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QUANTITY DISCOUNT PRICING OF FLUID MILK

by

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QUANTITY DISCOUNT PRICING OF FLUID MILK<sup>1/</sup>  
by John D. Helmberger and E. Fred Koller

When the consumer buys milk at the doorstep, she pays not only for the milk itself but also for the service involved. The cost of the delivery service is a substantial part of the consumer's price. These costs are not appreciably greater where several quarts are delivered than for a single quart. The pricing of milk completely ignores this fact in most markets, reflects it in a small way in a few, and reflects it adequately in none.

Delivery costs and therefore the consumer's price for fluid milk can be reduced substantially by reducing the service involved. Uniform prices, which generally prevail, give the consumer no incentive to reduce her demand for service. Such pricing overcharges the customer who takes several quarts at a delivery in order to make up for the failure to assess full cost to the one-quart customer. Prices which include small quantity discounts, such as Minneapolis had at the time information was gathered for this study (spring, 1954), give the consumer only a small incentive to reduce her demand for service. A substantial discount is required to induce consumers to take larger, less frequent deliveries or to induce large volume consumers to have their milk delivered. Increasing the average size of delivery is one of the principal ways in which unit delivery costs may be reduced.

The purposes of this study are: (1) to analyze milk delivery costs to determine the costs per unit for deliveries of various sizes, (2) to study the use of quantity discount pricing of milk, and (3) to analyze the effects of a substantially larger quantity discount in milk pricing than those generally used.

The study includes a brief survey and analysis of current practices in pricing fluid milk. It evaluates pricing arrangements which completely or partially reflect differences in delivery cost for various sized deliveries. Data for the analysis were obtained largely from a consumer survey and a study of the delivery operations of the two largest fluid milk distributors in Minneapolis. The sample for the consumer survey was designed to be statistically representative of the city.<sup>2/</sup> The survey

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<sup>1/</sup> The authors acknowledge with appreciation the excellent cooperation of the officers of milk companies and consumers in Minneapolis who supplied the basic data for this study. Credit is due Dr. Rex W. Cox and Dr. O. B. Jesness of the Department of Agricultural Economics, University of Minnesota, for many helpful suggestions. The assistance of Rueben C. Buse and Linley E. Juers, graduate research assistants in the Department of Agricultural Economics, is gratefully acknowledged.

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<sup>2/</sup> The method of selection of the sample is given in Appendix A.

involved interviewing 1,198 Minneapolis housewives to get a detailed picture of milk purchasing practices and attitudes toward quantity discounts. The study of the delivery operations was carried out to determine the delivery cost per delivery and per unit.

### The Minneapolis Market

The milk distribution problem is considered with special reference to the Minneapolis market. The population of Minneapolis and adjacent suburbs was 619,489 in 1950. The average daily volume of milk sales in February, 1955, was 729,393 pounds or 339,253 quarts.<sup>1/</sup>

There were nine distributors of fluid milk in Minneapolis in February, 1955. The five largest distributed 72 per cent of the milk.<sup>1/</sup> The two largest sold 35.5 per cent of the milk, accounting for 45.7 per cent of the retail sales and 26.9 per cent of the wholesale sales. The number of distributors has declined steadily since 1935 when there were 27 distributors of which the five largest distributed 58.4 per cent of the milk.<sup>2/</sup>

Minneapolis is no exception to the national trend toward sale of milk through stores. The percentage of fluid milk sales that is delivered to homes in Minneapolis and suburbs fell from 55.34 per cent in June, 1946, to 52.50 per cent in June, 1950,<sup>3/</sup> to 48.20 per cent in June 1953, and to 45.89 per cent in February, 1955.<sup>4/</sup>

There has been a decided trend toward selling milk in paper containers in Minneapolis as elsewhere. In June, 1950, 22.9 per cent of the fluid milk sold in Minneapolis and suburbs was sold in paper containers, ~~47.7~~ <sup>47.7</sup> per cent of the wholesale sales and 3.3 per cent of the retail sales. In June, 1953, these percentages had increased to 39.7 per cent of all milk sales, 64.4 per cent of the wholesale sales and 15 per cent of the retail sales. By February, 1955, the percentages had increased to 50.8, 70.8, and 27.2 per cent, respectively. The distributor with the largest wholesale sales sold 99.7 per cent of his wholesale milk in paper containers in February, 1955. One distributor handled well over half of his home delivered milk in paper containers and another handled nearly half in such containers. In addition to this the sale of milk in paper half gallons is growing rapidly relative to other sizes and types of containers.

In the spring of 1954 when data were being gathered for this study, Minneapolis and St. Paul had the lowest store margins for milk among the 137 urban markets reported in the Fluid Milk and Cream Report of the United States Department of Agriculture. The customary store margin in Minneapolis has been  $1\frac{1}{2}$  cents per quart over a long period of time.

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1/ Calculated from records of the Milk Market Administrator, Minneapolis.

2/ Alexander Swantz, "Economic Effects of Federal Regulation of Fluid Milk Markets With Special References to the Minneapolis-St. Paul Market", unpublished doctor's thesis, University of Minnesota, 1951, pp. 244-45.

3/ Ibid, p. 254.

4/ Calculated from records of the Milk Market Administrator, Minneapolis.

### PREVAILING PRACTICES IN PRICING FLUID MILK

The prevailing practice in pricing fluid milk at the retail level throughout the United States is to charge a uniform price per quart for a given type of milk within a given area regardless of the number of quarts of milk purchased by the consumer. The Fluid Milk and Cream Report includes monthly data on milk prices and discounts for a number of urban markets. Of the 137 urban markets <sup>1/</sup> (including 149 cities), 70 per cent reported uniform pricing in the spring of 1954. In smaller cities the practice of uniform pricing is even more prevalent.

When uniform pricing on home delivery routes is used the average delivery cost per unit is included in each quart of milk sold. Therefore a 6-quart customer, for example, pays six times as much for a delivery as does a 1-quart customer. This method of pricing ignores cost facts. Motion and time studies of delivery operations have been made in several markets to determine the relation between delivery costs and the size of deliveries. The scope of this study did not permit such an analysis of the Minneapolis market. However, other studies of milk delivery methods and costs indicate that costs depend more on the number of deliveries made on a route than on the total volume delivered. In a study of home delivery in New York City, Young and Bergfeld state that, "Functional analysis of home delivery clearly indicates that home delivery costs are created as a given amount per customer call rather than as a given amount per quart". <sup>2/</sup> A report of the New York State Temporary Commission on Agriculture states that, "Although the delivery of a large volume of milk to a home delivery customer required somewhat longer for the selection of merchandise and possibly for filling a carrier, this difference in time is not significant when compared with total time required for delivery. For practical purposes, the delivery of four quarts costs no more than the delivery of one quart". <sup>3/</sup> A study at Purdue University found that it took one-tenth of a minute <sup>4/</sup> more time to serve a 6-quart customer than to serve a 1-quart customer.

Perhaps no one would contend that the cost of serving a large volume retail customer is exactly the same as the cost of serving a small volume customer, but the studies do reveal that the costs are practically the same. Charging each customer the same amount for a delivery, regardless of the size of the delivery, is a much more accurate reflection of the costs involved than charging a given amount for each quart and concealing the charge in a uniform delivered price.

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- <sup>1/</sup> Representing 45 states and the District of Columbia. Only New Mexico, Nevada, and Delaware were not represented.
  - <sup>2/</sup> E. C. Young and A. J. Bergfeld, "Methods Employed in An Analysis of the Spread Between Farm and Consumer Milk Prices in New York City", Journal of Farm Economics, November, 1949, p. 1200.
  - <sup>3/</sup> Report of the New York State Temporary Commission on Agriculture, "An Analysis of the Spread Between Farm and Consumer Prices in Amsterdam", Legislative Document No. 17A, Part 2, 1951, p. 31.
  - <sup>4/</sup> J. W. Hicks and G. B. Wood, "Operations in Retail and Wholesale Milk Routes", Purdue University, Bulletin 556, 1950.

A uniform price discriminates against the large volume customer and subsidizes the small volume customer. That is, the former more than pays for the cost of the milk plus the delivery costs while the latter pays less than these costs. A consequence of this is that many large volume customers are buying part or all of their milk at stores to escape this discrimination. These are the very customers which could be served most profitably by home delivery. Many small volume customers are being served at home at a loss while they could be served profitably through stores.

As large volume customers leave retail routes to buy milk at stores, the volume density on routes falls. This increases unit cost of delivery and necessitates an increase in home delivered prices, both absolutely and relative to store prices. This induces more large volume customers to buy their milk from stores. The milk distributor finds himself caught in a vicious circle, from which the only escape seems to be a change in his pricing methods.

