Florida Dairy Marketing Cooperatives' Transfer Cost Associated With Non-uniform Delivery Schedules

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The economic basis for alternative delivery schedules between Florida Dairy Marketing Cooperatives (FDMCs) and fluid milk processors are analyzed, and the costs and benefits of improved coordination between these two market stages are highlighted. The additional costs incurred by FDMCs were they to switch from a uniform delivery schedule to various non-uniform delivery schedules are discussed. The seven-day uniform delivery schedule with the $0.25 discount scheme on total volume decreases FDMCs' net revenues by $0.1433 per hundredweight (cwt), compared to a five-day delivery schedule with no price discounts.

Introduction

The expanding role of the retail sector within the food market channel has led the recent evolution of vertical coordination within the food sector. Greater vertical coordination within the food industry can reduce costs and/or increase value. The role of retail food distribution has shifted from passive handler to active advocate for consumer preferences (Kinsey, 1998). These preferences are transmitted from the retail sector through the market channel, where adjustments in distribution, processing, and production can be made. The efficient consumer response (ECR) system is used to evaluate the entire marketing channel in order to ensure that customer needs are met effectively. The ECR concept led to the electronic linkage of retailers, distributors, and manufacturers for purposes of improving efficiency. This trend is neither as sophisticated nor as prevalent at the producer-first handler level. Regardless of the market stage, one of the best ways to increase efficiency is to decrease inventories and distribution costs. This article explores the efficiency and level of vertical coordination between dairy producers and fluid milk processors in Florida.

Within the agricultural sector, scheduling and coordination are critical economic activities in the production, processing, and distribution of highly perishable commodities. Grade A milk requires almost immediate handling and processing in order to ensure product safety and a marketable shelf life. Harrington and Manchester (1986) argue that integrated exchange arrangements are more common in areas where perishability is a factor. Perishability also generally influences the relationship between farmers and processors, transforming it from one of sequential dependency to one of reciprocal dependency (Sporleder, 1992).

Florida dairy farmers formed several marketing cooperatives to provide a more efficient system for collecting and transporting milk to processors. Florida Dairy Marketing Cooperatives (FDMCs) negotiate sales agreements with processors that stipulate the price and delivery schedule of fluid milk. In general, Florida milk processors order and receive smaller volumes of milk on Saturdays and Wednesdays, and occasionally delay or cancel milk deliveries. Some Florida processors prefer to receive milk only five days per week. During the late 1990s, FDMCs encouraged processors to accept more uniform deliveries of milk, seven days per week, by granting a $0.25 per hundredweight (cwt) price discount on the milk when it was received within agreed-upon scheduling guidelines.

This analysis evaluates the economic basis for alternative delivery schedules between FDMCs and fluid milk processors, and highlights the costs and benefits of improved coordination between these two market stages. The specific objective of this analysis is to determine the additional costs incurred by FDMCs were they to switch from a uniform delivery schedule to various non-uniform delivery schedules.

Although both the production and consumption of milk in Florida vary seasonally, there is very little variation in the volume of milk transported to processors from one week to the next. For the

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purposes of this analysis, a uniform delivery schedule is defined as one in which equal quantities of milk are delivered to local processors every day of a given week. Conversely, non-uniform delivery describes the case where unequal volumes are delivered on different days of the same week. Three non-uniform delivery schedules are evaluated: (1) a five-day delivery schedule with the same quantity delivered each of the five days; (2) a seven-day delivery schedule with different volumes received each day; and (3) a seven-day delivery schedule with different volumes received each day due to processor cancellations and over-orders. Cancellations occur when a processor orders a certain number of loads to be delivered on a particular day and then refuses or calls off the delivery of all, or part, of that order shortly before, or even after, it arrives. Over-orders represent the opposite situation, one in which a processor requests additional deliveries beyond what it had previously ordered for a given day.

The cost of non-uniform delivery of milk results from additional transportation, storage, transaction, and management activities by FDMCs. The different scenarios—as described in the previous paragraph—can be viewed as areas where vertical coordination between FDMCs and processors can be improved. When adequately defined, the costs associated with each scenario can be calculated and then used to evaluate the benefits of improved vertical coordination.

