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THE IMPACT OF PRICE DEREGULATION AND CHANGES IN ASSEMBLY AND PROCESSING COSTS ON THE MARKETING OF MILK IN MAINE

by

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FOREWORD

Simulation of marketing situations is a means of better understanding the impact of various changes which may or may not come about in an industry. This report reflects the impact of several assumptions about market situations in the dairy industry, many of which depart from existing conditions. A major assumption was that of complete price deregulation. The results are not considered final, but are offered as indicators of the impact of changes which may take place in the marketing of milk in Maine.

The information in this publication is based upon research reported in a Master's thesis submitted by Daniel B. Taylor to the Graduate School at the University of Maine at Orono in 1978. (13).

THE IMPACT OF PRICE DEREGULATION AND CHANGES IN ASSEMBLY AND PROCESSING COSTS ON THE MARKETING OF MILK IN MAINE

Daniel Taylor, Gregory White, Homer Metzger and Alan Kezis[1]

INTRODUCTION

The trend towards fewer producers, processors and distributors of fluid milk may be a fairly irreversible trend, except in the very long run. This is especially true when capital investments necessary to revive abandoned enterprises are considered. Farmlands which have gone out of production, or processing plants which have been closed, are not easily returned to their former productive capacities. Therefore, the retention of price regulations which allow the continued reduction in numbers of producers, processors, and distributors should be questioned. Diseconomies of size could exist where there were once economies of size. For example, a decrease in the availability of energy resources leading to an increase in their price might result in a localized system of milk production and processing being economically more efficient than the more centralized system of processing which has been developing in the State. A decrease in energy resources could have a greater impact upon Maine than upon many other states due to the amount of energy which is necessary to provide goods and services to its relatively dispersed population.

Regulation of the price of milk plays an important role influencing resources to stay in or leave milk production and distribution. The Maine Milk Commission Law (1) states that:

> A. The minimum wholesale prices paid to producers shall be based on the prevailing Class I and Class II prices in Southern New England, and after investigation by the Maine Milk Commission, shall reflect as accurately as possible the increased costs of production.
>
> B. The minimum wholesale prices paid to dealers shall be established to reflect the lowest prices at which milk purchased from Maine producers at Maine minimum prices can be received, processed, packaged and distributed within the State of Maine at a just and reasonable return.

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C. The minimum retail prices established for payment by consumers shall be based on the minimum wholesale price paid to dealers, and a rate of return deemed just and reasonable by the Maine Milk Commission.

Institution of a system of assembling, processing, and distributing milk in the State which will minimize these aspects of the total cost of providing milk will benefit consumers. Any method used to determine a system which will minimize costs will depend upon the assumptions used concerning the marketing conditions faced by the milk industry. Alterations in these assumptions can be made to simulate the effects of policy decisions (such as price deregulation) as well as altered resource availabilities (such as increases in transportation costs) upon the milk marketing system in the State. The results of these alterations, which form the basis for this study, would provide guidelines for future policy decisions.

The four objectives of the study were as follows:

1. To determine a cost minimizing, spatial equilibrium for the assembly, processing, and distribution of milk in the State of Maine for the year 1975 under the marketing conditions which were present in the State at that time.
2. To determine the effects of relaxing minimum retail price control upon the system determined in objective 1.
3. To determine the effects of increasing assembly transportation costs upon the system determined in objective 1.
4. To determine the effects of using more efficient transportation and processing cost parameters upon the system determined in objective 1.

METHODOLOGY

The market stimulating aspect of the reactive programming algorithm, and the cost minimization of the linear programming technique were used to model the Maine milk industry. A reactive programming model developed specifically for the fluid milk industry by Riley (2) at Oklahoma State University was obtained for use in this study. This was the model used in a study which was reported in 1976 by Riley and Blakely (3) concerning various aspects of the national milk industry.

Cost Minimization

The spatial equilibrium was achieved subject to a least cost flow of milk from the farm to a final retail outlet. Using a linear programming routine, cost was minimized as follows: (3)

Minimize:

$$Z = \sum_{i=1}^{m} \sum_{j=1}^{n} TT_{ij} Q_{ij}$$

Subject to:

$$\sum_{j=1}^{n} Q_{ij} + S_i = PT_i \quad i = 1, 2 \ldots . m.$$

$$\sum_{i=1}^{m} Q_{ij} = X_j \quad j = 1, 2 \ldots . n.$$

$$Q_{ij} \geq O \quad i = 1, 2 \ldots . m; \quad j = 1, 2 \ldots . n.$$

Where:

Z = total costs

$i = 1, 2 \ldots .$ m different producing areas

$j = 1, 2 \ldots .$ n different consuming areas

TT_{ij} = the sum of the retailing cost plus processing cost plus assembly cost required to get Class I milk from the producer in area i to the consumer in area j

Q_{ij} = quantity produced in area i and purchased in consuming area j

S_i = the fixed supply in production area i

PT_i = Class I milk supplied by each i producing area

X_j = milk used for Class I purposes in consuming area j

Reactive Programming

The general form of the reactive programming algorithm used in the study, as presented by Tramel and Seale (4) is as follows:

Given:

$i = 1, 2 \ldots .$ m different producing areas.

