RESEARCH CIRCULAR 162 FEBRUARY 1969

Hauling Costs and Rates in Bulk Milk Assembly

ROBERT E. JACOBSON

GARY F. FAIRCHILD

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER
Wooster, Ohio

CONTENTS

* * *

Hauling Costs and Rates in Bulk Milk Assembly

ROBERT E. JACOBSON and GARY F. FAIRCHILD[1]

INTRODUCTION

Hauling milk into fluid milk markets is a big business. In Ohio, haulers transport more than 4 billion pounds of Grade A milk annually directly from the farm into 150 licensed Grade A plants operating in the state. Gross hauling revenues approximate $13 million annually.

Since milk is priced f.o.b. the market, producers are assessed a charge for the hauling service. Various methods of making these charges are in effect. The most common procedure is to charge a flat rate per hundredweight, regardless of volume picked up per stop or distance the milk has to be moved to the market outlet. Other systems in less frequent use employ a schedule of rates which may be tied to volume or distance or both.

For the most part, milk assembly is undertaken by contract haulers. Milk marketing cooperatives, to greater or lesser degree depending upon the market, attempt to coordinate the milk hauling program through the contract haulers. However, because of producer loyalties to haulers, the decline in milk producer numbers, and the decline in milk production in Ohio, competition in milk hauling is very keen. Cooperatives are severely challenged to implement uniform and systematic haulling programs across their markets.

Several matters of continuing concern evolve out of this type of milk assembly operation. These include such questions as the following:

1. Do hauling rates permit a fair return on investment for the contract hauler?
2. Are hauling charges to the producer reasonable and related to the actual costs involved in hauling his milk?
3. Is the total milk pickup system for a market efficient, with a minimum of duplication of trucks on the same roads?
4. Is the milk marketing cooperative in a strong enough coordinating position so that it has effective control of milk hauling for its marketing and bargaining purposes.

[1]Professor and former Graduate Assistant, respecively, Department of Agricultural Economics and Rural Sociology. The authors are grateful for the counsel and assistance of Dr. Francis E. Walker in completing this study.

SCOPE AND METHOD

This study is directed only at answering the first two of these questions on hauling, i.e., the return on investment and the reasonableness of hauling rates.

To gain information on these matters, a detailed cost analysis was undertaken, based on a sample of six routes in the Columbus, Ohio, market. The immediate objective was to determine the actual costs associated with the transportation of bulk milk from farms to processing plants. Emphasis was also given to determining the variation in costs per hundredweight in picking up milk at a small volume stop as compared to a large volume stop.

At the time of data collection, a flat rate of 25 cents per cwt. was being charged all producers within 50 miles of downtown Columbus. Producers outside of that radius were charged 30 cents per cwt. Since there is a very large range in volume per stop in the milkshed (from less than 300 lb. to more than 7,000 lb. on an every other day basis), flat hauling rates create an obvious equity problem among producers if costs per hundredweight vary substantially with volume.

A sample of six routes out of the 60 routes in the Columbus milkshed were analyzed for this study. These six routes served 148 producers or about 10 percent of the producers in the market. Since Columbus is on a 100 percent bulk, every other day pickup program, each route was observed on the basis of its 2-day run. On four of the six routes, the truck made three runs during the 2-day period.

Three of the routes are owned by the cooperative and data on these were collected in September 1966. The other three routes are owned by contract haulers and data on these were collected in December 1966. Daily runs ranged from 72 to 201 miles, with an average distance of 150.4 miles per daily run. The trucks averaged 12.3 stops daily, with a range of 8 to 18 stops daily. Truck sizes ranged from 2200 to 3400 gallons, with an average of 2550 gallons. Complete cost data for these routes were made available by the cooperative and the contract haulers.

COST ANALYSIS

Allocation of Costs

To conduct a complete analysis of the costs involved in operating a bulk milk truck, the list of cost categories must include all costs incurred. All costs were allocated to one of the following categories:

1. Depreciation
2. Administrative office charge
3. License

4. Insurance
5. Gas, oil, and repairs
6. Spare truck charge
7. Interest on investment
8. Labor

The various cost categories were analyzed to determine if each producer stop contributed equally to each cost category or if the amount contributed varied among the different stops on a route. Observation revealed that the only variables among stops were the volume of milk produced and the location of the dairy farm. However, location considerations were not a matter of inquiry in this study. Therefore, the only cost category which would be affected by location, that of gas, oil, and repairs, was analyzed only with respect to volume. The relatively small size of the Columbus milkshed (70-mile radius) suggests that the location consideration has not been as important a problem as it is in larger procurement areas. The next step was to determine which cost categories are fixed and which are variable.