Vertical Coordination and Transfer Costs

Levels of vertical coordination form a continuum from spot markets through vertical integration. Spot markets occur when there is limited coordination between market stages. Complete vertical integration occurs when all intermediate products are transferred internally (Hobbs, 1997). Given that firms are organized with the intention of earning profits, internal transactions are chosen when they are less expensive than spot market transactions (Coase, 1937).

FDMCs function to balance the supply and distribution of raw fluid milk by negotiating the price that processors pay farmers, coordinating the pick-up and delivery of milk, transporting the milk from the farm to processors, and storing milk overnight when necessary. Transfer costs are defined here as the combination of transportation, storage, transaction, and management costs. At any point in time the price paid by processors minus the transfer costs equals the price received by farmers.

Looking at transfer cost graphically in Figures 1 and 2, the value of the marginal product curve ($\mathbf{VMP_x}$) (processor's demand curve) and the marginal cost curve ($\mathbf{MC_x}$) (farmer's supply curve) illustrate how transfer costs influence vertical coordination decisions in the dairy market. Transfer costs in the exchange between processors and farmers cause a wedge between the price paid by the processors and the price received by the farmer (Arrow, 1969). The height of this wedge is the per-unit transfer cost incurred by FDMCs. Assume the initial non-uniform total transfer cost is the area between the prices paid by processors ($\mathbf{P_p}$) and the price received by the farmers ($\mathbf{P_f}$) for volume $\mathbf{X_0}$ (Figure 1). Since the marketing cooperative is essentially a non-profit entity, any reduction in total transfer costs results in a price increase for producers. Thus, more efficient vertical coordination, such as a switch from a five-day non-uniform delivery schedule to a seven-day uniform delivery schedule, reduces total transfer cost; this, in turn, narrows the price wedge between the processor price and farm price to $\mathbf{P_p}$ - $\mathbf{P_f'}$ (Blair and Kasserman, 1983). This leads to real economic profits for the producers, which is shown graphically as the shaded area in Figure 1.

In the long run, higher prices at the farm level will lead to an increase in output from $\mathbf{X_0}$ to $\mathbf{X_1}$ (Figure 2). As the supplied quantity increases, the price that processors are willing to pay for milk declines, and the marginal costs of milk production increase. The magnitude of the price and quantity adjustments through the supply and demand response depends on the relative slopes of the $\mathbf{VMP_x}$ and $\mathbf{MC_x}$ curves and the bargaining power of each market stage. As quantity supplied moves to $\mathbf{X_1}$ and processor prices decline, the price wedge lengthens, narrows, and shifts downward to $\mathbf{P_p'}$ and $\mathbf{P_f''}$.

Data and Procedures

FDMCs' transfer cost was calculated for various delivery scenarios (Stevens and Kilmer, 1998). The impact of the alternative delivery schedules on the processors was not calculated due to a lack of data. A brief outline of the data and procedures is presented next, followed by a discussion of the results.

Figure 1. Price and Revenue Increases to Dairy Producers Due to Reduced Transfer Costs.