$j = 1, 2 \ldots .$ n different consuming areas.

There are n demand equations of the form:

$$P_j = F_j\left(\sum_{i=1}^{m} Q_{ij}\right) \quad j = 1, 2 \ldots . n.$$

Where:

P_j = the price of the homogeneous product in consuming area j.

F_j = parameters of the demand function in area i.

Q_{ij} = quantity produced in area i and purchased in consuming area j.

The net revenue per unit is:

$$R_{ij} = F_j\left(\sum_{i=1}^{m} Q_{ij}\right) - T_{ij} \quad i = 1, 2 \ldots . m; \quad j = 1, 2 \ldots . n.$$

Where:

R_{ij} = net average revenue per unit for the product produced in region i, and consumed in region j.

T_{ij} = per unit transportation cost of transporting the product from producing area i to consuming area j.

And:

$Q_{ij} \geq 0.$

For a given i, R_{ij}'s are equal for all j's to which shipments are made, and are greater than all R_{ij}'s for all j's to which shipments are not made.

$R_{ij} \geq 0$ for all i's and j's between which shipments occur.

$\sum_{j=1}^{n} Q_{ij} \leq S_i.$

Spatial Equilibrium

In the model, the producer's blend price was considered the net revenue per unit. Therefore, this model functioned to prevent arbitrage at the producer level. Spatial equilibrium would, therefore, be achieved when the producer blend price of Class I and Class II milk differed from that price in another market by no more than the cost of transportation between markets. The fulfillment of the following condition was therefore necessary for the model to achieve spatial equilibrium (3).

$$BPJ_{ij} \geq BPJ_j - T_{ij} \qquad i = 1, 2 \ldots . m; \quad j = 1, 2 \ldots . n.$$

Where:

BPJ_{ij} = the blend price for milk in market i delivered to market j.

BPJ_j = the blend price for all markets j.

T_{ij} = per unit transportation cost of transporting the product from producing area i to consuming area j.

The blend price was computed by the model as follows:

$$BPJ_j = \frac{(CI_j \times X_j) + (P_s \times S_j)}{X_j + S_j}.$$

Where:

CI_j = Class I or fluid milk price at the farm level in market j.

X_j = Milk used for Class I purposes in market j.

P_s = Class II milk price at the farm level.

S_j = Class II milk not used for fluid purposes in market j.

The model computes the Class I price of milk as a function of the retail price of fluid milk minus the costs of assembling, processing, and retailing of the farm produced milk. The Class II price is provided to the model as a fixed amount (2).

Functioning of the Model

The basic functioning of the model may be summarized as follows: The initial set of supply and demand quantities is established and used as the base of the procedure. The linear programming, cost minimization algorithm is then used to allocate the supplies to the markets in order to satisfy this initial demand. Based upon the quantity demanded in each market, the retail price is calculated through the use of a demand function for each consuming area. The transportation, processing, and retailing costs are subtracted from the retail price to obtain the net shipping point prices for the shipments required by the initial demand quantities. Next, the reactive algorithm is utilized. A new quantity of shipment is allocated among the markets (when a change was indicated) for one supply area in such a manner as to maximize the net returns for that supply area, given the market prices and previous shipping patterns of all other supply areas. This same allocation process is repeated for the next supply area, given the behavior of all other supply areas.

The iterative routine continues until it is not profitable for any supply area to reallocate supplies. Then based upon the quantities demanded as a result of this reallocation process, the cost minimizing, linear programming routine is used. This linear programming, reactive programming sequence continues until the conditions for the spatial equilibrium of the blend price are achieved.

Data Requirements of the Model

The major components of the data necessary to operate the model were as follows (2):

1. The number of supply and demand markets.
2. The accuracy acceptable for quantity and price calculations.
3. A demand function for each market of the form:

   $P_j = a_j + b_j X_j \quad j = 1, 2 \ldots . n.$

   Where:

   P_j = retail price (\$/cwt) of fluid milk $j = 1, 2 \ldots . n\text{-}1.$

   X_j = quantity (cwt) of fluid milk demanded $j = 1, 2 \ldots . n\text{-}1.$

   a_j = price intercept coefficient, $j = 1, 2 \ldots . n.$

   b_j = slope coefficient, $j = 1, 2 \ldots . n.$
4. The percentage retail markup in each demand area, to provide per unit retailing costs as a fixed percentage of the retail price.
5. The minimum Class I prices may be specified as an option for the simulation.
6. The number of processing plants per market.
7. A processing cost function, to represent all of the plants in the State of the form:

   $$PC_j = a + \frac{b}{V_j}.$$

   Where:

   PC_j = processing cost (\$/cwt) in demand area j, $j = 1, 2 \ldots . n\text{-}1.$

   V_j = volume (cwt x 10^6) of fluid milk processed per division (plant) in demand market j.

   a = constant value.

   b = coefficient value.
8. Mileage matrix of the distances between supply and demand points.
9. Quantity of the fixed supply.
10. Quantity of the initial demand.
11. A transfer cost function for all the assembly of milk in the State in the following form:

    $TC_{ij} = a + bM_{ij} \quad i = 1, 2 \ldots . m; j = 1, 2 \ldots . n.$

Where:

TC_{ij} = transfer cost ($/cwt) between supply area i and demand market j.