The following cost categories were determined to be completely fixed. They do not vary with volume but rather are equally contributed to and allocated among all stops on the route. These costs are incurred regardless of the volume of milk transported by the truck or even if no milk is transported. The completely fixed costs are:

1. Depreciation
2. Administrative office charge
3. License
4. Insurance
5. Spare truck charge
6. Interest on investment

The cost category of gas, oil, and repairs is determined to be partly a fixed and partly a variable cost. This is a departure from usual cost allocations where gas, oil, and repairs are considered variable costs exclusively. This analysis varies costs with volume per stop and not with mileage. Since a certain portion of the gas, oil, and repair costs can be attributed to the volume of milk hauled by the truck, these costs would increase with larger volumes. The remaining portion of these costs would be incurred by the truck on the route, even if the truck was empty.

The arbitrary means of differentiating gas, oil, and repair costs between the fixed and variable categories was to designate one-third of these costs as variable and the other two-thirds as fixed. Approximately one-third of the total mileage of the milk routes was from the first stop

to the last stop and this portion was classed as variable. The other two-thirds of the mileage was from the hauler's garage to the first stop and from the last stop to the plant and back to the starting point. This portion was classed as fixed.

The rationale for making this type of allocation was that all producer stops on a route should share equally in the fixed mileage aspects of the route, while a part of the gas, oil, and repair costs should vary with volume due to the slightly higher costs associated with hauling more weight.

Only the labor cost category was designated as completely variable. This was because the milk haulers on the routes studied were paid on the basis of volume (an average of 7 cents per cwt.).

It should be noted that there are applications of the Federal Fair Labor Standards Act, as amended in 1966, to labor hired for the hauling of milk. Under this Act, haulers in applicable situations must be paid a minimum of $1.60 per hour effective February 1, 1968, with time and one-half paid for all hours worked in excess of 40 hours a work week. It appeared generally in this study that wages paid on the volume basis met the Federal standard in terms of time.

Cost Calculations

As shown in Table 1, the fixed costs per stop include depreciation, administrative office charge, license, insurance, spare truck charge, and interest on investment, as well as the fixed portion of gas, oil, and repairs.

The depreciation on the investment represented by the truck and bulk tank was calculated by the 20 percent straight-line accounting method with a 10 percent salvage charge. The annual depreciation charge on the bulk tank and truck was first divided by 12 to determine the monthly charge and then divided by the number of every other day routes per month to determine the depreciation on a route basis. This route charge was then divided by the total number of producers on the route to determine the depreciation charge per stop of $0.7210. This same procedural breakdown was applied to all fixed cost categories.

It should be noted that the total investment includes not only the bulk tank and truck but also the investment in the ownership rights of the route. There was no depreciation charge made against the ownership segment of the investment since, unlike the tank and truck, the ownership of a route is an investment which does not necessarily depreciate over time.

The administrative office charge includes payment for various items such as accounting, bookkeeping, and other administrative functions. The average office charge for the sample routes amounted to $0.1092 per stop.

TABLE 1.—Fixed and Variable Costs for Six Bulk Milk Assembly Routes.

Fixed Cost per Stop	Route 1	Route 2	Route 3	Route 4	Route 5	Route 6	Simple Average
Depreciation	$0.7129	$0.3295	$0.6163	$0.9258	$0.9879	$0.7539	$0.7210
Office	0.0619	0.0641	0.0725	0.1201	0.1801	0.1566	0.1092
License	0.0451	0.0518	0.0742	0.0653	0.0979	0.0852	0.0699
Insurance	0.0615	0.0720	0.0756	0.0957	0.1436	0.1249	0.0955
Gas, oil, repairs	0.9565	0.6092	0.6920	0.8126	1.2189	0.5889	0.8130
Spare truck	0.0456	0.0456	0.0515	0.0395	0.0592	0.0515	0.0488
Interest on investment	0.1250	0.1210	0.1638	0.2195	0.1970	0.1629	0.1649
Total fixed cost per stop	$2.0083	$1.2932	$1.7459	$2.2785	$2.8846	$1.9239	$2.0223
Variable Cost per Cwt.							
Gas, oil, repairs	$0.0346	$0.0188	$0.0274	$0.0175	$0.0266	$0.0165	$0.0236
Labor	0.0800	0.0800	0.0800	0.0600	0.0600	0.0600	0.0700
Total variable cost per cwt.	$0.1146	$0.0988	$0.1074	$0.0775	$0.0866	$0.0765	$0.0936

Source: Original data.