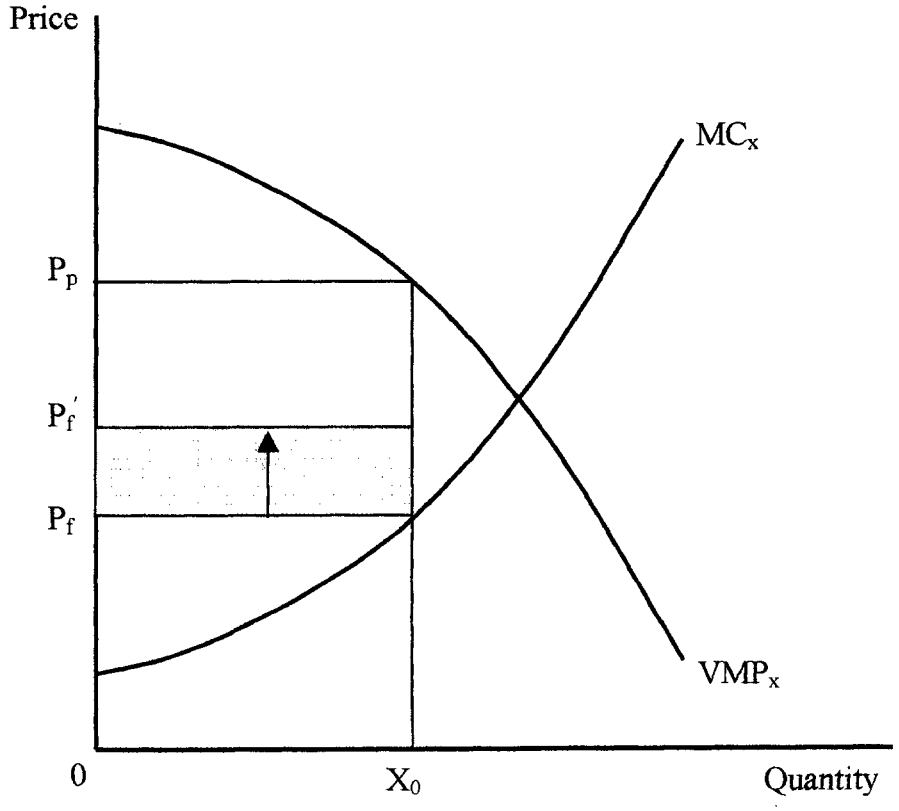
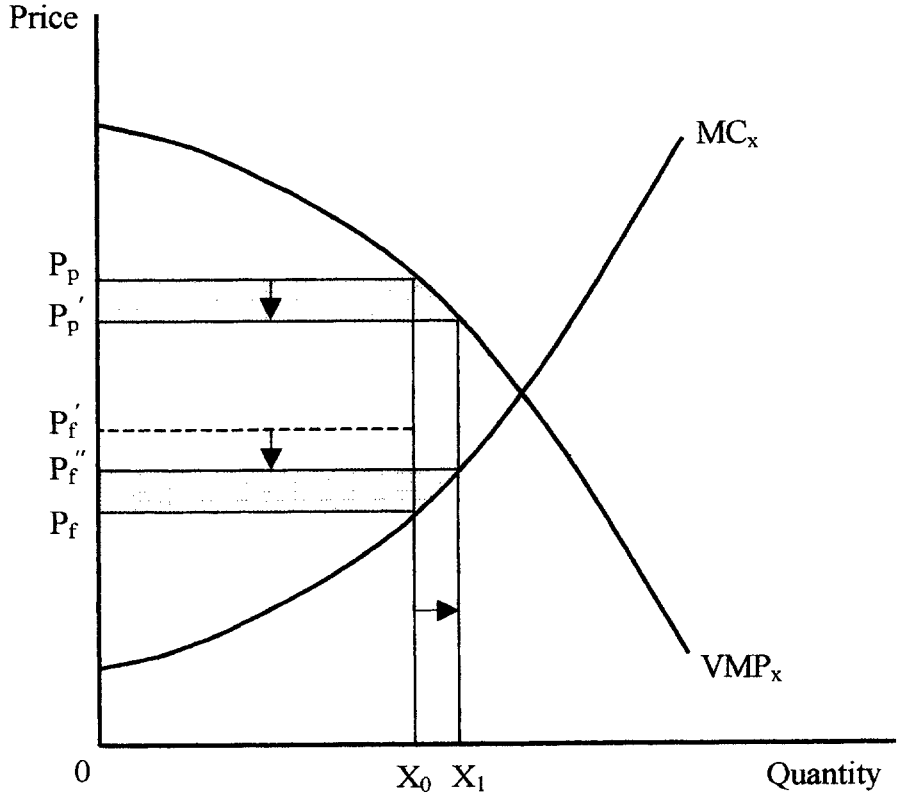


Figure 2. Supply Response and Change in Producer and Processor Surplus Due to Reduced Transfer Costs.