M_{ij} = one way mileage between supply market i and demand market j.

a = constant value.

b = coefficient value.

Determination of the Data

The year 1975 was chosen to model the milk marketing in Maine due to the availability of data for that period at the initiation of this study. More recent information in such important areas as demand for milk and costs of milk marketing was not available at that time. For the purpose of this study, and due to data limitations, areas not within the State controlled milk markets were assumed to be self-sufficient from the standpoint of production and consumption of milk. From the 1970 Census (6) the number of individuals residing in State controlled markets was determined to be 851,316. The total population of the State at the time was 992,048 individuals. Therefore, 86 percent of the population resided in State controlled markets. It is doubtful that there has been significant change in the distribution of this population between 1970 and 1975.

SUPPLY OF MILK

The total volume of milk produced for marketing in the State during 1975 was estimated at 635 million pounds (7). Of that quantity, 35 million pounds were assumed to be consumed in the unregulated self-sufficient area of the State based upon estimates of Metzger and Webster (7). This volume, therefore, was not considered in the 1975 marketing simulation. This assumption left 600 million pounds of milk to be allocated among Class I and II usage in controlled areas of the State, and out-of-state shipment, through Newport, Maine, to the area controlled by the New England regional order.

The 600 million pounds of milk produced were assigned to production areas on a per town basis. This was accomplished through the use of a study of the municipal taxation of dairy cattle in Maine (8) and a survey of milk shipments to processors conducted by Metzger in February, 1974 (9).

Our model considered the supply of milk as specified to be a fixed quantity. The total supply for each county was determined through summing the production for each producing town in the county. Kennebec County had the largest quantity of production, and Hancock County had the lowest quantity of production (Table 1).

SUPPLY AREAS

For the purposes of modeling the actual marketing situation, supply areas within counties were broken down into appropriate sub-units. This division was determined by breaking counties in half where appropriate, and aggregating units in adjoining counties where appropriate. The goal of the partitioning was to obtain supply areas roughly equal in size. In Figure 1, the supply areas are depicted along with their central points (key in Table 2). Such a breakdown gave the assembly cost factor in marketing situations a more reasonable weight. However, any further divisions of supply areas would have resulted in an unmanageable amount of data for this study. In addition the level of accuracy of the data did not encourage a further breakdown.

Table 2 lists the quantities assigned to each supply area and contains a key for Figure 1. In order to determine the distance from supply areas to processing plants, the geographic center of each supply area was determined. In the functioning of the model it was assumed that all shipments of milk to processing plants occurred from these points.

DEMAND DETERMINATION

The retail-price, state-controlled milk markets in 1975 are depicted in Figure 2. These were the areas which contained 86 percent of the population at that time. The demand for milk in these markets was determined through data tabulated by the Maine Milk Commission (10). The initial demand for fluid milk in these markets was equated with the volume of Class I milk sales to regulated markets which was reported by all plants servicing these markets. This initial demand was 2,821,184 cwt, or 47 percent of the total supply (Table 3).

In the operation of the model, the quantity demanded was centered at the processing plant. Each plant, therefore, served a marketing area. As will be described later, retailing costs were computed based upon the nature of the marketing situation faced by each processing plant. The advantage of such a system was that markets having a unique demand did not have to be specified, and the retailing costs could represent overlapping markets for the plants. This added to the realism of the simulation.

In order to keep data within manageable bounds, and in accordance with considerations of accuracy, some milk plants were eliminated from consideration in the initial marketing situation. This resulted in locating 30 plants in 27 towns. The Class I sales volume of plants which were eliminated was assigned to the geographically closest processor-dealers. Table 3 presents the results of this assignment process. When two plants were present in a town, each plant was assumed to process one-half of the Class I sales reported from that town. In order to determine distances from the supply to the processing plants, the center of each town or city in which a processing plant was located was assumed to be the location of that plant. Figure 3, with its key being found in Table 3, shows the spatial relationships of these processing plants. Only one out-of-state plant located in Portsmouth, New Hampshire, was considered in the simulation to be servicing the State.

The model considered only the assembly, processing, and retailing of Class I milk. *In-state Class II milk was purchased in the supply areas at a minimum price and the model gave no further consideration to its disposition. Its shipping, processing, and consumption were not considered.* The initial demand for Class II milk as presented in Table 3 represented 20 percent of the initial demand for fluid milk or 564,237 cwt.

All milk in excess of Class I and Class II demand was assumed to be shipped to the transshipment point in Newport, Maine, to meet the demand of the Boston Market. This 2,614,579 cwt of milk received the twenty-first zone blend price at Newport. *The model considered only the assembly cost of this milk.*

RAW MILK ASSEMBLY DISTANCES

The distance which milk had to be transported in the assembly process was actually the distance from the farms to the processing plants. In the operation of the model, this distance was represented by the distance between the supply points (Figure 1) and the processing plants (Figure 3). In order to determine this distance, the straight line distance between these two points was measured for all possible shipments. To make these distances a more realistic representation of the actual distances involved in assembling raw milk, a function was determined to convert these straight line distances to highway miles.

