disparity

among the family characteristics of households using dispensers and those who had them removed. The education of the homemaker, her age, the family size, and occupation of the head of household were all closely related. The only difference of any degree was in family income level. Families who had dispensers removed were, as a group, of lower income level than families using dispensers. Nearly 30% of the dispenser-using families were making over \$8,000 a year, while 19% of the dispenser-using families were in this group. Sixteen percent of the dispenser-removal families made under \$4,000 a year, while only about 2% of the dispenser users were in this group.

The arrangements former dispenser users had for placing milk in the dispenser and for paying for the dispenser were similar to arrangements of current dispenser users. Source of initial knowledge about the dispenser

and the percent of households starting as new accounts also varied little between the two groups.

Reasons dispensers removed

The majority of households interviewed gave several reasons for having dispensers removed. They were asked to rank their reasons in order of importance.

Most common reason given was "kitchen space requirement" (Table 9). Over half of this group mentioned they would take dispensers again if they had space for them in their kitchens.

The second most frequent reason for removal was cost of increased consumption. This group accounted for over 20% of the first-ranked removal reasons.

Spillage and spout drippage accounted for nearly 16% of first-ranked reasons for dispenser removal. This group consisted largely of families where youngsters lifted the dispensing spout when the mother was not around. Most households did not use

the locking device designed to prevent lifting of the spout. Others sometimes forgot to use the lock or children learned how to remove it.

Inconvenience of handling cans and poorer quality of milk were each cited twice by homemakers as their main reasons for having dispensers removed.

Other reasons ranked first in importance for dispenser removal were: "disliked milk man," "ran out of milk in the middle of a meal," "unsanitary and inconvenient," and "delivery man enters the home."

Advantages of dispenser

Eight, or 21%, of the former dispenser households could see no advantage of a dispenser (Table 10). Of the remaining 30 households, 20 cited convenience as the number one advantage. The next advantage given most frequently was saving of refrigerator space. Better quality milk rated third by 13% of the households. These three reasons were in the same order as given by dispenser users.

Table 9. Reasons for Having Home Bulk Milk Dispenser Removed, Portland Market, 1959.

Reason for removal	Order of importance		
	1	2	3
Cost of increased consumption	11	5	1
Space requirement	13	5	1
Spillage, drippage	6	6	2
Poorer quality	2	1	2
Inconvenience of handling cans	2	....	....
Other first ranked reasons ¹	4	....	....
Other reasons, than first ranked ²....	....	4	5
Total	38	21	11

¹ Includes "run out of milk in middle of meal," "unsanitary and inconvenient," "didn't like milk man," and "delivery man enters home."

² Includes "noisy motor," "notice milk bill more," "can't tell quantity remaining in can," and "didn't use enough milk for dispenser."

Table 10. Advantages of Home Bulk Milk Dispensers Given by Families Having Dispenser Removed, Portland Market, 1959.

Advantages	Order of importance			
	1	2	3	4
Convenience	20	6	2	1
Save refrigerator space	6	3	3	1
Better quality and colder milk	4	2	4	6
No bottles to handle .....	....	9	4	1
Encourage to use more milk.....	....	4	3	1
Less spoilage .....	....	1	3	....
Cheaper per quart .....	....	1	....	....
Total	30	26	19	10

Dairy Services to Consumers

Placing dispenser in home

A decided advantage of dispensers for the dairy handling them, besides the increase in milk consumption, was that many (65%) of the dispenser users were new accounts. Of the 57 new accounts, 19 (or one-third,) formerly obtained all their milk from grocery stores. The other 38 new accounts were transfers from competing dairies.

When the study was made, only one dairy in the Portland market was promoting home dispensers. Other dairies were putting in dispensers only on customer request, to prevent losing an account.

The households surveyed in Portland had the choice of renting a machine at \$1 a month, buying the machine outright, buying it on monthly installments of \$5, or using the dispenser free if consumption was large. Households used the dispenser the first month on a trial basis without charge. If desired, a stand for the dispenser was furnished for 50 cents a month.

Sixty-nine percent rented dispensers. Eighteen percent paid \$5-a-month installments. As expected, the lower the income group the higher the ratio

of families renting. Below the \$8,000 income group nearly 17% had or were purchasing dispensers, while about 39% of the families in the \$8,000 and above income group were purchasing or had purchased units.