Data on current operating procedures and costs for handling, transporting, and storing milk were collected and compiled in order to calculate FDMCs' transfer cost. Spreadsheet software was used to calculate the differences in transportation and storage costs for uniform and non-uniform delivery schedules. The seven-day uniform delivery schedule is used as a benchmark for comparison purposes. Based on 1998 data and the assumptions discussed below, scheduling worksheets were developed to estimate the daily volume of milk stored and transported for the different delivery schemes. Benchmark delivery schedules were calculated for both average and peak seasonal volumes of milk. From these estimates, fixed and variable cost budgets were constructed and then combined to obtain total costs. Per-unit costs were derived, and the average volume of milk placed in storage due to the non-uniform delivery schedule was calculated.

The additional costs realized by FDMCs for the accommodation of non-uniform milk deliveries include (1) fixed costs for truck-tractors, trailers, and parking space required to store and transport non-uniform deliveries; (2) other fixed costs related to the ownership of such assets, such as vehicle registration and insurance costs; (3) variable costs associated with the operation and maintenance of this equipment and real estate; and (4) management and overhead costs required to coordinate the storage and movement of non-uniform milk deliveries.

Assumptions

Some very specific assumptions were required to accurately predict the quantity of milk that FDMCs would store and reroute in order to accommodate non-uniform delivery schedules. All of the evaluated delivery schedules use the following assumptions. First, milk can only be stored in a truck-tanker for up to 72 hours, while being held at a temperature of 40 degrees Fahrenheit. Second, milk production and consumption vary seasonally but do not vary from one week to the next. Third, the same quantity of milk is produced each day of the week. Fourth, farm production and delivery of milk to processors must balance within a seven-day period so that there is no carryover of stored milk from one week to the next. Fifth, FDMCs own and maintain a sufficient inventory of equipment (tractors and trailers) to collect, store, and transport the peak volume of milk produced and delivered to processors on any given week of the year. For the benchmark seven-day uniform delivery schedule, milk is collected from farms and delivered to processors on the same day. Consequently, there is no storage of milk required for the benchmark schedule.

The five-day delivery schedule assumes that processors receive the same number of loads on each of the five days that they accept deliveries. Furthermore, processors receive the same weekly volume of milk, regardless of the delivery schedule. All milk held from one day to the next is stored in trailers owned by FDMCs at holding areas owned by FDMCs or staged at processing plants, using a first-in/first-out inventory system.

The seven-day over-order and cancellation delivery schedule balances during the week—that is, the weekly number of cancellations is equal to the weekly number of over-orders. Cancelled loads are always fresh milk (that is, fresh milk is picked up from the farm and delivered to the processing plant on the same day). Over-orders are filled with fresh cancellations and then with direct deliveries from the farm.

Results

The additional transfer costs for the three non-uniform delivery scenarios, compared to the seven-day uniform benchmark schedule, are presented in Table 1. These results provide a breakout of the cost savings that could be achieved through various forms of improved vertical coordination between FDMCs and Florida milk processors. Costs are presented in both absolute (weekly) and per-unit volume terms. Per-unit volume cost estimates are calculated for both total and variable volume transferred. Total volume represents the total weekly volume of milk that FDMCs transfer from the farm to the processors, assuming no carryover from one week to the next. Variable volume represents that volume of milk which must be placed in storage or rerouted due to a non-uniform delivery schedule. Variable volume is, by definition, less than or equal to total volume.

Fixed, Variable, and Total Transfer Costs

A detailed breakdown of the types of costs for each non-uniform delivery schedule is presented in Table 1. Total fixed cost is the sum of

Table 1. Additional Transfer Costs[a] for Five-Day, Seven-Day Non-uniform, and Seven-Day With Cancellation and Over-order Delivery Schedules for Florida Dairy Marketing Cooperatives.