Licenses were considered as a fixed cost upon which volume had no effect and which should therefore be divided equally among all route stops. The average charge for licenses for the routes studied was $0.0699 per stop.

Insurance was also considered to be a fixed cost and was likewise divided equally among all route stops. The average insurance charge amounted to $0.0955 per stop.

In any milk market, spare bulk trucks are required to meet unexpected needs. In the Columbus market, there are approximately 60 bulk trucks. There are also three spare trucks in the market or about one spare truck for every 20 bulk route trucks. The costs incurred in maintaining a spare truck include a charge for depreciation, administrative office, license, insurance, and interest on the truck and tank investment. This spare truck cost was divided among 20 routes and was then broken down to a fixed cost per stop on each route of $0.0488.

The interest on investment category includes a consideration of an interest on investment charge for two areas of investment required in the operation of a bulk milk truck route. The investment requirements are for the bulk tank and truck and also for the ownership rights to the bulk milk route. The first cost is the interest payment which would be required if the entire purchase of the truck and bulk tank was financed with borrowed funds. This cost would also be applicable if the hauler already had sufficient funds for the bulk tank and truck investment when considering the opportunity cost involved in any investment. To obtain an average investment charge, the half-life accounting method was used as follows:

$$\frac{\text{Original Cost} + \text{Salvage Value}}{2} \times .06$$

A salvage value of 10 percent of the original cost was added to the original cost, since the salvage value was present in the investment until the last year. This amount was then divided by two to obtain an average investment value. This average investment was then multiplied by 6 percent to determine the interest on the investment. The interest rate of 6 percent was considered to be representative of the rate currently being charged. The average interest on the truck and bulk tank investment for the sample was $0.1228 per stop.

In computing the interest on the investment in the ownership rights of the route, the original cost was multiplied by the rate of .06 since there was assumed to be no depreciation. The average interest on the route ownership investment for the sample was $0.0421 per stop. The average total interest on investment thus amounted to $0.1649 per stop.

TABLE 2.—Total Cost, Revenue, and Profit per Route and per Hundredweight (2 Days).

Route	Total Cost	Total Revenue	Total Profit	Av. Total Cost per Cwt.	Av. Profit per Cwt.
1	$ 99.7834	$103.7950	$ 3.1116	$0.2403	$0.0097
2	71.7423	95.4425	23.7001	0.1879	0.0621
3	73.7146	78.1225	4.4079	0.2359	0.0141
4	114.5800	149.4225	34.7819	0.1917	0.0583
5	91.7321	98.2675	6.5354	0.2334	0.0166
6	74.9883	90.3950	16.4786	0.2074	0.0426

Source: Original data.

Cost Summary

Table 2 presents the cost, revenue, and profit data associated with the six sample routes. The total cost column represents the total cost allocated to each route. The total revenue column was calculated by multiplying the hauling rate of 25 cents per cwt. by the volume of milk for each route. The total revenue was then compared with the total cost to determine the total profit (or loss) for each route. The total cost for each route was divided by the total volume to obtain the average total cost per hundredweight for each route. By comparing the average cost to the hauling rate of 25 cents, the average profit per hundredweight was reflected for the route.

Information on the total number of stops and the average size stop for each route is shown in Table 3. Stops averaged 1,659 lb. per pick-up. The total milk volume, amounting to 246,179 lb. for the six routes, or an average of 41,030 lb. per route, is also listed.

As Table 3 indicates, the average variable cost was $0.0936 and the average fixed cost was $0.1203 per cwt. Thus, the average total cost

TABLE 3.—Total and Average Cost Information by Category on a per Stop and per Cwt. Basis.

Route No.	No. of Stops	Average Size of Stop (lb.)	2-Day Route Volume (lb.)	Average Variable Cost per Cwt.	Average Fixed Cost per Stop	Break-even Point Volume (lb.)
1	26	1597	41,518	$0.1146	$2.0083	1480
2	26	1468	38,178	0.0988	1.2932	861
3	23	1359	31,249	0.1074	1.7459	1225
4	30	1992	59,769	0.0775	2.2785	1323
5	20	1965	39,307	0.0866	2.8846	1767
6	23	1572	36,158	0.0765	1.9239	1131
Average	24.7	1659	41,030	0.0936	2.0223	1298

Source: Original data.