Delivering milk for dispenser

More than 96% of the time when a household member was home, the milk route man put the can in the dispenser. Three of the 87 households had the route man leave the dispenser can on the doorstep, as he generally arrived during the breakfast rush. The husband or a son would then carry in the dispenser can.

Thirty-three of the homemakers, or 38%, reported they were always home when the route man came. If not planning to be home during delivery time, 38 householders left the doors unlocked, 11 had the dispenser cans left on the doorstep, and 5 left instructions or did not have milk delivered.

Consumer payment

Manufacturers of bulk home milk dispensers state there is no definite pattern by dairies for consumer pay-

ment of units. Arrangements vary with situations found in each market and with policies of different dairies. A dairy in Denver, Colorado, has over 300 dispenser accounts and offers dispensers free. The only stipulation is a

lease agreement allowing the dairy to charge a \$2 monthly rental fee if milk usage drops under six 3-gallon cans per month. In contrast, a dairy in Albuquerque, New Mexico, charges a flat \$3-per-month rental on dispensers.

Costs

Processing costs

Costs of processing and packaging milk in this study were determined by the synthetic or budgetary analysis procedure. Using this technique, a model plant of a specific capacity, equipment, and labor force was developed.

To achieve a realistic comparison between dispenser cans and conventional containers within the framework of existing firm procedures, the dairy with the largest bulk home milk dispenser volume in the Portland market was used as a base plant in determining the physical aspects, such as equipment needs and building size. As the base plant handled only dispenser cans and paper containers, comparable standards were developed for these items but were not developed for milk in glass bottles.

The synthetic plant was set up to process a daily volume of 35,058 quart equivalents per day. The number of units packaged daily in various sized containers is shown in Table 11.

This study was concerned only with costs incurred after milk reached the can filler or paper filler, as costs occurring up to this point would be the same, regardless of packaging method. Thus all expenses such as cost of milk, cost of procuring, storing, and pasteurizing were not computed.

Unit costs, representing the sum of processing and container costs are

shown in Table 12 for paper containers and 3-gallon dispenser cans.

Where only 13% of the milk was packaged in bulk cans, cost per quart of milk packaged in the 3-gallon dispenser can was 2.37 cents, compared to 1.95 cents per quart of milk put up in half-gallon paper containers, and 2.15 cents for milk packaged in quart paper containers (Table 12). The main reason processing costs for cans were higher than for paper was because of relatively fewer units among which to distribute fixed costs. Secondly, with can containers, certain functions, such as putting on lids, were done by hand. Also, the 3-gallon cans had to be cased before they could be conveyed to the cold room. These practices all required extra labor time.

In addition to the difference in total cost, there was a decided difference in the cost composition for milk processed and packaged in the two containers. Cost of supplies for paper represented nearly 70% of the total cost, while the can supplies constituted only 40% of the total can cost. Processing costs, therefore, accounted for 30% of the paper container costs and 60% of the dispenser can cost.

The percent of processing costs represented by labor was nearly identical for milk packaged in cans and paper containers.

The larger the container size for paper and cans, the lower was the

Table 11. Daily Volume of Milk Handled by Type and Size of Container, Model Plant Processing 35,058 Quart Equivalents per Day, Portland Market, 1959.

Container type and size	Units	Total output
<i>Cans</i>	<i>Number</i>	<i>Percent</i>
3-gallon.....	100	3.4
5-gallon.....	170	9.7
<i>Paper</i>		
Half-gallon.....	6,491	37.0
Quart.....	16,163	46.1
Pint.....	2,320	3.3
Half-pint.....	611	.5
Total	35,058 (qt. eq.)	100.0

Table 12. Daily Unit Costs for Processing and Packaging Milk in Various Container Sizes, Model Plant Processing 35,058 Quart Equivalents per Day, Portland Market, 1959.¹