Using the "Maine: 1976 Official Transportation Map" published by the Maine Department of Transportation (11), 116 pairs of towns and cities were randomly chosen from the "Mileage Chart showing approximate distances between cities and towns on numbered highways." The straight line distances were measured between each of these paired cities and the road distance indicated on the chart was recorded for each of these pairs. Using these data, a regression analysis was performed to determine the following relationship:

$$RD = a + b\,(SD)$$

Where:

RD = road distance in miles

SD = straight line distance in miles

a = intercept value

b = coefficient value

The following relationship was determined:

$$RD = 2.956360 + 1.345753\,(SD)$$

$$r^2 = 0.92$$

Using this relationship the previously determined straight line distances between supply and demand points were converted to road distances for utilization in the model.

PRICES FOR THE 1975 MARKETING CONDITIONS

An initial Class I price of $10.575 per hundredweight was used for all areas in the market simulation. This was the average minimum price established by the Milk Commission in 1975.

A fixed Class II price of $7.68 per hundredweight was used for all areas. This was the minimum Class II price for 1975 established by the Milk Commission.

The price paid for milk received at Newport, Maine for out-of-state sale was set at $8.93 per hundredweight. This was the 1975 blend price for the twenty-first zone of the New England Federal Order in which Newport was located.

The retail fluid milk price was established on a dollar per hundredweight basis for three container sizes of whole milk based upon the Milk Commission's 1975 minimum prices. These three container sizes — quart, half gallon, and gallon (including twin pack paper half gallon and gallon containers) — were selected based upon available data and their importance in the market. From Metzger's 1977 cost studies (12), whole milk was found to represent 80.4 percent of the volume of milk processed for fluid consumption in those plants studied, and these three container sizes accounted for 89.7 percent of the volume of whole milk processed by these plants.

A weighted average retail price for all milk was determined from these container types. As shown in Table 4, the average retail price for these three container sizes was determined to be $18.48 per hundredweight or 39.7 cents per quart in 1975. This figure was used for the initial retail price of all fluid milk sold in the State in our market simulation.

COST RELATIONSHIPS

The various cost computations which the model utilized in the simulation of the milk market in Maine were obtained from both published and unpublished studies conducted in the State. These "actual" cost relationships were used to determine the initial spatial equilibrium.

Assembly Cost. Assembly costs were calculated for Class I and out-of-state usage by the model. Class II milk had no assembly costs associated with it. A function had to be determined for the farm-to-processing-plant assembly costs for raw milk. The required form of the function was previously illustrated. A per unit transfer cost was calculated with this function among all supply and demand points. The sum of these transfer costs multiplied by the quantities of milk shipped from supply areas to a processing plant determined the total assembly cost of that plant. The sum of the assembly costs for all plants was the total assembly cost for the marketing system.

Unpublished data from a survey of processors (9) concerning the hauling charges and distances transported for various assembly operations, were used to determine the required function. Regression analysis was utilized to determine the function's parameters with the following results:

$$T_{ij} = 0.26897 + 0.00242\,(D_{ij})$$

Where:

T_{ij} = assembly cost per hundredweight between supply area and demand market

D_{ij} = distance in miles between supply area and demand market

$r^2 = 0.20$

The r^2 value indicated that distance accounted for 20 percent of the variation in costs per hundredweight. Several reasons for the low r^2 value may be hypothesized. Firstly, different accounting systems may have been used by the hauling firms in establishing hauling charges. Secondly, failure to consider more of the parameters which contribute to assembly costs may have resulted in the low value. Finally, in light of the various systems used for the assembly of milk, failure to consider the systems used, due to lack of data, could easily have lowered the predictive capacity of this equation.

Processing Cost. Processing costs as reported by Metzger (12) for whole milk in container sizes of quart paper, half gallon paper, half gallon plastic, and gallon plastic were used to determine the processing cost function used in the model. Using the processing cost for these four container types, an average-per-unit processing cost per plant was determined. Each container type contributed to the total per unit figure proportional to its weight in the overall product mix. Regression analysis was used to determine the processing cost function in the required format utilizing this weighted per unit processing cost figure and the volume processed. Data were used for sixteen plants handling all four container sizes and types. The equation was determined to be as follows:

$$PC = 2.709067 + .009761935 \div (VP \times 10^{-6})$$

Where:

PC = processing cost per hundredweight

VP = hundredweight of milk processed

$r^2 = 0.27$

The relatively low r^2 may be due to factors such as different cost accounting systems used by the plants, as well as failure to consider relevant parameters in the regression equation. One critical parameter, for which no data were available, was the capacity at which these plants were operating for the period in which they reported their cost data.

Processing cost was calculated for Class I usage. No processing cost was calculated by the model for Class II and out-of-state shipments. The per unit processing cost determined through the equation for a processing plant multiplied by the volume processed in that plant resulted in the total processing cost of that plant. The sum of all such processing costs equalled the total processing cost for the entire milk industry in Maine.