TABLE 4.—Relationship of Milk Hauling Costs to Volume per Stop.

Category by Volume	Frequency of Stops	Average Total Cost per Cwt.	Average Volume per Pickup	Average Total Cost per Cwt.
0-499 lb.	6	$0.5944	405	$0.3564
500-999	42	0.3389	787	
1000-1499	29	0.2516	1,288	0.2254
1500-1999	29	0.2056	1,700	
2000-2499	18	0.1855	2,227	0.1627
2500-2999	9	0.1674	2,743	
3000-3999	10	0.1564	3,324	
4000-4999	4	0.1390	4,750	
5000-up	1	0.1100	7,003	

Source: Original data.

per cwt. equalled $0.2139. The break-even point by volume averaged 1298 lb. per stop. This volume is based on the assumption that the hauling rate charged is 25 cents per cwt. The break-even point is that volume per stop at which the total costs equal the total revenue. The average total cost per route is $87.76 and the average total cost per day is $43.88.

The total of 148 producer stops were categorized on the basis of volume of pickup. The total volume for each category was divided into the total cost for the category to determine the average total cost per hundredweight for each pickup level. These results are presented in Table 4 in terms of nine different volume categories.

The nine volume categories were then grouped into three categories, each containing about one-third of the total number of producer stops. The divisions were stop volumes less than 1000 lb., between 1000 and 1999 lb., and 2000 lb. and more. The total cost per hundredweight for each component category was multiplied by the volume for the respective category to obtain a value in terms of dollars. The component values were grouped into the three major categories, as were the respective volumes. By thus weighing each component category, the total cost per hundredweight for each major category was obtained by dividing the dollar cost by the category volume. The average total costs for the three categories were computed to be $0.3564, $0.2254, and $0.1627 per cwt., respectively.

Total Stop Costs

The cost allocation information discussed above is translated into the total cost per stop through an estimating equation which assumes the following values:

$$\text{Total Cost per Stop} = \$2.0223 + \$0.0936(V)$$

where \$2.0223 is a constant value per stop representing the fixed cost

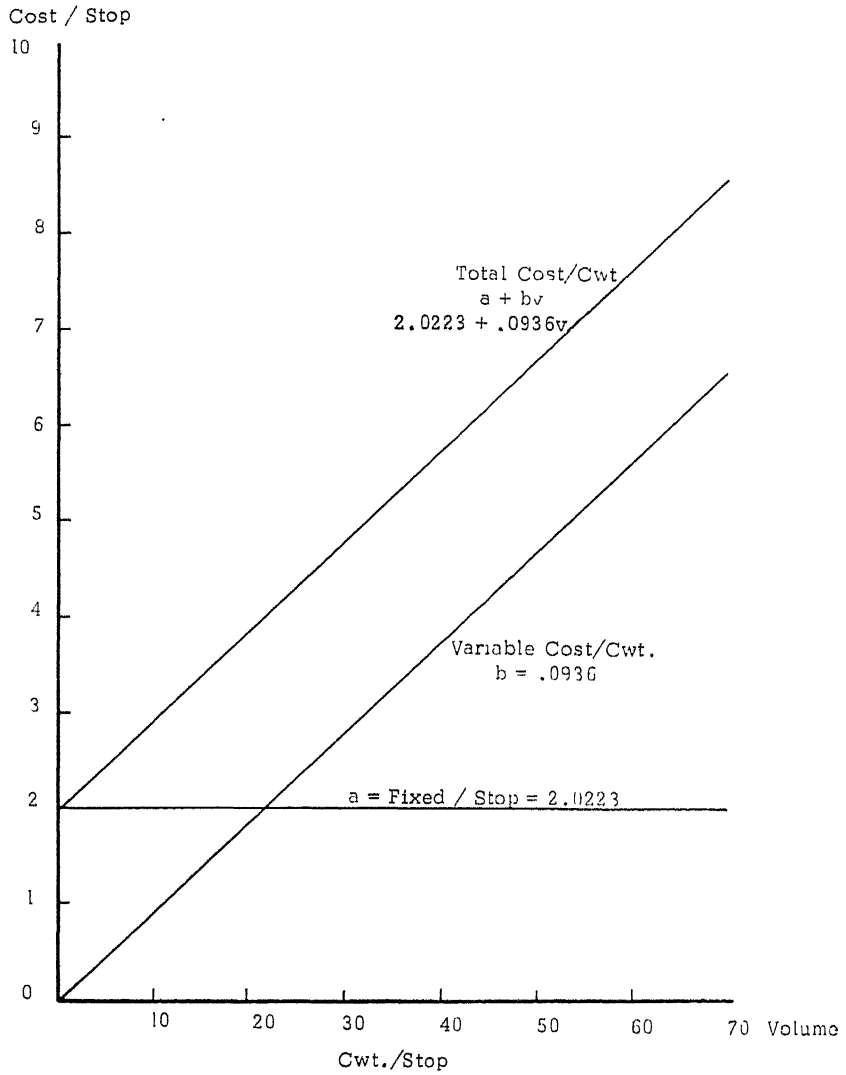

Fig. 1.—Components of the total cost per stop equation, Y = a + bV.

factor and where $0.0936 is a variable cost per cwt. which, when multiplied by the volume of the particular stop (V), produces a value representing the variable cost factor. This total cost per stop relationship is shown in Figure 1.

This cost information is converted to total cost per hundredweight for all producer stops by dividing the derived total cost per stop by the corresponding stop volume, as shown in Figure 2. This conversion assumes the following form, where (V) is given volume per stop:

$$\text{Average Total Cost per Cwt.} = \$0.0936 + \frac{\$2.0223}{V}$$

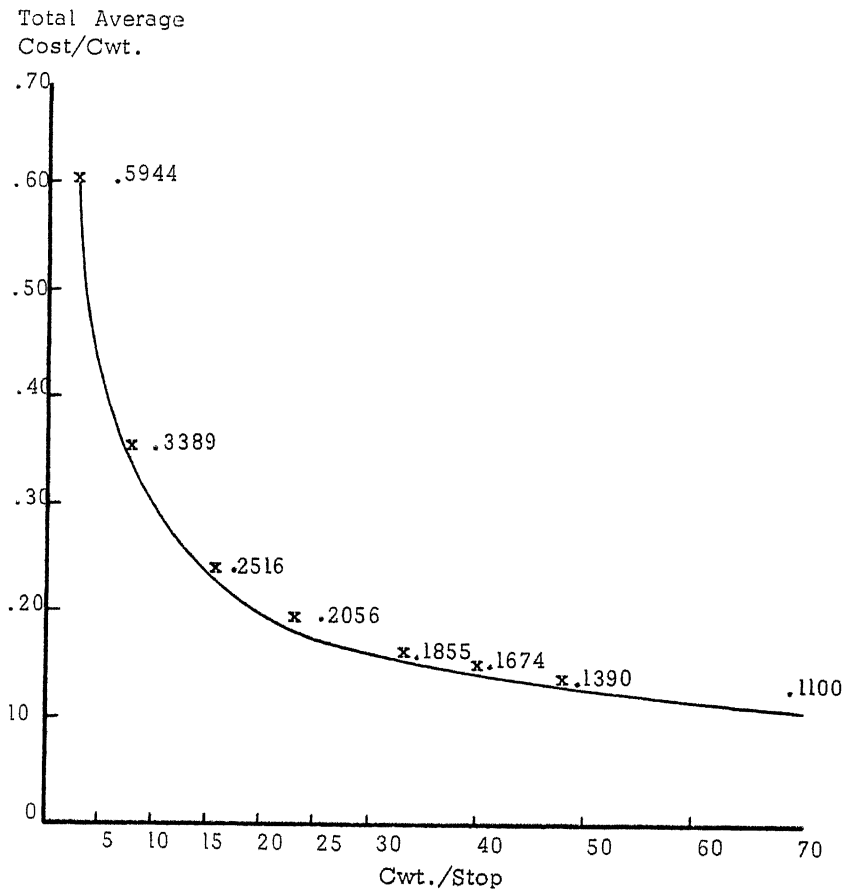

Fig. 2.—Relationship of average total cost per hundreweight to total volume per stop.