#### Some Markets Have Quantity Discounts

While a uniform price is the custom in most markets, discounts on quantity purchases are provided in some. Of the 137 markets reported in the Fluid Milk and Cream Report, 41 or 30 per cent had some form of retail quantity discount.<sup>1/</sup> The types used include the following: (1) Discounts on purchases of a certain amount during a given period such as one half cent a quart on purchases of 60 to 90 quarts a month, and one cent on purchases of 90 quarts or more. These are referred to as bracket type discounts. (2) Discounts on individual purchases of a specified size or sizes such as 3 quarts at a delivery. These may be of the bracket type or the service charge type.<sup>2/</sup> (3) Discounts on purchases in gallon or half gallon containers. The 41 markets included 10 of the first type, 18 of the second, and 13 of the third. While the discounts vary in amount, in no case do they reflect adequately the differences in delivery costs per unit between large and small deliveries. In most cases the discounts offered are too small to be much of an inducement to take larger deliveries.

It is difficult to determine the extent of the discounts for comparative purposes since one needs to know the distribution of sales by size of sale per delivery or per month before the size of the discount can be assessed properly. The distribution of sales by size was found for Minneapolis as of the spring of 1954 by consumer survey. This distribution, shown in table 1, was used as a basis for measuring the extent

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<sup>1/</sup> March to June, 1954.

<sup>2/</sup> The service charge type of discount is described on page 8.



Table 1. Distribution of Retail Milk Sales by Size of Sale,  
Minneapolis, March - May, 1954.

Average size of delivery in quarts	Per cent of customers	Cumulative per cent of customers	Per cent of volume	Cumulative per cent of volume
1	12.46	12.46	3.63	3.63
2	26.62	39.08	15.28	18.91
3	18.94	58.02	16.41	35.32
4	17.06	75.08	19.79	55.11
5	10.41	85.49	15.04	70.15
6	7.17	92.66	12.04	82.19
7	2.39	95.05	4.96	87.15
8	2.90	97.95	6.78	93.93
9 or more	2.05	100.00	6.06	100.00

of the discounts for the various reporting cities which have retail quantity discounts. A weighted average price was calculated for each city<sup>1/</sup> This is compared with the listed price for each of the ten markets<sup>1/</sup> which had an effective quantity discount of more than one half cent per quart for all milk retailed. The results are shown in table 2. It is recognized that the distribution of sales by size of sale varies with time and among cities so that the values in this table are not precise. It is believed, however, that they are fairly good approximations.

<sup>1/</sup> Ten out of 41 markets which reported quantity discounts.

Table 2. Retail Quantity Discounts For Regular Milk For Ten Markets Which Had An Average Discount of Half a Cent Per Quart or More, Spring 1954\*

City	Listed retail price per quart	Discount or discounted price per quart	Weighted average price per quart	Average discount
Fort Wayne, Indiana	\$.18	2¢ for 2 qts., 2 1/3¢ for 3, 4¢ for 4, 5, or 6, and 4 1/2¢ for 7 or more.	\$.146	\$.034
Minneapolis, Minnesota	.20	20¢ for the first qt., 16¢ for additional qts.	.172	.028
Wausau Wisconsin	.21	2¢ for 3 qts. or more.	.194	.016
Binghamton, New York	.22	1¢ for 3 qts., 2¢ for 4 or more.	.205	.015
Duluth, Minnesota	.22	1¢ for 2 qts. or more.	.210	.010
Norfolk-Portsmouth Virginia	.245	1¢ for 3 qts. or more.	.237	.008
Detroit Michigan	.21	1¢ for 60 qts. per mo. 2¢ for all over 60.	.202	.008
Grand Rapids, Michigan	.20	1¢ for 60 qts. per mo. 2¢ for all over 60	.192	.008
Canton, Ohio	.18	1¢ for 60 qts. per mo. 1 1/2¢ for 90 or more.	.172	.008
South Bend, Indiana	.20	1¢ for 4 qts., 3¢ for 12 qts.	.194	.006

\*There may be other cities with discounts this large. The weighted average discount was not calculated for the 13 cities which have a discount for gallon sales only.

It should be pointed out that the effective discount in Gary, Indiana; Beloit, Wisconsin; and perhaps Chicago might be in excess of one half cent for all milk retailed. In those markets the discount was 4, 3, and 2 cents per quart, respectively, when purchased in gallon jugs. Because the proportion of retail sales made in gallon jugs in those markets is not readily available, it is not feasible for present purposes to determine the extent of these discounts.

The New York studies support the conclusion that quantity discounts

in use do not reflect adequately the differences in delivery cost among deliveries of various sizes. The unit delivery costs for various sized retail deliveries in four New York markets are shown in table 3. These costs do not include commissions. If commissions had been included and properly allocated, all of the figures in table 3 would have been larger and the differences in delivery cost for each unit would have been greater. In Buffalo the per quart delivery cost to a 1-quart customer was 10.6 cents greater than to a 6-quart customer, that is, 12.7 cents minus 2.1 cents. If commissions had been included, the difference would have been more than 10.6 cents. Even if commissions are excluded, it can be seen that the differences in delivery costs per unit among various sized deliveries are very substantial.

Table 3. Retail Milk Delivery Cost Per Quart and Per Delivery in Four New York Markets, 1948-1950\*.

Size of delivery in quarts	New York City	Buffalo	Amsterdam	Binghamton
	delivery cost in cents per quart			
1	14.3	12.7	8.1	9.6
2	7.2	6.4	4.1	4.8
3	4.8	4.2	2.7	3.2
4	3.6	3.2	2.0	2.4
5	2.9	2.5	1.6	1.9
6	2.4	2.1	1.4	1.6
	cost in cents per delivery			
	14.3	12.7	8.1	9.6

\*Source: Report of the New York State Temporary Commission on Agriculture, "An Analysis of the Spread Between Farm and Consumer Milk Prices", Legislative Documents No. 46, 1949, p. 47; No. 30, 1950, p. 53; No. 17A, 1951, p. 36; No. 17, 1951, p. 39. These costs do not include commissions.

In Binghamton, which had the largest quantity discount among these New York markets and the fourth largest reported in the Fluid Milk and Cream Report, the quantity discount was as follows: 1 cent for 2 or 3 quarts in a delivery and 2 cents for deliveries of 4 quarts or more. The single quart price was 19.5 cents. The price to a 6-quart customer was thus 2 cents per quart less than the price to a 1-quart customer, while the unit cost of delivery was 8 cents less (table 3). If commissions had been included, the unit delivery cost for the 6-quart customer would have been 12 cents less than for the 1-quart customer.<sup>1/</sup>

In view of the very substantial reduction in unit delivery cost between deliveries of 1 quart and 2 quarts (table 3), it is significant that only 5 of the 41 cities which had quantity discounts in the spring of 1954 allowed any discount for 2-quart deliveries. Two of these allowed only one half cent a quart.

<sup>1/</sup> The New York State Temporary Commission in Legislative Document No. 34, 1951, p. 37, states that "The 1-quart customer paid no more, in most markets than the 4-quart customer, although his distribution cost might be higher by more than 10 cents per quart".

## QUANTITY DISCOUNTS OF THE SERVICE CHARGE TYPE

With a quantity discount of the service charge type, milk prices are determined by two factors: (1) the base, or platform, price of milk (including the cost of raw milk, processing, packaging, overhead, and profit) and (2) the cost of delivery or service charge. Thus, the first quart of milk delivered carries the base price plus the service charge. Additional quarts in the same delivery are then sold at the base price, that is, the platform price. If the milk dealer desires to make the service charge less than the cost of making a delivery, then the base price has to be somewhat larger in order to cover the balance of the delivery costs.

The service charge type of quantity discount, in contrast to the bracket type, allows a discount to all customers who buy more than one quart of milk at a time and each size of purchase has a different average price. It should be emphasized that the size of the quantity discount in either the bracket type or the service charge type can be made as large or as small as the dealer chooses. It should be noted that the use of the service charge type of discount enables the dealer to pass on to the consumer all or a part of the savings effected by the consumer's willingness to take larger deliveries. Without adequate incentive there is no reason to expect consumers to economize on service.

The Minneapolis market is one of the few markets which has a quantity discount of the service charge type. No matter how many units a customer buys at a time, she can always get a lower average price by increasing the size of her purchase. This method of granting quantity discounts was put into practice in the Minneapolis market in 1939 and has been used ever since except during the price control period of World War II. <sup>1/</sup>

The difference between the bracket type of quantity discount and the service charge type is illustrated in table 4. The table compares a bracket type discount, under which customers receive a discount of 1 cent a quart for purchases of 3 quarts or more at a time and a 2 cents a quart discount for purchases of 6 quarts or more, with a service charge type, in which the service charge is 4 cents per delivery. It is assumed that the list price is 21 cents a quart in the first case and 22 cents in the latter.

While the actual prices under a service charge type of discount are derived from a price for milk as such and a price for service, the plan

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<sup>1/</sup> The service charge type of quantity discount was developed by E. S. Elwell, President of Northland Milk and Ice Cream Company of Minneapolis. It is often referred to as the Elwell type of discount. Many of those familiar with this type of discount are accustomed to thinking of it in terms of a relatively large discount. However, this type can be used with any size of discount.