Cost Category and Milk Volume	Delivery Schedules		
	Five-Day Non-uniform	Seven-Day Non-uniform	Seven-Day w/Cancellations & Over-orders
Fixed cost[b]			
Weekly	$14,116	$1,000	$584
Per 100 lbs. of total volume	$0.0416	$0.0029	$0.0017
Per 100 lbs. of variable volume[c]	$0.0728	$0.0579	$0.0579
Other fixed cost[d]			
Weekly	$9,551	$678	$392
Per 100 lbs. of total volume	$0.0281	$0.0020	$0.0012
Per 100 lbs. of variable volume	$0.0493	$0.0392	$0.0389
Variable cost[e]			
Weekly	$12,549	$984	$920
Per 100 lbs. of total volume	$0.0370	$0.0029	$0.0027
Per 100 lbs. of variable volume	$0.0647	$0.0570	$0.0913
Total additional transfer cost[f]			
Weekly	$36,217	$2,662	$1,896
Per 100 lbs. of total volume	$0.1067	$0.0078	$0.0056
Per 100 lbs. of variable volume	$0.1868	$0.1541	$0.1881
Total milk volume			
Weekly (cwt.)	339,360	339,360	339,360
Variable milk volume			
Weekly (cwt.)	193,920	17,280	10,080
Percent of total volume	57.14%	5.09%	2.97%

[a]The costs in this table are the costs in excess of a benchmark seven-day uniform schedule.
[b]Interest and depreciation were calculated for the additional equipment required for each delivery scenario. This calculation included indirect mileage, maintenance costs, as well as additional tractors, trailers, and parking requirements.
[c]Variable volume represents the quantity of milk that is stored at least one day and is not transported directly from farmer to processor.
[d]Recurring costs associated with the ownership of additional tractors and trailers that are not directly related to their purchase or the intensity of use. These costs include insurance, license plates, permits, general shop supplies, and parking maintenance.
[e]Variable costs include items such as fuel, tires, and maintenance, as well as items such as wages, taxes, employee insurance, and related items. Both cost categories are based on historical per-mile data provided by FDMCs.
[f]Total transfer cost is equal to the sum of fixed cost, other fixed costs, and variable costs.

fixed cost for capital purchases, such as tractors, tank-trailers, and parking facilities, plus "other" fixed costs that are incurred due solely to the ownership of such capital (but not the intensity of its use). This includes such expenses as insurance, license plates, permits, and parking facility maintenance. Interest expense (calculated at a rate of 7.5 percent) and depreciation (straight line with salvage value of 7.75 percent and 6.75 percent for purchase price for tractors and trailers, respectively) were calculated for the additional equipment required for each delivery scenario.

Variable costs are for activities directly related to the volume of milk stored and transported by FDMCs. This category includes expenses for inputs like labor, management, fuel, equipment maintenance, tires, taxes, and employee insurance. Estimates of variable costs were based on historical per-mile data provided by FDMCs. Total transfer costs are calculated as the sum of total fixed and total variable costs.

Five-Day Non-uniform Delivery Schedule Costs

Compared to the seven-day uniform delivery schedule, total transfer costs to the FDMCs increased by $0.1067 per cwt of total volume, or $0.1868 per

cwt of variable volume, for the five-day delivery schedule (Table 1). Total fixed costs (that is, fixed costs plus other fixed costs) represented almost two-thirds of this increase (65.3 percent), at $0.0697 per cwt of total volume. Variable cost increased by $0.0370 per cwt of total volume. The variable milk volume due to this five-day schedule amounts to approximately 57.14 percent of total milk volume or 193,920 cwt of milk weekly.

Seven-Day Non-uniform Delivery Results

At $0.0078 per cwt of total volume, the total increase in transfer cost for the seven-day non-uniform schedule is considerably smaller than that calculated for the five-day schedule ($0.1067). The difference in the total transfer costs between the five-day schedule and the seven-day non-uniform schedule is not nearly so pronounced when they are compared on a variable volume basis ($0.1868 per cwt for the five-day, versus $0.1541 per cwt). The variable volume of milk (17,280 cwt) represents only 5.09 percent of the total volume for the seven-day non-uniform delivery schedule. Again, total fixed costs (that is, fixed costs plus other fixed costs) represented about two-thirds of the total transfer costs for this non-uniform schedule ($0.0049 per cwt on a total-volume basis).

Seven-Day Delivery With Cancellations and Over-orders

The estimation of transfer costs associated with cancellations and over-orders is based on historical records provided by FDMCs. A seven-day delivery schedule incorporating cancellations and over-orders shows the smallest increase in total transfer costs on a total-volume per-unit basis ($0.0056 per cwt of total volume) but the largest cost increase on a variable volume basis ($0.1881 per cwt). This result was due primarily to the relatively greater administrative effort and transportation mileage involved when the delivery of milk is rescheduled on very short notice. For this scenario, the distribution of cost between total fixed and variable categories was nearly equal, at $0.0029 and $0.0027 per cwt of total volume, respectively. Variable milk volume under this scenario was quite small, only accounting for 2.97 percent of total volume.