Retail Markup Percentages. The retailing cost used in this simulation involved all costs and profits associated with the Class I product from the point at which it left the processing plant to the point at which consumers purchased it at the final retail outlet. This method of cost determination was attractive because data were lacking concerning the components of this retailing cost for Maine milk marketing conditions. In addition, no final demand points had to be specified. The processing plants retained the same retail markup percentage between the initial (regulated prices) and spatial equilibrium (non regulated prices) conditions. This assumed that there was no change in the character of the retailing system used by the plants between the initial and the spatial equilibrium. A disadvantage of this technique was that it removed the possibility of minimizing distribution costs through the linear programming technique.

Retailing costs were determined as a fixed percentage of the retail price. As retail price fluctuated due to changes in quantity demanded, so did the per unit retailing cost. The retailing cost component was an over simplification which prevented a total cost minimization solution which could be achieved through considering distribution costs in a classic transshipment framework.

Each processing plant had a unique retailing cost percentage based upon the conditions within the initial marketing situation. This percentage was calculated as follows:

1. Retail Price — Class I Price = Marketing Margin
2. Marketing Margin — Processing Cost = Retail Margin
3. (Retail Margin ÷ Retail Price) x (100) = Retailing Cost Percentage

The retailing cost percentage multiplied by the retail price of milk sold by a processing plant resulted in a per unit retailing cost. This per unit retailing cost multiplied by the volume of Class I milk processed by a plant resulted in the total retailing cost of the plant. The sum of all such retailing costs equalled the total retailing cost for any marketing simulation. No retailing costs were computed for Class II or out-of-state milk sales.

The calculated retailing cost percentages for the initial marketing situation are presented in Table 5. With the same retail price throughout the State, retailing cost percentages were directly related to the volume of milk processed by a plant due to the economies of size embedded in the processing cost function. When two plants were present in one location, it was assumed that one-half of the volume was processed by each plant, thus both had the same retailing cost percentage.

Retail Price Demand Functions. As previously stated, a retail price demand function of the form:

$$P_j = a_j + b_j X_j$$

Where:

P_j = Per unit retail price in market

X_j = Quantity demanded in units

a_j = Constant

b_j = Coefficient

was required for the operation of the model. The function for each processing plant was determined based upon the initial quantity processed at the plant and the elasticity of demand for fluid milk products. An elasticity of 0.20 was used for this purpose. This elasticity was the value for the

Northeastern milk markets considered by Riley and Blakely (3) in their study of the national milk industry. Table 6 presents the coefficient and constant values as they were calculated for this equation for the various demand areas.

Determination of Alternate Parameters

Alterations were made in some of the cost functions to simulate changes in resource availability and adoption of optional technologies. Alterations of resource availability were simulated through price level changes. Optional technologies were modeled through the use of nationally determined transportations and processing cost parameters (3).

OPTIMAL ASSEMBLY TRANSPORTATION AND PROCESSING COST FUNCTIONS

The transportation cost function determined by Riley and Blakely (3) was used to represent the national "state of the art" transportation cost. The function had the following form:

$$T_{ij} = 0.248950 + 0.001583\ D_{ij}.$$

Where:

T_{ij} = assembly cost per hundredweight between supply area and demand market.

D_{ij} = distance in miles between supply area and demand market

The processing cost function representative of national conditions was also taken from Riley and Blakely (3). The equation had the following form:

$$PC_j = 1.3926 + 0.3844 \div (VP \times 10^{-6})$$

Where:

PC_j = processing cost per hundredweight

VP = hundredweight of milk processed annually

INCREASING THE ASSEMBLY TRANSPORTATION COST FUNCTION

The alteration of resource availability was examined through the increase in the transportation cost function. This assumes the maintenance of current technology and that scarcity of oil will be represented in the increased price of fuel. This increased fuel price would then result in increased transportation cost. It was also assumed that while more expensive fuel caused transportation costs to increase, it did not affect other marketing costs. It was realized that this was not a realistic assumption.

The transportation cost function was increased in increments of 25 percent, 50 percent, 75 percent, and 100 percent. Table 7 presents the various transportation functions which were determined for the Maine assembly-cost function.

Marketing Simulations Conducted

Five simulations representing differing marketing conditions were conducted. First, a simulation was made for the actual marketing conditions. That is, the cost functions as determined for Maine firms were used in the model. Second, the effects of decreased transportation costs were analyzed. A nationally determined transportation cost function was used with the other Maine determined parameters. Third, the effects of a change in processing cost were examined. A nationally determined processing cost function was used with the other Maine determined costs. This was to allow the plants the potential of achieving greater size economies than with the Maine-determined processing-cost function. Fourth, the effects of both a decreased milk assembly transportation cost and the possibility of achieving greater scale economies in processing were evaluated. In this simulation, nationally determined processing and transportation cost functions were used in the model. Fifth, the effects of increasing milk-assembly-transportation costs were determined. The Maine-determined transportation-cost function was altered to incorporate increases in transportation costs and used for these simulations.

Each marketing simulation consisted of an initial (price regulation) marketing condition segment, and a spatial equilibrium (price deregulation) segment. The initial marketing condition was determined through using the linear-programing cost-minimizing segment of the model without the spatial or reactive algorithms. This was accomplished by holding the retail price constant and corresponded to marketing conditions in which prices were fixed by the Maine Milk Commission. The spatial equilibrium was determined with the use of the complete model. This was achieved by allowing retail prices to fluctuate through the demand functions presented in Table 6. The spatial equilibrium, therefore, corresponded to conditions in which there was no price regulation by the Commission.