Table 4. A Comparison Between the Bracket Type of Quantity Discount And a Quantity Discount of the Service Charge Type.

Size of delivery in quarts	Bracket Type Price per quart	Service Charge Type* Price per quart
		cents
1	21	22
2	21	20
3	20	19 1/3
4	20	19
5	20	18 4/5
6	19	18 2/3
7	19	18 4/7
8	19	18 1/2

\*Notice that a customer always gets a lower average price by increasing the size of her purchase in the case of the service charge type of discount. With the bracket type discount, the 5-quart customer pays the same price as the 3-quart customer.

is usually presented as one of quantity discounts. Usually no mention of the term "service charge" is made. The first quart in a delivery usually is offered at a "list price", which is equal to the sum of the base price and the service charge, and each additional quart in the same delivery is priced at a discount. The discount is equal to the service charge. For example, if the base price is, say, 18 cents per quart and the service charge is 6 cents, then the prices are listed as 24 cents a quart with a 6 cents per quart discount allowed for each additional quart taken on the same delivery. Service charge discount prices have also been quoted as 24 cents for the first quart and 18 cents for additional quarts. The former method of quoting prices to home delivery customers is believed to have the advantage of being less disturbing to the wholesale trade.

The alternative ways of presenting the service charge type of quantity discount are illustrated in table 5.

Table 5. Alternative Ways of Presenting a Quantity Discount of The Service Charge Type and Average Prices Which Result.

Size of delivery in quarts	Milk 18¢ per quart, service 6¢	Milk 24¢ per quart, 6¢ discount for all over one quart	24¢ for the first quart, 18¢ for additional quarts
	average price in cents per quart		
1	24	24	24
2	21	21	21
3	20	20	20
4	19 1/2	19 1/2	19 1/2

The service charge type of discount has an additional advantage over other methods in that it is easier for the dealer to use. For example, if a dealer who has uniform retail prices contemplates offering a quantity discount plan, he wants to know **what** the probable immediate effects on his receipts would be. This effect is easily determined if he contemplates using a discount of the service charge type since all the information needed is the daily volume of his retail sales and the number of retail customers served per day. With any other type of quantity discount, he must know at least part of the distribution of sales by size of sale, information which very few dealers have.

Regardless of the type of quantity discount used, the distribution of sales by size can be expected to change over time because of the fact that the discount encourages old customers to take larger deliveries, attracts large volume customers away from stores, and encourages some small volume customers to go to the stores for milk. As this occurs, the average price received for milk sold on routes would fall, but so would unit delivery costs since more milk would then be sold per delivery.

#### The Service Charge Type of Quantity Discount in Minneapolis

From the end of World War II until 1954, home delivered prices of regular (or standard) milk in Minneapolis, where the service charge type of discount is used, have included a discount of 2 cents for additional quarts. In May, 1954, the quantity discount was increased to 4 cents. In July, 1955, the discount was increased to 10 cents for each additional quart by two distributors while the others continued to use the 4 cent discount. These increases in the size of the discount indicate recognition of the fact that the "service charge" incorporated into home-delivered milk prices in the past did not sufficiently reflect differences in delivery costs. Furthermore, delivery costs have risen rapidly in recent years.

In Minneapolis, the average cost of making a retail delivery for the two largest distributors was 24.72 cents in 1952-53. The relation between the unit delivery costs of 1952-53 and discounted prices of August, 1954, for various sized deliveries are given in table 6. The difference in unit delivery cost between 1-quart and 6-quart customers was 20.6 cents while the difference between prices for these customers was only 3 1/3 cents. The consumers' incentive for buying in larger quantities was relatively small with the 4-cent discount used at this time. Large volume customers continued to be attracted to stores while small volume customers were subsidized and remained on retail routes. There was little incentive for retail customers to economize on services.

Table 6. Quantity Discounted Prices and Delivery Cost Per Quart For Various Sized Deliveries of Regular Milk, Minneapolis, Minnesota\*

	Size of delivery in quarts					
	1	2	3	4	5	6
Price per quart	21	19	18 1/3	18	17.8	17 2/3
Delivery cost per quart including commissions	24.7	12.4	8.2	6.2	4.9	4.1

\*August, 1954 prices and 1952-53 delivery costs are used in the table. The prices result from charging 21 cents for the first quart in a delivery and 17 cents for additional quarts.

In view of the price and cost differences shown above and the fact that delivery costs for milk have increased since 1953, it is clear that the quantity discounts reflect in only a small degree the differences in delivery cost for various sized deliveries. This is true even though Minneapolis had one of the largest quantity discounts for home delivered milk found anywhere in the country in the spring of 1954.<sup>1/</sup> Quantity discounts then in use were inadequate to get and keep large volume customers on retail routes. Unless retail quantity discounts are substantially increased, it seems clear that the trend toward distribution of milk through stores will continue with obvious effects on retail milk distribution.

#### A Modification of the Current Quantity Discount

The hypothesis tested in this study was that a substantially larger quantity discount of the service charge type would be acceptable to consumers and would improve the efficiency of retail milk distribution. One alternative in administering a quantity discount of this type is to price milk in such a way as to reflect fully the differences in delivery cost for various sized deliveries. This amounts to establishing a price on the first quart which exceeds the price on additional quarts by the full cost of making a delivery. A second alternative would be to price milk to only partially reflect differences in costs for deliveries of various size. However, the more nearly the size of the discount follows the decline in delivery costs per quart as the size of delivery increases, the nearer prices come to being faithful reflectors of costs.

#### Retail Delivery Costs in Minneapolis

Before the effects of full reflection of delivery cost differences in prices can be analyzed, it is necessary to consider the size of delivery costs. The overall delivery operations and delivery costs of the two largest distributors of fluid milk in Minneapolis and suburbs were studied. These two distributors together accounted for 35.5 per cent of the total fluid milk sales in the area in February, 1955. Their retail sales were 45.7 per cent of the total retail sales and their wholesale

<sup>1/</sup> See table 2.

sales were 26.9 per cent of the total.

Unfortunately neither distributor made any attempt to separate his retail delivery costs from his wholesale delivery costs. It was necessary therefore to make cost allocations on the basis of available information.<sup>1/</sup> Some of the results of the cost study appear in table 7.

Table 7. Summary of Retail Delivery Operations of the Two Largest Fluid Milk Distributors in Minneapolis, 1952-1953\*

Total number of packages of all products delivered . . . . .	28,445,922
Total number of deliveries made - - - - -	7,442,666
Total retail delivery cost - - - - -	\$ 1,839,829.61
Average cost per delivery - - - - -	24.72¢
Average cost per package delivered - - - - -	6.47¢
Average number of routes operated - - - - -	211.9
Average volume per route day, in packages - - - - -	367.8
Average number of customers served per route day - - - - -	96.2
Average size of delivery - - - - -	3.8

\*The figures are combined for the two companies. Averages are weighted. The data from one company was found for its fiscal year, 1952-53 and for the other the data was for the calendar year, 1953.

Prices Which Fully Reflect Cost Differences for Minneapolis

To determine home delivered prices for milk which fully reflect delivery cost differences it is necessary to: (1) calculate the platform price for retail milk which equals the weighted average price for all retail milk minus the average delivery cost per unit, and (2) add to this platform price the delivery cost per unit for whatever sizes of delivery are under consideration.

The retail prices for regular milk in Minneapolis during August, 1954, were determined by charging 21 cents for the first quart in a delivery and 17 cents for additional quarts. This resulted in a weighted average retail price of 18.15 cents a quart given the distribution of sales by size as determined by the consumer survey.<sup>2/</sup> The weighted average cost of delivery per unit was 6.47 cents and the weighted average cost of making a delivery was 24.72 cents (table 7). Thus, the average platform price was 11.68 cents, that is, 18.15 cents minus 6.47 cents.

<sup>1/</sup> The method used to make the cost allocations is given in Appendix B.

<sup>2/</sup> See table 1.



Retail prices which fully reflect delivery cost differences were calculated by adding the platform price, or 11.68 cents per quart, to the price of the delivery service per quart, that is, 24.72 cents divided by the size of delivery. The results appear in table 8. To reflect all costs a 1-quart delivery of milk in Minneapolis should have been priced at 36.40 cents a quart. A 6-quart delivery would be priced at 15.8 cents a quart.

Table 8. Home Delivered Prices Which Completely Reflect Delivery Cost Differences, Minneapolis, 1954.

Size of delivery in quarts	Price of milk on the platform, per quart	Price of service per quart	Prices which fully reflect cost differences*
1	11.68	24.72	36.40
2	11.68	12.36	24.04
3	11.68	8.24	19.92
4	11.68	6.18	17.86
5	11.68	4.94	16.62
6	11.68	4.12	15.80
7	11.68	3.53	15.21
8	11.68	3.09	14.77
9	11.68	2.75	14.43
10	11.68	2.47	14.15

\*These prices are equivalent to charging 11.68 cents per quart for milk and 24.72 cents per delivery.