Item	Paper container				Dispenser can	
	$\frac{1}{2}$ -gallon		Quart		3-gallon	
	<i>Cents</i>	<i>Percent</i>	<i>Cents</i>	<i>Percent</i>	<i>Cents</i>	<i>Percent</i>
Processing costs						
Case washer .....	.161		.073			
Paper filler .....	.935		.527			
Cold room .....	.087		.039		3.760	
Can washer					7.651	
Can filler					5.493	
Total processing	1.183	30.30	.639	26.69	16.904	59.51
Supply costs						
Paper containers						
Glue .....	.012		.010			
Staples .....	.038		.038			
Wax .....	.397		.281			
Paper cartons	2.137		1.122			
Cases .....	.138		.062			
Dispenser can						
Tubes					7.232	
Parchment .....					.429	
Seals .....					.648	
Dispenser cans ²					3.133	
Dispenser racks .....					.060	
Total supply	2.722	69.70	1.513	70.31	11.502	40.49
Total	3.905	100.	2.152	100.	28.406	100.
Cost per quart equivalent	1.952		2.152		2.367	

¹ Includes only those costs incurred after the milk reaches the filler.

² Assumes 400 trips per can.

cost-per-quart equivalent. This occurs because costs are not proportional for different sized units of a product. It requires nearly equal machine time to fill quart containers and half-gallon containers. Furthermore, the supply cost, which is 100% variable, for paper quart containers was 1.5 cents, compared to 1.35 cents per quart for half gallons. The same general relationship holds for 3- and 5-gallon dispenser cans.

In this study only a relatively small percent of the output was in dispenser cans as compared to paper containers. It was therefore thought desirable to determine effect on costs of increasing percentage of plant output packed in bulk can containers.

A volume modification was made so that the amount processed in bulk cans was increased from about 13% to 20% of the daily volume. This required use of 200 additional home dispenser cans daily and a reduction of 1,400 paper quarts and 500 paper half gallons. This modification was made to indicate change in processing cost that would occur if a dairy were to greatly expand its dispenser trade.

After plant modification, cost per quart equivalent for paper quarts changed from 2.15 to 2.17 cents and half-gallon containers increased from 1.95 to 1.97 cents (Table 13). The cost per quart equivalent for the home dispenser can declined from 2.37 to 2.14 cents.

The modification resulted in reducing daily processing costs for milk packaged in paper containers by \$9.05 and in reducing paper supply cost by \$34.79. Processing cost for milk packaged in bulk cans increased \$20.27 while expenditure for can supplies increased \$23.00. Cost change occurring, therefore, was a decrease in total sup-

ply costs of \$11.79 and an increase in daily processing costs of \$11.22. The major portion of the increase in daily processing costs occurred because of increase in labor time created in handling of more cans. Net result of increasing the dispenser volume at the expense of paper container volume was to decrease daily plant costs by 57 cents.

Delivery costs

Numerous studies have been made on costs of delivering milk on retail routes. However, none of the studies are known to include costs of distributing milk in bulk home dispenser cans.

There were no all-dispenser retail routes in the Portland area, as of 1959. Bulk home dispenser customers were served by the same routes serving other home delivery customers.

Accounting records and time studies were utilized in determining distribution costs. Truck expense and driver costs were obtained from plant records. Time spent in load breakdown, loading and unloading trucks, and retail route delivery time were obtained through time studies.

Total daily costs of retail distribution per route, as shown in Table 14, amounted to \$32.20 per route.

To obtain direct or off-truck delivery time per customer, total time spent by the retail delivery man in making each delivery trip from truck to point of delivery and return was recorded. For paper container delivery time, each departure from the route delivery, such as making a collection or talking to a customer, was recorded. Time spent on these somewhat irregular elements was then deducted from the gross delivery time to determine "net delivery time," which would be consistent for all observa-

Table 13. Daily Unit Costs for Processing and Packaging Milk in Various Container Sizes, Model Plant Processing 20% of Daily Volume in Dispenser Cans, Portland Market, 1959.

Item	Paper container				Dispenser can	
	½-gallon		Quart		3-gallon	
	<i>Cents</i>	<i>Percent</i>	<i>Cents</i>	<i>Percent</i>	<i>Cents</i>	<i>Percent</i>
Processing costs						
Case washer .....	.168		.076			
Paper filler .....	.979		.550			
Cold room .....	.076		.034		2.685	
Can washer					6.758	
Can filler					4.800	
Total	1.223	31.00	.660	30.37	14.243	55.32
Supply costs						
Paper containers						
Glue .....	.012		.010			
Staples .....	.038		.038			
Wax .....	.397		.281			
Paper cartons	2.137		1.222			
Cases .....	.138		.062			
Dispenser cans					7.232	
Tubes .....					.429	
Seals .....					.648	
Dispenser cans					3.133	
Dispenser racks .....					.060	
Total	2.722	60.00	1.513	69.63	11.502	44.68
Cost per unit	3.945		2.173		25.745	
Cost per quart equivalent	1.972		2.173		2.145	

Table 14. Total Daily Retail Distribution Costs per Route, Portland Market, 1959.