For all of these simulations, the supply location and quantity were the same as shown in Table 2. The other parameters were specified for each simulation which was conducted.

PRICE REGULATION VS PRICE DEREGULATION (SPATIAL EQUILIBRIUM) UNDER CURRENT MARKETING SITUATIONS[2]

The simulations in this section were designed to point out the differences between the conditions of price regulation (initial marketing conditions) and price deregulation (spatial equilibrium) using existing marketing costs. In subsequent sections marketing cost changes were simulated under both price regulation conditions and price deregulation conditions in order to better note the effects of the cost changes.

With deregulation of milk prices, the quantities of milk demanded increased as prices declined. Thus all of the processing plants had increased volume in the spatial equilibrium compared with the initial condition, Table 8. For example, the plant in Southwest Harbor increased its annual processing volume by 426 cwt, and the Bangor plant by 6,095 cwt between the initial and spatial marketing conditions. The increased quantity of Class I milk processed by these and other plants was acquired from a decline in an initial Class II allocation in the supply areas of 59,787 cwt. Though not evident from Table 9 due to rounding, there was a slight decline in the processing cost of all of these plants due to economies of size resulting from the increased processing volume.

With price deregulation, the average retail price declined $2.38 per cwt ($.05 per quart). The lowered retail price, in turn, resulted in all plants experiencing a lower per unit retailing cost. The average retailing cost declined to $4.43 per cwt from the initial cost of $5.08 per cwt (Table 9). Net supply area prices (prices to farmers) were lowered substantially under price deregulation. Average net supply area prices declined from $9.24 per cwt to $8.46 per cwt, Tables 10 and 11.

The change in the milk shipment pattern was for the supply areas to ship to closer processing plants in the spatial equilibrium compared with the initial (price regulated) marketing condition. The change in the shipments out of Southern Aroostook County was such a change. Under price deregulation milk moved only to Houlton and Presque Isle, while under price regulation large quantities went to Bangor and Brewer. In addition,

[2]In this simulation, all of the parameters used were those determined for Maine marketing conditions. Specifically, the assembly transportation cost function had the form:

$$T_{ij} = 0.26897 + 0.00242\,(D_{ij}).$$

The processing cost function had the form:

$$PC = 2.709067000 + 0.009761395 \div (VP \times 10^{-6}).$$

The retail markup percentages were the same as those presented in Table 5.

more of the Class II milk was now allocated from more isolated areas of the State (Aroostook County), Tables 10 and 11. These changes resulted in lowered assembly costs.

The summary of costs and revenues for the initial and spatial marketing conditions is presented in Table 12. It is apparent that there was little change in the percentage of the functional costs as a percentage of total costs or of all factors as a percentage of total revenue. Retailing costs were still the most important component of total costs. The assemblers, processors, and retailers, as a group, and the producers maintained the same percentages of the total revenue. Since a larger quantity was processed under price deregulation, the percentage of total costs which was due to processing increased three percentage points to 35 percent. The percentage of costs due to retailing declined three percentage points to 56 percent of total costs. This can be attributed to the decline in the retail price since unit retailing costs were computed as a percent of the retail price. Despite an increased volume of sales, total retailing costs were less under price deregulation.

The overall decline in total distribution costs was $1,557,732, which was a 6 percent reduction in costs due to price deregulation. Retailing costs were reduced by $1,583,376 or 11 percent. Processing costs increased by 2 percent or $161,965. There was a decline in assembly costs of $136,320 or 6.5 percent.

There were substantial changes in the amount of revenues obtained under price deregulation. Total revenue declined by $6,205,254 which was a decrease of 8 percent. The total farm revenue declined by $4,647,522, or 8 percent, and assembly, processing, retailing revenue declined by $1,557,-732 or 6 percent. Total revenue declined despite increased demand for milk. Declines in the retail price resulted in increases in quantities demanded, but generated less total revenue than the initial regulated market situation with higher prices and reduced consumption. Farmers bore the brunt of this revenue reduction.

CHANGES IN ASSEMBLY COST

Changes in the assembly cost function were designed to simulate changes in resource availability and technological innovations. It is taken for granted that a decrease in the availability of fuel would increase the assembly cost and that an increase in the availability would decrease assembly costs. It was also assumed that such a change in fuel availabilities would not affect other marketing costs.

Decrease in Assembly Cost

A more efficient assembly cost function was utilized to determine the effects of increased fuel availability upon price regulated (initial) and price deregulated (spatial) marketing conditions.[3] This simulation also tested the effect of cost reducing technological innovation in assembly procedures. The more efficient function is referred to hereafter as an optimal function.

PRICE REGULATION

There were two major differences in the initial marketing systems determined by the use of the optimal rather than the Maine determined assembly cost function. Producers experienced a $0.05 per cwt increase in their net farm price, (Table 13), which amounted to a $324,411 increase in total farm revenue with the change to an optimal assembly cost function, (Table 14). The other major difference was a decrease in the assembly cost (revenue to assembly operations) of $328,411 with the optimal function.