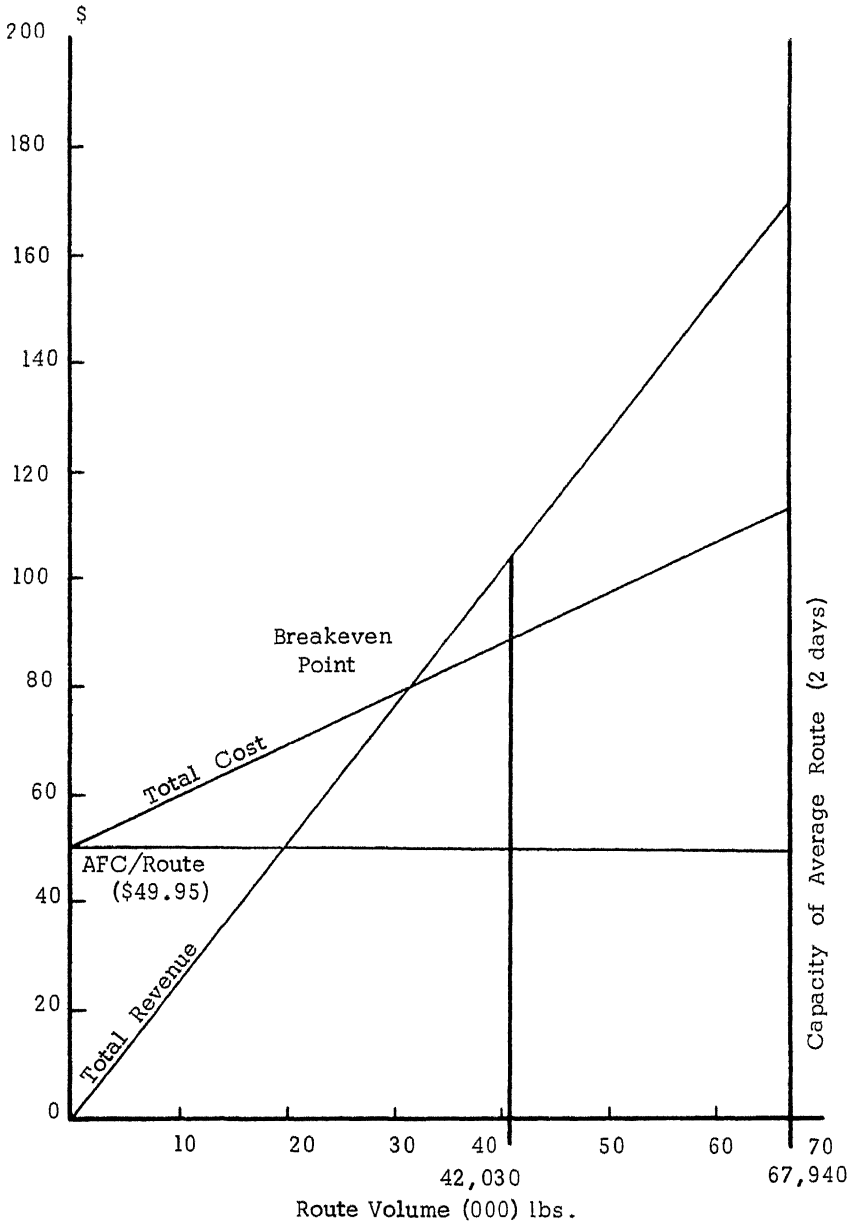

Fig. 3.—Relationship of total cost and total revenue to total route volume.

Route Analysis: The Break-Even Point

In Figure 3, the intersection of the total cost curve with the total revenue curve defines the break-even level of route operation under the given cost allocation. The break-even route volume is 31,935 lb. At this level, total cost equals total revenue equals $79.83. This is calculated at the 25-cent hauling rate.

As Figure 3 indicates, the average route volume of 42,030 lb. was substantially larger than the break-even route volume of 31,935 lb. However, the trucks were operating only at about three-fifths of their potential capacity for the routes and runs sampled.

The cost-volume relationships for the bulk milk routes analyzed are shown in Figure 4. The relatively large allocation to fixed costs accounts for the sharply declining functions for average total cost and average fixed cost Most economies of scale had been achieved by the time the