Items	Daily cost
	<i>Dollars</i>
Load breakdown .....	.25
Truck expense	7.43
Driver expense	24.52
Total	\$32.20

tions. Six-hundred and seventeen observations were made on retail paper container delivery time.

The average delivery time per paper container customer was .56 minute, with an average delivery volume of four quarts.¹ Delivery time per quart of milk in paper containers for the average 4-quart delivery was .14 minute. For a 12-quart paper delivery, delivery time per quart was .07 minute.

For retail dispenser can delivery time, 27 observations were made. Average delivery time per dispenser customer was 2.36 minutes, or .196 minute per quart.² All dispenser customers took one can, or 12 quarts, per delivery. Some took three deliveries, while others took only two deliveries per week. About 95% of the customers had the milk put in dispensers in their kitchens.

Largest percent of the increase in delivery time for bulk cans occurred because of time spent in the home, which averaged 1.3 minutes. Increased time for dispenser delivery also was partially due to greater distance as dispenser delivery was generally through the back door, while paper delivery was on the front steps. The average dispenser delivery distance was 177 feet compared to 131 feet for paper delivery.

As indicated earlier, a plant modification was made transferring to bulk

cans 2,400 quarts of milk formerly processed in paper containers.

For retail route distribution a further modification was considered desirable—modification of frequency of delivery for accounts which were switched from paper containers to bulk cans. It was assumed that 400 new accounts were set up. Two hundred of these accounts were to take delivery three times a week and 200 were set up for delivery twice a week.

The retail sales density for the Portland dairy studied was approximately five customers per mile. The assumption was made that half of the 200 homes on twice-a-week delivery were off the normal delivery route, resulting in a reduction of 20 miles a week when can delivery was instigated.

The cost decrease caused by reduced truck mileage occurs only for variable expenses including fuel, tires, and repairs. Savings occurring through these factors amounted to 90 cents daily (Table 15).

Multiple correlation equations were used to get total change in customer delivery time with the processing modification. The supposition was made that the 2-can-a-week customers were former 8-quart-stop deliveries and the 3-can-a-week customers were former 12-quart-stop deliveries. Average delivery time per dispenser can was 2.36 minutes. Total can delivery time for the 1,000 cans per week thus totaled 2,360 minutes.

Average delivery time for the 8-quart paper delivery was .69 minute while the average delivery time for the 12-quart paper delivery was .82 minute. Delivery time for the 600 8-quart delivery stops and the 600 12-quart delivery stops per week totaled 909.84 minutes. Increase in off-truck labor delivery time created by delivering a larger

¹ The function for delivery time per paper container customer was

$$tp = .1363 + .0022X_1 + .0086X_2 + .0325X_3$$
 with tp representing the total paper delivery time per paper container customer in minutes, X_1 the round trip distance in feet, X_2 the number of stair steps incurred per delivery trip, and X_3 the amount of milk delivered per trip.

² The function for delivery time per dispenser customer was

$$Td = .46 + .0028X_1 + .0141X_2 + .9811X_3$$
 where Td represents the total delivery time per dispenser customer in minutes, X_1 the round trip delivery distance in feet, X_2 the number of stair steps incurred per delivery stop, and X_3 the time spent in the home servicing the dispenser. A t -test made on the regression coefficients found them to be significant at the 5% level.

volume in cans was 1,450 minutes per week or 241.69 minutes per day on a 6-day week.

This increase in off-truck time was partially offset by a reduction in recording time, driving time, and conversation time. Recording time per delivery was .178 minutes, average weekly time spent talking to customers was 41.4 minutes, and average retail truck speed was 15 miles per hour. These savings, plus a reduction in truck distance of 20 miles per week, amounted to 127.3 minutes a week or 21.2 minutes a day. Daily net increase in delivery time thus was 220.49 minutes when the percentage of bulk can deliveries was increased (Table 15).