PRICE DEREGULATION

There were many more differences observed between the Maine determined and optimal assembly costs under the spatial equilibriums. With the optimal assembly cost function, producers received a $6,361 greater total farm revenue. (Lowered assembly costs resulted in lower retail prices which generated greater milk sales, benefiting producers.)

Those engaged in assembly operations received $243,838 less in total revenue (total assembly costs). The processors had greater costs (revenue) under the optimal assembly cost spatial equilibrium of $8,739 (Table 14). Table 15 shows a decline in the average retailing cost of $0.03 per cwt with the optimal assembly cost. This resulted in a decline in distributors' revenue (total retailing costs) of $80,525. Finally, the optimal assembly cost function resulted in consumers spending $0.12 per cwt less for milk purchases than with the Maine determined assembly cost function. These results emphasize that consumers tend to immediately benefit from an improvement in technology under price deregulation. This of course assumes no monopoly powers on the part of any segment of the industry.

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[3]In these simulations the optimal assembly cost function was of the form: $T_{ij} = 0.24895 + 0.001583\,(D_{ij})$ rather than $T_{ij} = 0.26897 + .00242\,(D_{ij})$.

Increase in Assembly Cost

Decreased fuel availability was simulated through a 25, 50, 75, and 100 percent increase in the Maine determined assembly cost function.[4] The effects upon initial or price regulated marketing conditions and upon spatial equilibrium or price deregulated marketing conditions are examined in turn.

PRICE REGULATION

There were two major changes in the initial marketing conditions as assembly cost increased. First, total assembly cost (or revenue to assembly operations) increased from $2,096,944 with the original cost relationships to $4,170,635 with the 100 percent increase in assembly costs (Table 14). Second, the net supply area (farm) price declined steadily from $9.24 per cwt with no cost increase to $8.89 per cwt with a 100 percent increase in assembly costs or a net reduction of 35 cents per cwt (Table 13). This decrease reduced total farm revenue by $2,073,693 between these two extremes.

Since retail prices are fixed, the increases in assembly costs are absorbed by adjustment in farm prices. One alternative to this would be that the regulatory agency raise retail prices to recognize the cost increase.

PRICE DEREGULATION

There were many changes apparent in the marketing conditions when spatial equilibriums for the increasing assembly cost were compared. Net farm prices experienced an overall decline of $0.04 per cwt over the course of the assembly cost increases (Table 13). This reduced total farm revenue by $240,052. The total revenue received by the assembly operations (total assembly cost) increased a total of $1,952,400 with the 100 percent increase in assembly costs. The revenue received by processors declined by $59,469 from the original assembly cost function to the 100 percent increased assembly cost function (Table 14). This was due to reduced processing volume as retail prices increased to reflect increased assembly costs. As shown in Table 15, there was an overall increase in the retailing cost of $0.23 per cwt from the 0 to the 100 percent increase in the assembly cost function. This meant an increase in total revenue (total retailing costs) to the retail operations of $561,912 during the course of the assembly cost increase (Table 14). Consumers experienced a total increase in retail price of $0.84 per cwt (1.8 cents per quart) due to a 100 percent increase in the assembly cost.

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[4] See Table 7 for function intercepts and coefficients.

It is evident that increased costs resulted in increased retail prices and that all segments of the industry were affected through the reduced consumption of milk. Under price deregulation consumers were more directly affected by cost increases than under retail price regulation.

CHANGES IN PROCESSING COST

The change in the processing cost function was designed to simulate optimal technological innovation, as well as changes in resource availability. In this simulation, however, Maine processing plants, because of their small volume, could not achieve the economies of size indicated by this optimal processing cost function. *Therefore, this function served to simulate an increase in processing costs.*[5] This function also simulated a decrease in energy resources used for processing which could result in increases in the processing cost.

Price Regulation

There were several differences between the initial conditions with the Maine determined parameters and those with the optimal processing cost function. Table 15 illustrates two of these differences. The average processing cost was $0.65 per cwt higher with the optimal processing function. This increased total processing cost (revenues received by processors) by $1,849,228 (Table 14). The average retailing cost declined $0.44 per cwt which decreased the total retailing cost (revenue received by retail operations) $1,269,822 (Table 14). Another difference is apparent in Table 13. The average net supply area revenue was $0.10 per cwt lower with the optimal processing cost function. This resulted in a decrease in total farm revenue of $601,396 (Table 14). Thus under price regulation increases in processing costs would affect both retailing revenue and farm revenue since retail prices remain fixed. Of course adjustments in fixed prices by the control agency could remedy the situation.

Price Deregulation

There were also noticeable differences between the spatial equilibriums determined with all Maine parameters, and with the optimal processing cost. Table 15 depicts some of these differences. The average pro-

[5]In these simulations the processing cost function was of the form: $PC = 1.3926 + .3844 \div (VP \times 10^{-6})$ rather than $PC = 2.709067 + .009761935 \div (VP \times 10^{-6})$.

cessing cost was $0.64 per cwt higher with the optimal processing cost function which resulted in $1,829,431 more revenue received by processing operations (Table 14). The average retailing cost was $0.33 per cwt lower with the optimal processing cost function which decreased total revenue to retail operations by $983,436 (Table 14). The consumers had a $0.20 per cwt higher average retail price for milk purchases with the optimal processing cost function. Table 13 shows that net supply area price was $0.05 lower with the optimal processing cost function which reduced total producer revenue by $322,727 (Table 14). Total assembly revenue was $2,012 lower with the optimal processing cost function.