Let us examine the probable consequences of the use of milk prices which fully reflect delivery cost differences. First, and perhaps most important, these prices would not continue to reflect fully the delivery cost differences. One of the most important determinants of the cost of making a delivery is the density of the customers. Quantity discounts, especially large ones, very probably would change the distribution of sales by size, customer density, and sales density on retail routes.

Given the prices as shown in table 8, it could be expected that: (1) many small volume customers would leave retail routes, (2) many of them would take larger, less frequent delivery to get a lower price, and (3) some large volume customers who currently buy milk elsewhere would shift to retail routes. The fact that many large volume customers already buy their milk on home delivery routes and that there are many more relatively small volume than large volume customers means that (3) would only partially offset (1) and (2). It should be emphasized here that this applies where the service charge is equal to the full cost of making a delivery, that is, 24.72 cents. The consequence of using a discount this large very likely would reduce substantially the density of customers served on a given route day. It probably would increase rather than decrease both the unit cost of delivery and the cost of making a delivery. This would be due not to the fact that the average size of delivery is greater but because customers are further apart.

Increasing the cost of making a delivery would necessitate increasing the price to the smaller volume customers still more to keep prices which fully reflect cost differences. It appears that a full reflection of cost differences would hasten rather than stop the decline of home delivery.

Even if one is not disposed to regret the passing of home delivery, it should be recognized that many consumers want and are willing to pay for the service. There are not enough large volume consumers to permit efficient home delivery unless a considerable number of small volume customers are kept on home delivery routes. It is to the interest of large volume customers to have a quantity discount which only partially reflects differences in delivery cost in order to keep some small volume customers to carry part of the cost of route operation. It appears, then, that the question is not whether any of the delivery cost differences should be reflected in the price structure, but how much of these differences should be reflected.

#### Prices Which Partially Reflect the Differences in Delivery Costs

Any quantity discount partially reflects the differences in unit costs for various sized deliveries. Even a small retail quantity discount, like the one in use in Minneapolis in 1954 (4 cents a quart), tends to attract large volume customers to retail routes and discourage small volume customers. If the discount were a little larger, and the price level of milk remained the same, prices to small volume customers would be increased so that a few of them would leave the retail routes. The price to large volume customers would be reduced so that some of them, who buy from the store currently, would be attracted to retail routes. If the differential were slowly increased, the volume of milk sold on retail routes would increase and the number of retail customers probably would increase at first. As the discount approached the full cost of making a delivery, 24.72 cents, the number of customers and, later, the volume of milk sold on retail routes would fall. It appears that the optimum degree to which milk prices may reflect delivery cost differences lies somewhere between limited partial reflection as is true where small quantity discounts are used and full reflection. The optimum size of the differential, that is, service charge, depends largely on how consumers would react. The primary purpose of the consumer survey made in Minneapolis in the spring of 1954 was to shed light on this point.

#### Consumer Reaction to Larger Discounts

For the purpose of estimating consumer reaction to a larger discount on home delivered milk, a differential of 10 cents a quart was selected for use in a survey of Minneapolis consumers. That is, the first quart in a home delivery was priced at 25 cents and additional quarts at 15 cents. It was estimated that this schedule of prices would allow the distributors about the same level of total receipts as was possible under the prices of 20 cents for the first quart and 18 cents for additional quarts which prices were in use in Minneapolis when this study was started. It was believed that a 10-cent differential or discount would be more significant and have a greater impact on the consumer than a

smaller odd cents amount, say 4 cents or 7 cents a quart. At times a substantial price change is required to induce consumers to change their buying habits. To find the best differential or discount in a given market, a range of them should be tested. It was concluded, however, that in a market survey of a large group of consumers only one quantity discount schedule could be tested at a time.

The home delivery price schedule on which consumer reaction was sought in the Minneapolis study is shown in table 9. It is based on the

Table 9. Home Delivery Price Schedule Used in Minneapolis Fluid Milk Survey, 1954\*

Size of delivery in quarts	Present price	Proposed price	Saving	Average price per quart	
				present	proposed
				cents per quart	
1	20	25		20	25
2	38	40		19	20
3	56	55	1	18 2/3	18 1/3
4	74	70	4	18 1/2	17 1/2
5	92	85	7	18 2/5	17
6	110	100	10	18 1/3	16 2/3
7	128	115	13	18 2/7	16 3/7
8	146	130	16	18 1/4	16 2/8
9	164	145	19	18 2/9	16 1/9
10	182	160	22	18 2/10	16

\*The prices in the 6th column are equivalent to a charge of 15 cents per quart for milk and 10 cent per delivery for service.

price of 25 cents for the first quart and 15 cents for additional quarts. Prices through a range of 10 quarts are shown on this schedule. The schedule also shows average prices per quart at the time of the survey and average prices per quart under the new proposed quantity discount price schedule.

Besides obtaining reaction to the 10 cent a quart quantity discount price schedule, the survey was designed to obtain information on current milk buying patterns such as source of milk supply, size of purchases, frequency of purchase, etc.

About 70 per cent of those interviewed favored the larger quantity discount as shown in column 6 in table 9. That is, they favored prices which more nearly reflected costs than was true with the smaller quantity discounts then in use. About 12 per cent opposed the larger discount and 18 per cent expressed no opinion (table 10).

Of the consumers who purchased milk on retail routes about 71 per cent favored the larger discount. Of those who bought 4 quarts or more at a time, about 86 per cent favored the larger discount. The majority of every group of customers classified by size of purchase, regardless

of where they currently bought milk, were in favor of the larger discount.

Table 10. Consumer Reaction Toward Use of a Ten Cents Per Quart Discount In Retail Milk Pricing, Minneapolis, 1954.

	Per cent favorable	Per cent unfavorable	Per cent no opinion
All customers	70	12	18
Exclusively home delivery customers	71	14	15
Exclusively store customers	68	9	23
Home delivery and store customers	75	16	9
One-quart customers	55	17	28
Three-quart customers	68	12	20
Six-quart customers	82	7	11

Consumers were also asked how much milk they purchased at a time, how frequently they purchased, where they bought, and where they would buy if they could have milk delivered at prices shown in column 6 of table 9. The expected interchanges of customers between various sources of milk supply, by size of purchase classes, are shown in figure 1. Of the 4-quart customers, 33 per cent had been buying all of their milk from the milkman, 14 per cent bought milk from the milkman and the store, and 53 per cent bought at the store only. Given a 10-cent discount, 52 per cent indicated they would buy all of their milk from the milkman, 8 per cent said they would buy from the milkman and the store, and 40 per cent said they would buy all of their milk at the store.

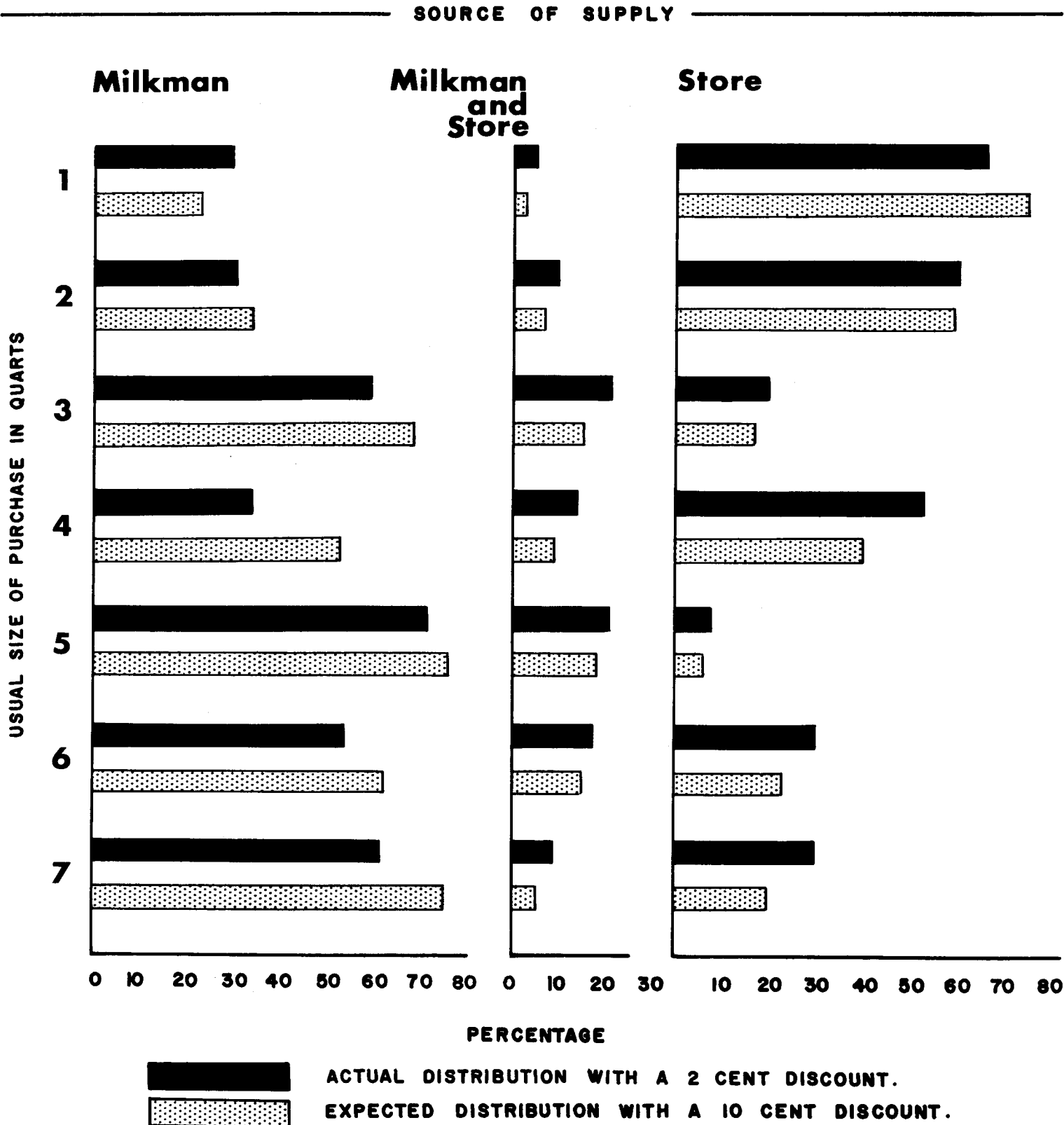
The shifts to and from retail routes which consumers expected to make upon adoption of a ten cent per quart discount are summarized in table 11. It is clear that a 10-cent differential is better than a