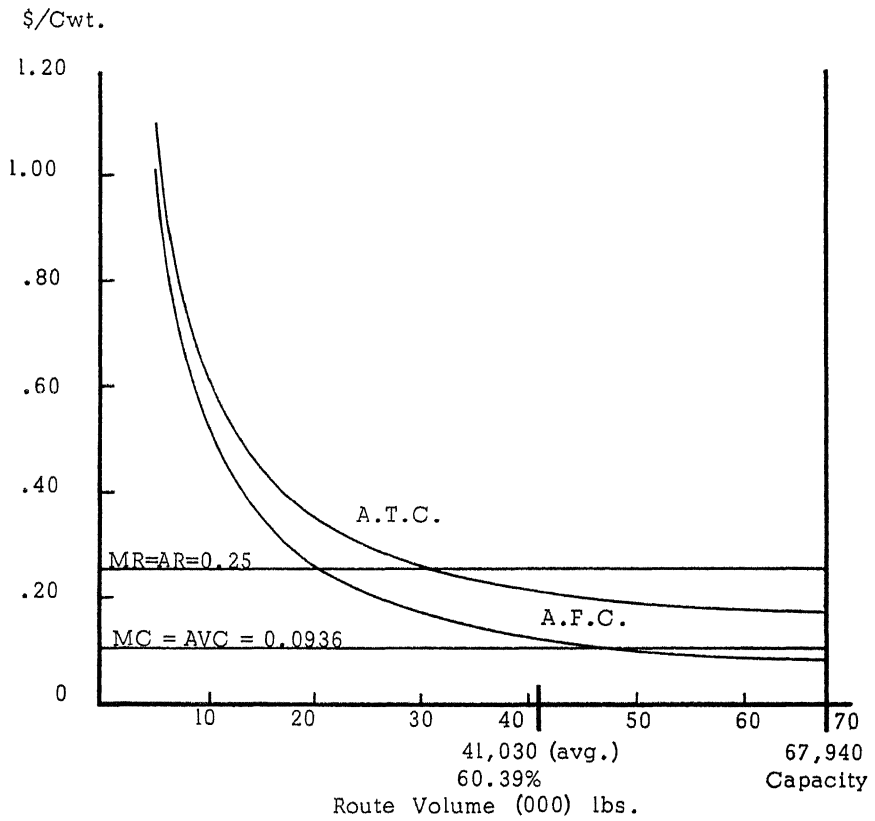

Fig. 4.—Relationship of per hundredweight costs and revenues to total route volume.

average route volume of 41,030 lb. was loaded. At the given current hauling rates, total revenues to haulers were in excess of total costs.

This cost analysis illustrates the lower total cost per hundreweight or economy involved in hauling milk for a large volume producer as compared to a small volume producer. While the cost and revenue involved in bulk milk transportation appear to be in a reasonable relationship on an average basis across the market, the revenue is obviously not related to cost on an individual producer basis. This implies that on a cost-revenue basis, the larger producer not only pays for his costs but he also supports the costs of the smaller producer. However, the small producer contributes to total route volume and therefore lowers fixed costs on both a hundredweight and stop basis.

The analysis indicates that the profit of a bulk milk route is maximized only if it operates near full capacity. Bulk routes now operate at an average level of less than 73 percent of capacity. This implies some inefficient market operation due to an excessive number of milk trucks in relation to bulk volume produced in the market. It should be noted, however, that full capacity would be difficult to obtain due to the seasonal fluctuation of milk production.

Alternative Rate Plans

Based on the given volume associated with the six routes, the following alternative rate structures have been constructed to provide equal total revenue by each plan to the six routes. In other words, the total revenue for the combined six routes will be the same regardless of the plan used. The three rate structures considered include: (1) a constant rate for all producers as at present, (2) a schedule of rates varying with volume, and (3) a stop-charge system.

Flat Rate Plan: The flat rate assumed here is 25 cents per cwt. for all stops, regardless of volume. All producers are charged this same rate, which is related to the present average total cost per cwt. of $0.2139.

Schedule-of-Rates Plan: This plan sets up a schedule of rates varying with volume. Three volume categories are set forth as follows: less than 1,000 lb. per pickup, 1,000 to 1,999 lb., and 2,000 lb. and more.

Volume	ATC/Cwt. for This Volume Category	Rates Charged to Equal Total Revenue in Flat Rate Plan
0- 999 lb.	$0.3564	$0.40
1000-1999 lb.	0.2254	0.26
2000 lb. and more	0.1627	0.20

Stop-Charge Plan: This plan assigns all fixed costs per stop to a charge for the stop. Then a volume charge is assessed which relates to the variable cost.

TABLE 5.—Alternative Rate Plans Which Equate Total Revenue.