Discussion

At the time of this study, the FDMCs were allowing processors a $0.25-per-cwt discount on the total volume of milk delivered when those deliveries were accepted on a uniform seven-day schedule. This discount provision could be interpreted as an inducement for processors to collaborate with FDMCs' desire to reduce its transfer costs and improve vertical coordination, thereby decreasing the price wedge between farmers and processors (Figure 2). A closer look at the results of the previous analysis casts some doubts on this interpretation.

The results of the cost analysis show that FDMCs would have realized an increase in total transfer costs of approximately $0.1067 ($0.1868) per cwt on total volume (variable volume) if it switched from a seven-day uniform schedule to a five-day delivery schedule (Table 1). Given this result, the $0.25 incentive paid by FDMCs to processors on total volume for a seven-day uniform schedule is $0.1433 ($0.25 - $0.1067) more per cwt than it would cost FDMCs to adopt a five-day schedule. This suggests, at first glance, that FDMCs are misapplying their discount scheme to induce processors to help reduce FDMCs' transfer costs.

One possible explanation is that FDMCs decide to implement a reward system—that is, the issue of discounts—to encourage processors to accept uniform deliveries as opposed to a punitive system—that is, the charging of premiums for milk storage. In this case, FDMCs may have rationalized that they should award processors a discount on the quantity of milk delivered, which was not placed in storage, or in the terminology used here—the non-variable volume. If FDMCs decided to calculate a discount based on the non-variable volume delivered on a five-day schedule (which would represent 42.86 percent of total volume), then the cost savings would work out to $0.2490 ($0.1067 ÷ 0.4286) per cwt—quite close to $0.25. At some later point, after the adoption of a seven-day uniform schedule, processors may have negotiated the application of the discount over total volume, since it was all being delivered uniformly. This could have been due to competitive market pressures from other producer marketing cooperatives to the north. In addition, consolidation at the food distribution and retail

market stages may have resulted in competitive pressures from processors and affiliated retailers that permit them to demand concessions from their suppliers. Furthermore, FDMCs may be willing to pay for the reduced risk that results from a decrease in milk spoilage, accidents, and the coordination of stored milk and fresh milk.

The seven-day non-uniform schedule and the seven-day with cancellation and over-order schedule are preferred by processors because they allow them more flexibility in their operating schedules and reduce their need for on-site storage. FDMCs incurred total transfer costs of $0.1541 per cwt of variable volume for the seven-day non-uniform schedule and $0.1881 per cwt of variable volume for the seven-day with cancellations and over-orders. Variable volume was 5.09 percent of total volume for the non-uniform case and 2.97 percent of total volume for the case with cancellations and over-orders. The total transfer cost on total volume for both schedules was less than $0.01 per cwt of total volume. In order for the FDMCs to accommodate either type of delivery schedule, processors should compensate FDMCs at the variable-volume cost-rate.

Summary and Conclusions

The above results show that the cost differences between the seven-day uniform and five-day uniform schedules did not warrant the $0.25-per-cwt discount provided by FDMCs to milk processors. The seven-day uniform delivery schedule with the $0.25 discount scheme on total volume actually decreases FDMCs' net revenues by $0.1433 per cwt, compared to a five-day delivery schedule with no price discounts.

Since the FDMC initiated the discount-scheduling plan, many speculated about the motivation for such a change. Certainly, FDMCs should be willing to grant processors a discount to accept uniform deliveries that is equal to or less than FDMCs' savings in transfer costs. If the discount exceeds total transfer savings, then perhaps competition from larger northern cooperatives or competitive pressures exerted by larger processors may be compelling FDMCs to grant larger price discounts. In addition, FDMCs may be willing to pay for the reduced risk that results from a decrease in milk spoilage, accidents, and coordination of stored milk and fresh milk. Further research is needed in order to ascertain the true reason for the $0.25-per-cwt discount.

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