Table 11. Distribution of Sample Retail Customers by Size of Current Purchase and Expected Distribution Assuming a Ten Cent per Quart Discount, Minneapolis, Spring, 1954.\*

Size of purchase in quarts	Current Purchases		Expected Purchases		Per cent change in number of customers
	Number of customers	Per cent of customers	Number of customers	Per cent of customers	
1	73	12.46	54	8.85	- 23.29
2	156	26.62	159	26.07	+ 1.92
3	111	18.94	115	18.85	+ 3.60
4	100	17.06	125	20.49	+ 25.00
5 or more	146	24.92	157	25.73	+ 7.53

\*This distribution includes consumers who buy part of their milk supply at stores.

Figure 1: Actual and Expected Percentage Distribution of Sample Milk Consumers According to Sources of Supply and Size of Purchase, Minneapolis, 1954



smaller one for the reason that its use means the loss of only 23 per cent of the 1-quart customers on retail routes, 17 out of 73 in the sample, a slight increase in the number of 2-quart customers, from 156 to 159, and a gain of 11.2 per cent in the number of customers who take three quarts or more at a time, from 357 to 397. Given a 10-cent differential, the survey indicated that large volume customers were more sensitive to price reduction than small volume customers were to price increases. It is likely that this would be true in the case of a smaller differential as well.

The volume of milk purchased by those who indicated they would buy milk on retail routes if the 10-cent quantity discount were used was 15.2 per cent greater than the volume bought on retail routes at the time of the survey. The number of customers who indicated that they would buy milk on retail routes was 4.1 per cent greater than the number who did so at that time. The average size of milk delivery according to the survey was 3.38 quarts. The average size of delivery of non-milk items sold on retail routes was .61 packages. The average size of milk purchase of those who indicated they would buy milk on retail routes, given a 10-cent differential, was 3.75 quarts. The average size of delivery could be expected to rise more than this, of course, for two reasons: (1) some consumers would take larger, less-frequent delivery to take advantage of the lower price obtainable by doing so, and (2) the lower price would cause at least some customers to consume more milk.

The number of customers who would split their patronage between retail routes and stores would decline substantially. Of the 11.6 per cent of the customers who were splitting their patronage, 26.1 per cent indicated they would buy all of their milk on retail routes and 7.5 per cent indicated they would take their total supply from stores.

Assuming that consumers would react as they said they would, the use of a 10-cent quantity discount would increase both the customer density and the sales volume density on retail routes. This would reduce both the retail delivery cost per unit and the delivery cost per delivery.

While it appears to be true that a 10-cent discount is preferable to a smaller one, it does not follow that it is the best one possible. The use of a 15-cent differential, for example, might yield more favorable results than one of 10 cents. Whether it would or not depends on how consumers would react.

It should be noted that consumers, who expressed opinions relative to the larger quantity discounts and indicated shifts in their patronage as given above, were comparing prices based on a 10-cent per quart discount with the current (spring of 1954) 2-cent per quart discount. In addition they were comparing these home delivered price schedules with existing store prices. In other words the situation envisaged by consumers interviewed was the reflection of delivery cost differences in home delivered prices only. The above, therefore, is of interest primarily to those distributors who are interested in the use of larger quantity discounts in retail prices only.

The discussion thus far has been limited to milk but the quantity

discount pricing method can easily be extended to include the other products handled by fluid milk distributors. Current prices of these other products include delivery costs. To reflect cost differences in the prices of these products at the retail level to the same extent as in milk prices by the use of a 10-cent differential, it is necessary to deduct 40.5 per cent of the embodied retail delivery cost per unit from the current prices of these other products to get the additional units price.<sup>1/</sup> The first units price would be the additional unit price plus 10 cents. However, in order to collect the delivery costs only once, consumers would be permitted to buy as much as they please of any products handled at the additional units price after having purchased a unit of any product at the first unit price. As a practical matter, if one wishes to assume that every retail customer buys at least one quart of milk per delivery, which is close to the truth, price schedules could be simplified by simply stating a first unit and an additional units price for milk only. Then only the additional units price for all other products handled would need to be listed.

#### Recent Experience with Larger Quantity Discounts

An 8 cents per quart discount plan has been adopted recently by a milk distributor in a smaller city in southern Minnesota. As part of the present study, a survey was made of the milk buying habits of a statistically representative sample of 200 consumers in that city. A re-survey after adoption of the larger discount has not yet been made but the distributor who is using the 8-cent a quart discount plan reports that his sales on home delivery routes have increased 16 per cent since the plan was adopted.

A Des Moines milk distributor started a discount plan in July, 1954, under which the first quart in a delivery was priced at 26 cents and additional quarts at 16 cents. This firm retails milk outside of the city as well as within. Its home delivery sales within the city in March and April of 1955 were 19.5 per cent greater than for the same months of 1954. Its area sales, including those within the city increased 25.1 per cent. Other firms in the market have not followed the lead but have granted discounts to large volume consumers where necessary to keep them on their routes. These results support the expectations indicated by the Minneapolis consumer survey.

#### QUANTITY DISCOUNTS ON WHOLESALE ROUTES

Quantity discounts are used more widely on wholesale than on retail milk routes. To the extent that such discounts are systematic, that is, a given discount applies to all customers on the same basis, they are usually small. Additional discounts are frequently given on an individual basis. The latter discounts appear to be more a function of local competition or bargaining than of differences in costs.

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<sup>1/</sup> The use of a 10-cent differential amounts to 40.5 per cent reflection of the delivery cost differences in retail prices, since 10 cents is 40.5 per cent of 24.72 cents, which is the cost of making a delivery.

The August, 1954, wholesale price for regular milk in Minneapolis was 17 cents a quart. The formal discounts are one-half cent per quart for the first 300 quarts per month and 1 cent a quart for quarts in excess of 300 per month. Apparently few, if any, pay the list price so the one-half cent discount is no quantity discount at all. A discount of  $1\frac{1}{2}$  cents a quart is given on purchases of half gallons, regardless of volume. In addition to these, informal discounts are given on an individual basis through bargaining. The weighted average discount amounts to about  $1\frac{1}{2}$  cents a quart for all wholesale milk. In addition to discounts, special services are granted frequently to customers on an individual basis. These special services and special discounts are increasing greatly the cost of making wholesale sales and are making for more or less chaotic conditions in the market.

The above discounts reflect only slightly the differences in wholesale delivery costs per unit for various sized deliveries. In 1953, the delivery cost for a 10-quart wholesale customer was 10.639 cents a quart for the two largest distributors in Minneapolis. For a 100-quart customer, the delivery cost per unit was 1.459 cents (table 13).

Wholesale Delivery Cost in Minneapolis

Before wholesale prices which reflect delivery cost differences can be discussed, it is necessary to know the magnitude of these costs. A summary of the results of the study of the wholesale delivery operations of the two largest fluid milk distributors in Minneapolis appears in table 12. It will be observed that the average cost of a wholesale delivery for these two firms was \$1.2294. This amounts to about 2.6 cents for each package of product delivered on wholesale routes.