1.	Flat Rate Plan	
	246,179 lb. x 25 cents/cwt.	= $615.45
2.	Schedule-of-Rates Plan	
	35,500 lb. x 40 cents/cwt.	= $142.00
	86,614 lb. x 26 cents/cwt.	= $225.20
	124,017 lb. x 20 cents/cwt.	= $248.03
		$615.23
3.	Stop-Charge Plan	
	$2.00/stop (148)	= $296.00
	246,179 lb. x 13 cents/cwt.	= $319.06
		$615.06

The actual fixed cost per stop in this study was $2.02. This figure is rounded to $2.00 for simplicity. The break-even rate = $2.00 per stop + $0.0936 per cwt. With a $2.00 stop charge plus a per cwt. charge of 13 cents, the return to the hauler would be identical to the 25-cent rate under the flat rate plan.

The information is summarized in the set of alternative rate plans in Table 5. The rates set forth under the latter two plans equate the total revenue of the alternative plans with that of the present flat rate plan at 25 cents per cwt.

The element which stands out in this analysis is the major economy in hauling milk for large volume producers as compared to small volume producers. While the cost curve continues down steadily as volume per stop increases, most of the reduction is accomplished by the time volume reaches 2,000 lb. per stop.

Hauling is a service which producers purchase. Like any other goods or services, hauling has a value and the price of that value must be based at least partly in terms of the cost of the service. On an average basis across the market, costs and rates appear to be in a reasonable relationship. For individual producers, however, costs are obviously not related to rates. Producers shipping less than 500 lb., for example, with hauling costs assigned to them of 59 cents per cwt., are obviously being carried in the program by large volume producers whose hauling costs are as low as 11 cents per cwt. This creates a serious equity problem.

Some persons would argue that the constant or flat rate system is equitable from the standpoint that everyone is charged the same rate per hundredweight. This is appealing but it is not sound from an individual cost standpoint. However, the constant rate plan is the easiest one to administer.

The schedule-of-rates plan and the stop-charge plan are only slightly different versions of the same rate-making principle. From a cost standpoint, they both serve the principle of equity in terms of rates being more closely related to the lower costs achieved through volume.

SUMMARY

Costs of bulk milk assembly and associated rate schedules are a matter of continuing concern to milk producers, milk haulers, and milk marketing cooperatives. One aspect of this concern is the cost per hundredweight of picking up milk from a large volume producer as compared to the cost at a smaller volume stop. If costs vary with volume per stop, it is argued, then hauling rates should reflect this cost variation.

In this study, cost analysis was completed on 148 producer stops on six every-other-day pickup bulk routes in the Columbus, Ohio, milkshed. Stops ranged in volume from less than 200 lb. to more than 7,000 lb. per pickup.

The analysis indicated that the average total cost for milk hauling on stops of less than 1,000 lb. was 35.6 cents per cwt.; for stops in the range of 1,000 to 1,999 lb., the cost was 22.5 cents per cwt.; and for stops of 2,000 lb. and more, the cost was 16.3 cents per cwt. Since a flat hauling rate of 25 cents per cwt. was being charged producers at the time of this study, hauling rates for many individual dairy farmers bore only a limited relationship to the costs incurred in hauling their milk.

To establish rate making on a basis which reflects hauling economies associated with larger volume stops, two alternative rate plans are suggested. Both plans would provide haulers with the same total revenue they now receive through the flat rate plan. The first alternative, a schedule of rates, would simply vary rates with volume. The second alternative, a stop-charge plan, would set a charge related to the fixed cost per stop. A volume charge based upon variable cost per hundredweight would then be added to the stop charge.

The State Is the Campus for Agricultural Research and Development

Ohio's major soil types and climatic conditions are represented at the Research Center's 12 locations. Thus, Center scientists can make field tests under conditions similar to those encountered by Ohio farmers.

Research is conducted by 13 departments on more than 6200 acres at Center headquarters in Wooster, ten branches, and The Ohio State University.

Center Headquarters, Wooster, Wayne County: 1953 acres

Eastern Ohio Resource Development Center, Caldwell, Noble County: 2053 acres

Jackson Branch, Jackson, Jackson County: 344 acres

Mahoning County Farm, Canfield: 275 acres

Muck Crops Branch, Willard, Huron County: 15 acres

North Central Branch, Vickery, Erie County: 335 acres

Northwestern Branch, Hoytville, Wood County: 247 acres

Southeastern Branch, Carpenter, Meigs County: 330 acres

Southern Branch, Ripley, Brown County: 275 acres

Vegetable Crops Branch, Marietta, Washington County: 20 acres

Western Branch, South Charleston, Clark County: 428 acres