The operating modification resulted in 1,000 more dispenser cans and 490 less cases being handled each week. Time studies showed that such a volume modification, on a daily basis, would increase total load breakdown time by 7.5 minutes, increase total truck loading time by 7 minutes, and increase total truck unloading time by 18.2 minutes (Table 15). The large increase in truck unloading time occurred because cans were carted to the can washing center five at a time. This procedure required extra walking time.

As indicated by Table 15, there was a total increase in labor time of 253 minutes per day when 2,400 quarts of milk formerly distributed in paper were shifted to bulk cans. At 1959 wage rates total increase in cost was \$11.68 or about .5 cent per quart. About 90% of this increase resulted from additional time in placing bulk cans in dispensers inside homes.

Cost of dispenser to dairy

A major equipment expense affecting the profitability of handling dispensers is dispenser cost itself.

Costs to a Portland dairy of purchasing a dispenser on a cash basis, 3-year plan, and a 5-year plan, as given by a leading dispenser company, are given in Table 16.

The actual dollar outlay to a dairy purchasing home dispensers can be readily ascertained through price lists. In making management decisions, however, factors such as tax rate and depreciation allowance need to be taken into consideration. For illustration purposes, the dispenser cost for an incorporated dairy netting under \$25,000 annually, which would be the situation for many commercial dairies, has been developed. The federal income tax rate

Table 15. Daily Changes in Retail Distribution Costs Resulting from Increasing Relative Volume of Milk Sold in Dispenser Cans from 13% to 20%, Portland Market, 1959.

Item	Changes	
	Labor time	Costs
	<i>Minutes</i>	<i>Dollars</i>
Load breakdown	+ 7.50	+ 0.37
Truck loading time	+ 7.00	+ 0.35
Truck unloading time	+ 18.20	+ 0.90
Truck expense		— .90
Delivery time	+220.49	10.96
Total net increase in delivery costs	253.19	\$11.68

Table 16. Dispenser Cost to Dairy, 1959 Prices, Portland, Oregon.

	Cost	Total cost
	<i>Dollars</i>	<i>Dollars</i>
Cash payment		
Dispenser only	159.85	
Less 1% cash discount	1.60	
		158.25
Dispenser and stand	198.35	
Less 1% cash discount	1.98	
		196.37
Three-year payment		
Dispenser only	159.85	
Less down payment ¹	15.98	
	143.87	
Interest ²	25.89	
		169.76
Monthly payment	4.72	
Dispenser and stand	198.35	
Less down payment	19.84	
	178.51	
Interest	32.13	
		210.64
Monthly payment	5.85	
Five-year payment		
Dispenser only	159.85	
Less down payment ¹	15.98	
	143.87	
Interest ²	43.00	
		186.87
Monthly payment	3.11	
Dispenser and stand	198.35	
Less down payment	19.84	
	178.51	
Interest	53.55	
		232.06
Monthly payment	3.87	

¹ Ten percent down payment.

² Six percent interest charge on original cost. If the interest charge was on the unpaid balance, the total interest charge would be reduced by one-half.

for such a corporation is 30%. By using the fast write-off allowance allowed on equipment, depreciating the dispenser on a 5-year basis through the sum of the digits method, and charging \$1 a month rental on the machine, the net cost of the dispenser becomes \$69.90. With the addition of financing charges, assuming a 5-year payment plan, the cost of the home dispenser to the dairy becomes \$100 (Table 17). With a machine life of 10 years, the yearly cost would be \$10.

Cost of the dispenser and the increased cost in delivery with a large dispenser volume would need to be offset by increased sales of milk or increased sales of by-products as a result of the bulk cans. Another alternative for reducing the costs of bulk can distribution would be to discontinue placing the cans in the kitchen dispenser. Rather they would be left on the doorstep or porch as is the milk delivered in paper containers.

Table 17. Analysis of Dispenser Cost to Dairy, on a 5-Year Payment Program, Portland Market, 1959.