Table 12. Summary of Wholesale Delivery Operations of the Two Largest Fluid Milk Distributors in Minneapolis, 1952-53.

Total number of packages of all products delivered during the year*	22,702,280
Total number of deliveries made	475,464
Total wholesale delivery cost	\$ 584,529.72
Average cost per delivery	\$ 1.2294
Average cost per package	.025748
Average number of wholesale routes operated	37.643
Average number of mixed routes which made some wholesale deliveries	213.125
Average volume per wholesale route day, packages	1128.84
Average size of wholesale delivery, packages	47.748

\*All products except ice cream which was handled in completely separate departments by both companies.

1/ See Appendix B for methods used in the study.



Wholesale delivery costs in these firms were not allocated to deliveries of various sizes as they were in the case of retail delivery costs. While it is true that the cost of making a delivery to a large volume retail customer is practically the same as it is to a small volume retail customer, this is not the case in wholesale deliveries. A significant part of the cost of making a wholesale delivery is a function of the size of the delivery. It is estimated that about 17 per cent of the wholesale delivery cost is a function of volume.<sup>1/</sup> The remaining 83 per cent depends on distance traveled and the number of customers served. For a given size of delivery, the wholesale delivery cost equals (17 per cent of the overall average delivery cost per unit times the size of the delivery) plus (83 per cent of the overall average cost of making a delivery). Using the data from this study would work out as follows: (17 per cent of 2.5748 cents times the size of the delivery) plus (83 per cent of \$1.2294). For example, a 10-quart delivery costs (.439 times 10) plus \$1.02 or \$1.0639. This amounts to 10.639 cents a unit. The delivery cost per delivery and per unit for various sizes of wholesale deliveries is shown in table 13.

Table 13. Estimated Fluid Milk Delivery Costs Per Delivery and Per Unit for Wholesale Deliveries of Various Sizes, Minneapolis, 1952-53.\*

Size of delivery in quarts	Delivery cost per delivery dollars	Fixed delivery cost per quart cents	Variable delivery cost per quart cents	Total delivery cost per quart cents
5	1.042	.439	20.40	20.84
10	1.064	.439	10.20	10.64
20	1.108	.439	5.10	5.54
30	1.152	.439	3.40	3.84
50	1.240	.439	2.04	2.48
100	1.459	.439	1.02	1.46
200	1.898	.439	.51	.95

\*The New York Commission found that wholesale delivery costs per unit varied from .8 of a cent to 19.9 cents in New York City in 1949. Legislative Document No. 46, 1949, pp. 38-41.

Effects of Inadequate Wholesale Quantity Discounts

If wholesale prices are uniform or include only a small quantity discount, distributors may face a number of serious problems. Large

<sup>1/</sup> According to data obtained from the New York State Temporary Commission on Agriculture's "An Analysis of the Spread Between Farm and Consumer Prices" (Legislative Document No. 30, 1950, p. 64), 18.28 per cent of wholesale delivery costs were a function of volume in Buffalo. Using Bressler's formula for time requirements on wholesale routes, (see R. G. Bressler's City Milk Distribution, Harvard University Press, Cambridge, 1952, p. 167) together with wholesale route volume and cost per minute of operating wholesale routes for the two Minneapolis distributors, the proportion of the cost of a wholesale delivery which varies with volume was found to be 15.38 per cent. For purposes of this study, 17 per cent is used.

volume wholesale customers may be encouraged to establish their own source of supply either within or outside the market in order to get lower cost milk. Large volume retail customers who are being discriminated against on routes are encouraged to go to their nearby neighborhood grocers, many of whom can offer an attractive price only because they are being subsidized. Many stores will buy in relatively small quantities from several distributors which increases the cost of delivery for all concerned.

In markets which have a store differential, many consumers go to stores for milk because they would prefer to avoid the costs of home delivery service. Distributors sell to stores at a lower price than to retail customers because the unit cost of delivery is generally less. However, if a distributor sells milk to small volume, neighborhood stores at an unduly low price, one insufficient to cover the delivery costs as well as the platform price, he is really performing part of the retail service of home delivery, that is, he is bringing the milk within a block or two of the consumers' doorsteps instead of all the way. According to the consumer survey, 69.8 per cent of those who buy milk at stores in Minneapolis buy it at neighborhood stores at an average distance of 1.8 blocks from their homes. Nearly two thirds of these lived within one block of the store. Thus, the usual practice among distributors is to discriminate against the large volume customer on retail routes and then subsidize the corner store to make it easy for the customer to escape the discrimination.

It is well known in the industry that many stores handle too many brands of milk. These split stops reduce efficiency and add greatly to delivery costs. Clearly an adequate quantity discount would reduce the number of split stops substantially or eliminate them. In addition to this, the store differential (the home delivered price minus the price charged by stores) would be smaller at the small volume, nearby neighborhood store. With a smaller differential in these stores more consumers would be encouraged to take their milk on home delivery routes assuming that adequate quantity discounts were available to them.

The fact that wholesale delivery costs per unit are lower than retail delivery costs and, perhaps, generally by more than the customary 2-cent store margin, means that there should be a store differential - at least for the larger volume stores. It does not follow from this that there should be a store differential for all stores. Small wholesale deliveries are often more costly on a per quart basis than middle sized or larger retail deliveries. In these cases, the store differential should be negative, that is, the store price should be higher than the home delivered price.

#### Wholesale Prices Which Reflect Cost Differences

To derive wholesale prices which fully reflect delivery cost differences, it is necessary to: (1) calculate the platform price for wholesale milk which equals the weighted average price for all wholesale milk minus the average delivery cost per unit, and (2) add to this platform price the delivery cost per unit for whatever sizes of delivery are under consideration.

In Minneapolis, the weighted average wholesale price was 15.5 cents a quart. The average delivery cost per unit was 2.57 cents. The average platform price of wholesale milk was thus 12.93 cents a quart. Wholesale prices which fully reflect costs, then, equal 12.93 cents a quart plus delivery cost for the sizes of delivery involved. For deliveries from 10 to 200 quarts, the cost reflecting prices range from 23.569 cents a quart to 13.879 cents a quart. A schedule of these prices is shown in table 14.

Table 14. Wholesale Prices Which Fully Reflect Delivery Cost Differences, Minneapolis, August, 1954.

Size of delivery in quarts	Platform price per quart	Delivery cost per quart	Average price of delivered milk.*
		cents per quart	
10	12.93	10.64	23.57
20	12.93	5.54	18.47
30	12.93	3.84	16.77
50	12.93	2.48	15.41
100	12.93	1.46	14.39
200	12.93	.95	13.88

\*These prices amount to charging 13.369 cents per quart for milk plus \$1.02 per delivery. They fully reflect delivery cost differences between deliveries of different sizes.

It will be noticed that, when prices fully reflect differences in delivery costs, the price to a 10-quart wholesale customer is actually more than 9 cents greater than it is to a 10-quart retail customer (see tables 8 and 14). This may appear to be unreasonable until one considers all the service customarily given to wholesale customers, especially small volume customers, but not to retail customers. Some examples of these services are: arranging articles in the refrigerators, cleaning or otherwise maintaining the refrigerator, figuring out the order, that is, performing the buying function for the customer, making out the sales slip, waiting for the grocer to sign the slip or pay for the merchandise, waiting for the store to open, etc.

It may appear that such a pricing system would make it impossible for a small grocery to handle fresh milk. However, this is not the case as many small groceries now buy milk in small quantities from several distributors. By concentrating his purchases, such a customer could get the 20-quart price, the 30-quart price, or the 50-quart price depending on the number of distributors from whom he currently buys and his willingness to reduce the number of brands handled.

Wholesale prices which reflected cost differences fully would reduce substantially the number of wholesale deliveries made because of the price incentive for taking fewer, larger deliveries. Split stops might almost disappear. The average size of wholesale delivery would increase. Each routeman, while serving fewer customers, would deliver more milk. The wholesale delivery cost per unit would fall.

It will be recalled that full reflection of cost differences in retail prices was considered impracticable on the grounds that there are not enough large volume consumers to permit efficient retail distribution unless a considerable portion of the small volume consumers are kept on retail routes. This argument does not apply to wholesale distribution. There is no need to subsidize small volume wholesale customers. While full reflection of cost differences in retail prices would almost certainly reduce retail sales, such reflection in wholesale prices probably would increase wholesale sales. The large quantity discounts would lead to sufficient economizing on services to permit price reduction which would stimulate milk consumption.

#### The Interdependence of Retail and Wholesale Operations

The effect of a given retail quantity discount on overall milk sales and the distribution of sales between retail and wholesale would depend on: (1) what discounts are given in wholesale prices and (2) how store prices are adjusted to the resulting wholesale and retail prices.

In the section on partial reflection of cost differences in retail prices, it was estimated on the basis of the consumer survey that the use of a 10-cent discount would result in increasing the number of retail customers by about 4 per cent and the volume of retail sales by about 15 per cent. The 15 per cent figure does not allow for any increased consumption due to lower prices and is, therefore, conservative. However, it must be remembered that the consumers, whose responses led to the 4 per cent and 15 per cent figures, were assuming no change in prices charged by stores. If store prices were changed, whether or not wholesale prices changed, consumers could not be expected to react to the 10-cent discount as indicated by the survey.

If store prices were increased, one could expect an even greater increase in retail sales to result from the use of a 10-cent discount. If store prices were decreased, one would expect a smaller increase, no increase, or even a decrease in retail sales, depending on the magnitude of the decrease in store prices.

Analysis of this problem is complicated in Minneapolis by the failure of many stores to take their normal margin. The typical store margin throughout the country has been quite stable at about 2 cents a quart. In Minneapolis, the customary margin has been about  $1\frac{1}{2}$  cents a quart. However, in the period January 1954 to August 1955 the prevailing store margin on fluid milk was apparently less than this.<sup>1/</sup> Presumably this is a temporary departure from customary practice but the effect is disturbing to the retail delivery system.

Now let us consider the probable effects on overall sales and the distribution of sales between retail and wholesale of simultaneously

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<sup>1/</sup> During most of this time store prices ranged from 1 cent a quart lower to 1 cent a quart higher than the wholesale price. See Fluid Milk and Cream Reports for January, 1954, to August, 1955.

introducing a 10-cent quantity discount on retail routes and complete reflection of delivery cost differences in wholesale prices.<sup>1/</sup> Retail prices were 17 cents per quart for milk plus 4 cents per delivery for service in June, 1955, and net wholesale prices were about 15.5 cents per quart on the average. What changes in patronage could be expected by charging 15 cents per quart for milk and 10 cents per delivery on retail routes and charging 13.369 cents per quart for milk (neglecting rounding) and \$1.02 per delivery on wholesale routes? This question cannot be answered without considering how stores would adjust their prices. Let us assume further that stores (1) would take the customary 1½ cents a quart gross profit margin, or (2) that they would sell at a loss of 1 cent a quart. Table 15 shows milk prices under these various assumptions.

Table 15. Retail, Wholesale, and Store Prices For Various Sized Deliveries and Volumes Handled\*

Retail		Wholesale		Stores		
Size of delivery in quarts	Price per quart	Size of delivery in quarts	Price per quart	Volume handled in quarts	Price with 1 1/2 cent profit margin per quart	Price with 1 cent loss margin
1	25¢	10	23.57¢	10	25.07¢	22.57¢
2	20	20	18.47	20	19.97	17.47
3	18 1/3	30	16.77	30	18.27	15.77
4	17 1/2	50	15.41	50	16.91	14.41
5	17	100	14.39	100	15.89	13.39
6	16 2/3	200	13.88	200	15.38	12.88

\*Retail prices: 25 cents for the first quart and 15 cents for additional quarts. Wholesale prices: 13.369 cents per quart and \$1.02 per delivery.

If dealers were to adopt the retail and wholesale prices given in table 15, the overall quantity of milk sales undoubtedly would increase. Both retail and wholesale customers would have a substantial incentive to take larger and less frequent delivery. Consumers would buy less service with their milk whether they got it on home delivery routes or at stores. The lower average consumer prices would stimulate consumption. While the demand for milk is not very elastic, there surely would be some consumption response to lower prices.

If the customary 1 1/2 cent store margin is adhered to so that store prices would be as indicated in column 6 of table 15, it is reasonable to expect a substantial shift from wholesale to retail sales. Only the larger volume stores would have resale prices lower than home-delivered prices. Even there the differential would be smaller than it

<sup>1/</sup> The third and fourth columns of table 15 show wholesale prices which fully reflect cost differences. Wholesale prices which only partially reflect differences in delivery costs would be lower for small volume customers and higher for large volume customers.

has been for larger volume consumers. In addition to this, any small volume consumer can get a lower price by buying more at a time on a retail route. This opportunity is not present if she buys from stores. If stores maintained 1 1/2-cent margins, many of their customers could do as well or better taking home delivery. It is entirely possible that the use of a 10-cent differential in retail prices and wholesale prices which completely reflect delivery cost differences would result in more than a 15 per cent increase in the volume of retail sales. On the other hand, if stores sell at a loss, it seems that home delivery sales can only continue to decline relative to wholesale sales.

#### AN APPRAISAL OF SOME OBJECTIONS

While quantity discounts have many desirable features, there are a number of objections to their use. A few of the more important ones will be discussed in this section.

Some milk dealers fear that quantity discounts are a form of price cutting and would lead to market instability. A recent study in New York state found that 23 of 38 dealers who had quantity discounts believed that their discounts reduced price cutting. Only five believed price cutting was increased because of their discounts. <sup>1/</sup> Any dealer who wants to cut his prices can always do so without resorting to quantity discounts. The incentive for granting price reductions to large volume consumers informally and thus inviting price cutting of competitors is less where discounts are in use than where uniform prices are used. The use of quantity discounts can be accompanied by price increases as well as price cuts and there is no reason whatever why it need be accompanied by any change in the average price for home delivered milk. The proposed retail quantity discount of 10 cents per quart, which for Minneapolis amounts to charging 25 cents for the first quart in a delivery and 15 cents for additional quarts, involves neither a price increase nor a price cut. These prices merely collect the delivery costs more nearly where they are incurred. As for the fear of market instability, quantity discounts of the service charge type have been used in Minneapolis for about 15 years. Yet it is one of the most stable milk markets in the nation.

Some dealers believe that such a discount pricing plan would involve unusually difficult bookkeeping and driver checking problems. Surveys have been made among dealers who are using quantity discounts and generally they report that bookkeeping is no special problem. Probably the dealers who have not used quantity discounts are really thinking of the changes in bookkeeping that would be necessary upon adoption of discounts rather than the bookkeeping after the change in pricing method has been accomplished.

There are a number of ways of dealing with the driver checking

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<sup>1/</sup> S. K. Christensen and John R. Moore, "Quantity Discount Pricing on Retail Milk Routes in New York State", Department of Agricultural Economics, Cornell University, Bulletin AE895, 1955, p. 26.

problem. A commission plan under which the driver would receive the whole 10 cent service charge is one way of dealing with the problem. As far as checking out the load is concerned, each load of milk could be checked out at the additional quarts price plus 10 cents for each customer on the route to cover the service charge. Of all types of quantity discounts, the service charge type is the simplest to handle from the bookkeeping viewpoint.

Milk route drivers may fear that the use of quantity discounts of this magnitude would result in fewer jobs. The consumer survey indicates that there would be more customers as well as more volume on retail routes as a result of using a 10-cent differential. However, many consumers would take less frequent delivery to get the benefit of the discount. As a result the number of customers served on a given day might decline somewhat. If this should happen, route reorganization would be necessary and some routemen might be laid off. However, the efficiency of retail delivery would be increased and the decline in the importance of home delivery would be slowed down or even reversed. If this occurred, routemen would be more secure in their jobs than at present and there may be even more jobs.

Routemen are also fearful that customers would not understand the reasons for the discount. The fact that the survey reveals that the vast majority of consumers favor the discount and most of the others are indifferent should allay those fears. A well designed educational program should accompany the inauguration of quantity discount pricing in order to make it understood by all.

A few consumers object to the quantity discount proposed here because they think it would work a hardship on small volume users. A 1-quart customer, however, can get the 2-quart price by taking 2 quarts at a time and buying less often. The keeping quality of milk has so improved in recent years that twice a week delivery or every fourth day delivery could be taken without significant deterioration of the milk. The consumer survey revealed that one out of eight Minneapolis consumers were buying milk either twice a week or less often than that. In the event anyone thinks that the quantity discount prices proposed here discriminates against small volume users, it may be pointed out that with these prices large volume consumers are still subsidizing small volume users. If some consumers fail to pay for the service they are getting, others must pay for it. Delivery involves costs which must be borne by someone.

#### SUMMARY AND CONCLUSIONS

The primary purpose of this study was to determine the effects of substantially increasing the size of quantity discounts in retail fluid milk prices in the Minneapolis market. During most of the period of this study, the price for the first quart of milk in a delivery in Minneapolis was 20 cents. The price of additional quarts in the same delivery was 2 cents less. These quantity discounts were of the service charge type since the 2 cents a quart discount amounted to a charge for delivery service which was borne by the first quart taken in a delivery.

The study undertook to evaluate the probable effects of increasing this quantity discount from 2 cents to 10 cents a quart, that is, charging 25 cents for the first quart in each delivery and 15 cents for additional quarts.