Item	Cost	Total cost
	<i>Dollars</i>	<i>Dollars</i>
Gross		159.85
Less federal tax saving via depreciation ¹		
Rapid write-off allowance	9.59	
1st year ²	12.79	
2nd year	10.23	
3rd year	7.66	
4th year	5.12	
5th year	2.56	
	47.95	
Net		111.90
Rental receipts ³	60.00	
Net receipts after taxes ⁴		42.00
Dispenser before financing		69.90
Financing		
Five-year purchasing plan	43.00	
Financing after tax allowance		30.10
Total after five years		100.00

¹ Thirty percent of the total depreciation allowance.

² Sum of the digits depreciation method, on a 5-year basis, made on the amount remaining after 20% write-off allowance deducted from gross cost.

³ With a rental basis of \$1 per month for a 5-year period.

⁴ Seventy percent of total receipts.

Procedure

All fluid milk plants in the Portland, Oregon, market using home bulk dispensers were contacted. These plants gave a list of their customers currently using home dispensers, along with a list of accounts which had had dispensers removed. These households were then interviewed about their milk consumption habits, family characteristics, and attitude towards home dispensers. A total of 125 households were interviewed. Eighty-seven schedules were taken from households with dispensers and 38 schedules were taken from households where dispensers had been removed. Tabulation of data from the completed schedules was done on IBM equipment. All tests of significance were made at the 5% level using the F test.

Model used

Cost of processing and packaging milk was determined through budgetary or synthetic model procedure. Using this technique, a model plant of specific capacity, equipment, product mix, and labor force was developed. Monetary and physical coefficients were then attached to the various inputs, thus enabling calculations of unit costs.

The budgetary method involves use of standards of fuel consumption, electrical power consumption, equipment performance, and labor time for various tasks.

In this study, standards were derived from observations of a chosen dairy plant and from secondary sources. Time studies were made to determine plant labor standards. Equipment, heat, electrical, and water rates were obtained from dairy equipment specialists and dairy technologists.

Information on labor costs for distributing milk in bulk containers as compared to conventional containers was obtained through time studies. Other cost information was obtained from plant accounting records. Time-study information collected included truck loading, driving, retail delivery time, and unloading time. For retail delivery time, the time spent talking, collecting, soliciting, recording, arranging load, and for personal reasons was accounted for so that net delivery time per customer could be obtained. Number of steps, stairs, and milk units delivered per stop also were recorded. Six-hundred and seventeen observations were made on paper container deliveries. Twenty-seven observations were made on bulk container deliveries. Because most retail routes carried only two or three dispenser cans, only that many observations could be obtained per day. After 27 observations were made on bulk dispenser deliveries, a statistical test was made, indicating the data to be statistically reliable.

Multiple correlation was used in statistical analysis of total delivery time. A digital computer was used to derive normal questions. The Crout method for solving simultaneous equations was then used to obtain "b" and "r" values. The "t" test was used to test significance at the 5% level.

Response bias

In an attempt to determine response bias, records were obtained when possible, from dairy plants on consumption of milk before and after dispenser installation, and length of time the household had been using the dispenser.

Dispenser users were asked how long they had been receiving milk in bulk dispensers. In 35 cases the dairy was able to supply the exact date the machine was installed. These households reported they had been using dispensers for a total of 460 months, while the dairy records indicated a total of 497 months. Nearly an 8% underestimate was made by householders.

Distributor records for 68 dispenser households indicated they had taken 1,972 quarts of bulk milk in the past seven days. These same homemakers reported purchase of 2,048 quarts of bulk milk in the last seven days, an overestimate of almost 4%.

Dairies could not provide records on previous milk consumption for 57 households as these were new accounts starting with dispenser installation. In addition, the records for one old account could not be located. The remaining 29 households reported they consumed 736 quarts of whole milk in a 7-day period before using dispensers, overestimating by 8% the dairy plant

records of 679 quarts of whole milk bought during this period.

In all figures on comparative consumption before and after dispenser installation, dairy figures were used in preference to the respondents if a discrepancy existed.

The reported 23.5% increase in consumption after dispenser installation should be accepted with the reservation that the bias in consumption of milk from other sources was not measured. The bias in reporting purchases of milk from other sources probably may be higher than the bias in reporting consumption for delivered milk because it would not have been purchased regularly and therefore was more difficult to recall.

Effect of the bulk home dispenser on sales of dairy products other than milk was not measured. Although dispenser manufacturers list this as one of the big advantages of a dispenser, Portland route men indicated there was no noticeable increase in extra dairy products sold to dispenser users.