The delivery operations of the two largest milk dealers in Minneapolis were analyzed. The average cost of a retail delivery was found to be 24.72 cents. The delivery cost per quart was found to be 6.47 cents. Detailed motion and time studies made elsewhere indicate that the cost of delivering one quart of milk is practically the same as for delivering several quarts. This means that the delivery cost per quart decreases as the size of delivery increases. Since this is the case, a quantity discount of the service charge type reflects costs more closely than any other type of quantity discount.

Another advantage of a quantity discount of the service charge type is that it is the only type of discount which encourages every consumer to economize on service. No matter what quantity of milk a consumer would take on each delivery, taking larger deliveries would result in a lower average price. Where one quart is delivered, the use of a 10-cent discount, or service charge, amounts to charging 10 cents for a service which costs 24.72 cents.

The question may be raised why the charge for a delivery is not made equal to the full cost of making a delivery. If the differential were made as large as 24.72 cents, first quarts would be priced at 36.4 cents and additional quarts at 11.68 cents, neglecting rounding. This would so increase the price to small volume customers that the customer density would decline which would increase the cost of making a delivery—since customers would be farther apart. If an effort were made to keep the charge for a delivery equal to its cost, the customer density would continue to decline. There are not enough large volume customers to permit efficient retail delivery unless many small volume customers are kept on routes. It seems that the only way large volume customers can continue to have home delivery is to subsidize small volume customers to a certain degree.

In order to keep some small volume customers on retail routes, it appears to be necessary to make the differential or service charge somewhat less than the full cost of making a delivery. A 10-cent differential was selected arbitrarily for detailed study.

A survey of 1,198 housewives revealed that about 70 per cent of the consumers favored the use of a 10-cent per quart quantity discount in retail milk prices. Twelve per cent opposed it and 18 per cent were indifferent. The majority of the consumers favored the larger discount regardless of the size of their usual milk purchase or their current source of milk.

The survey indicated that the number of home delivery customers would increase about 4 per cent and the volume of home delivery sales would increase about 15 per cent in response to the larger discount. Since many consumers would take less frequent delivery to take advantage of the discount and some would increase their consumption, the average



size of retail sale would probably increase substantially. Both customer and volume density on home delivery routes could be expected to increase. This would reduce the unit cost of delivery, reduce the price of delivered milk, and stimulate milk consumption.

The estimated effects of using a 10-cent differential on customer and sales density on retail routes indicated that a 10-cent differential is better than a smaller one. No claim is made that a 10-cent discount is best. A larger one might be better.

The same logic which applies to the use of a quantity discount in retail prices applies generally to the use of such discounts in wholesale prices. The study of wholesale delivery operations of two large firms in Minneapolis revealed that the average cost of making a wholesale delivery was \$1.22. The delivery cost per unit was found to be 2.57 cents. The cost of a given size of wholesale delivery was found to be \$1.02 plus .439 cents per quart.

If every wholesale customer were to pay for the full cost of the service he received, the delivered prices to small volume customers would be much greater than to large volume customers. The delivered price for a 10-quart wholesale customer in Minneapolis would have been 23.57 cents a quart while it would have been 13.88 cents a quart to a 200-quart customer during most of 1954. While it is considered untenable to charge the small volume retail customers the full cost of service because it would drive nearly all of them to the store for milk, it is considered tenable to charge the small volume wholesale customer the full cost of delivery provided all dealers charged for this service.

The simultaneous use of a 10-cent a quart quantity discount in retail prices and a \$1.02 differential in wholesale prices undoubtedly would increase total milk sales because of the incentive given to all customers to economize on service. However, it can not be determined what the effect on the distribution of sales between retail and wholesale routes would be - without knowing what store prices would be. If stores could be depended on to take the normal margin, which for Minneapolis has been 1 1/2 cents a quart, it seems probable that retail sales would increase even more than the 15 per cent expected on the basis of using a 10-cent discount in retail prices with no change in wholesale discounts.

Substantially larger quantity discounts of the service charge type have been adopted by a number of milk distributors in other cities. One distributor in a smaller town in southern Minnesota experienced more than 16 per cent increase in its retail sales after adopting an 8-cent a quart quantity discount. Another in Des Moines experienced more than a 20 per cent increase after adopting a 10-cent quantity discount.

The use of larger quantity discounts has many advantages. The use of such discounts is a step in the right direction in that it deals directly with one of the most troublesome problems in milk distribution today, that is, high delivery costs. It allocates the burden of these costs in such a way that the customers who are responsible for a large proportion of these costs relative to the amount of milk they buy will bear a larger part of them.

Quantity discounts of the service charge type are desirable in that they should set in motion adjustments which will reduce the amount of service and delivery cost per unit of product delivered. It will help reduce the costly demands for service which are perpetuated by uniform price plans or small quantity discounts. It will help retail milk routes to recover many of the large volume customers who can be served efficiently and profitably in this way.

Admittedly these larger discounts need further trials and testing, but these should be encouraged by the fact that the first tests have been successful and bear out the findings of preliminary market research. To make progress in the field of milk distribution, the industry must dare to innovate.

## APPENDIX A

### The Method of Selecting the Sample for the Consumer Survey of Fluid Milk Consumption in Minneapolis, March-May, 1954.

The sample was selected by selecting blocks and dwelling units within blocks. The blocks were selected by taking every 20th block from the "Census Block Statistics - 1950". Before dwelling units were selected, they were conceptually numbered in each block as follows: Dwelling units were numbered counter clockwise starting with the unit on the southwest corner of each block. Dwelling units in multiple dwellings were numbered as follows: the lower left dwelling unit was assigned the smallest number and other units on the same floor were numbered counter clockwise. Upper floor dwelling units were numbered similarly. Every 6th dwelling unit was selected from each sample block. To avoid bias toward or away from corner dwelling units, numbers 6, 12, 18 ... were selected from one block, numbers 7, 13, 19, ... 1 were selected from the next, numbers 8, 14, 20 ..... 2 from the next, etc.

If a sample dwelling unit was occupied but no responsible member of the household was home, a call back was made at a different time of the day. The rule was that if a dwelling unit was visited unsuccessfully in the day time, the call back was made in the evening and vice versa. If a sample dwelling unit was unoccupied or if its occupants were out on call back, the next occupied dwelling unit counter clockwise around the block was substituted as an alternate. The sample included the occupants of 1,198 dwelling units in 227 blocks.

## APPENDIX B

### The Method of Allocating Delivery Costs to Retail and Wholesale Operations

Neither of the firms whose delivery operations were studied made any attempt to allocate total delivery costs between retail and wholesale. One of them had separated drivers' wages between retail and wholesale and divided its delivery costs into "delivery expense" and "garage expense". These delivery costs excluded selling costs and administrative costs. The annual "delivery expense" including mostly drivers' wages and payroll expenses was divided on the basis of retail drivers' wages and wholesale drivers' wages. The annual "garage expense" was allocated on the basis of the average number of routes operated. The retail delivery cost thus obtained was divided by the number of deliveries made during the year to get the cost of a retail delivery. The cost of a wholesale delivery was similarly obtained.

The other distributor made no attempt to separate retail delivery cost from wholesale delivery costs. It seemed reasonable to assume that the ratio of the delivery cost of a wholesale delivery to the cost of a retail delivery would be about the same for these two firms - except for the fact that one of them delivered 55.3 packages per wholesale delivery on the average and the other delivered 41.9 packages. Since the volume per delivery is significant in the determination of the wholesale cost per delivery, the use of this ratio to allocate costs for the second

firm would not be warranted. The ratio was adjusted for the fact that the average size of wholesale delivery was quite different for the two firms by using R. G. Bressler's formula showing the relation between volume delivered and wholesale delivery time required.<sup>1/</sup> The adjusted ratio of the cost of a wholesale delivery to the cost of a retail delivery was used to allocate delivery costs of the second firm.

The Sampling Procedure Employed to Estimate the Number of Deliveries Made:

The number of retail deliveries was estimated for each company by the selection of a sample for route days for which the number of deliveries was obtained by counting deliveries made in the route books. The retail routes were numbered; and the days of the year were numbered in pairs (consecutive days). (The days were numbered in pairs to avoid variance caused by unequal splitting of the route served by one man in two days). Tippetts Random Numbers was used to select six digit numbers, the first three of which supplied the sample route number and the last three of which supplied the sample dates.

The samples for the number of wholesale deliveries made on mixed routes for both companies and the sample for the number of wholesale deliveries made on wholesale routes for one company were similarly selected though the data came from daily route reports rather than from route books. The daily route reports for the other company did not contain the number of deliveries made for wholesale routes. For that company the number of wholesale deliveries made on wholesale routes was estimated by determining the average number of wholesale route days operated and the average number of customers per route from data supplied by the company. This estimate did not involve sampling.

This is a preliminary report. It is expected that a final report will appear later as a bulletin.

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<sup>1/</sup> Bressler, R. G. Jr., City Milk Distribution, Harvard Univ. Press, 1952, p. 167.