CHANGES IN BOTH ASSEMBLY AND PROCESSING COSTS

This simulation used both the optimal assembly cost and the optimal processing cost function. This, in effect, simulated a decrease in assembly costs due to technological innovation and an increase in processing costs due to higher prices paid for goods and services.

Price Regulation

Table 15 depicts some of the differences between the initial conditions, with the Maine determined parameters, and the optimal assembly cost and processing cost functions. Average processing cost was $0.65 per cwt higher with the optimal parameters. This increased processor revenue (total processing cost) by $1,849,228 (Table 14). There was a $0.33 decrease in the average retailing cost with the optimal functions. This reduced retailer revenue (total retailing cost) by $1,269,822 (Table 14).

Assembly cost (revenues) decreased $328,411 with the optimal function (Table 14). As shown in Table 13, the average net supply area revenue (farm revenue) was $0.04 per cwt lower with the optimal functions. Therefore, there was a reduction in the total farm revenue of $242,984 (Table 14).

Price Deregulation

There were many differences between the spatial equilibrium determined with Maine functions, and the spatial equilibrium determined with both optimal functions. There were differences apparent in the average costs of processing and retailing. The average processing cost was $0.64 per cwt higher with the optimal functions which gave the processors $1,829,531 more in total revenue (Table 14). The average retailing cost was $0.36 lower with both optimal functions. This decreased the revenue accruing to retailing operations by $1,004,862 as illustrated in Table 14. The assembly operations experienced a decline in total costs (revenue) of $255,181. Consumers had to spend $0.09 per cwt more (Table 15) and producers received $0.05 per cwt less (Table 13) with the optimal functions.

SUMMARY

Retail price regulated (initial) marketing conditions were contrasted with price deregulated (spatial equilibrium) marketing conditions to determine the effects of deregulation. Maine determined cost and demand parameters were used in both of these simulations. Alternatives to Maine determined costs were also incorporated in additional simulations. Thirty processing plants located throughout the State were included in the simulations.

The producers experienced a decrease in average net price of $0.78 per cwt between the inital (price regulated) conditions and spatial equilibrium (price deregulated) conditions. This resulted in a decline in the total farm revenue of $4,647,522 — an eight percent decline.

Those assembling milk experienced a decline in revenue (total assembly costs) of $136,320 from the initial to the spatial equilibrium due to milk moving shorter distances to market. The processors experienced a small decline in unit processing costs while their total revenue (total processing costs) increased $161,965 in the spatial equilibrium due to increased volume handled.

The average retailing cost declined $0.65 per cwt in the spatial equilibrium (price deregulated) conditions from the average cost in the initial (price regulated) condition. This reduced the retailer's total revenue by $1,583,377. Finally, consumers realized a decline of $2.38 per cwt ($.05 per quart) in the retail price of Class I milk upon price deregulation.

Decreases in unit costs of raw milk assembly of five cents per hundredweight would raise producer prices the same amount with no change in consumer prices, under retail price regulation. Under price deregulation both producers and consumers would benefit from economies in milk assembly. The retail price would decline by 12 cents per hundredweight. Increases in unit assembly costs would on the other hand result in a decrease in producer prices under price regulation, and a decrease in producer prices and a rise in consumer prices, with price deregulation.

An increase of 65 cents per hundredweight in unit costs of processing milk would reduce producer prices under price regulation conditions by 10 cents per hundredweight. Under price deregulation, the decrease in producer price would be held to 5 cents per hundredweight with consumer prices rising 20 cents per hundredweight.

The largest total farm revenue was experienced by price regulated market conditions with optimal assembly transportation costs.

The lowest total assembly, processing and retailing costs were experienced by price deregulated market conditions with optimal assembly transportation costs.

CONCLUSIONS

Price deregulation results in lower retail prices. However, price deregulation also results in lower producer revenue. This lower producer revenue may jeopardize the supply security of raw milk. Therefore, it may be advisable to regulate only producer prices at a level to maintain the supply security. If such partial price deregulation is undertaken, retail prices would not fall as much as they would with total deregulation, and consumer benefits would not be as great as with total price deregulation. This is because consumers would absorb the increase in costs which result from maintaining higher producer revenues.

Since milk imports cannot be controlled by the State, assurance of producer prices without retail price control (which assures processor-distributor margins) is highly unlikely. If producer prices can be assured, (through federal regulation) then the deregulation of other prices could benefit consumers, if adequate assembly, processing and retailing operations would still be provided for milk under conditions of reduced returns. Under conditions of reduced returns to assembly, processing and retailing these services likely would continue only with substantial reduction in both number of firms and the services provided. Monopoly elements may eventually appear and establish price levels providing adequate returns.

Increases in milk assembly and processing costs will result in lower producer prices with a fixed retail price and no control over producer prices. Under price deregulation all segments of the milk industry including consumers would be affected by such cost increases.

If prices are to be regulated, both cost increases and cost decreases which occur at any level of operation must be reflected in appropriate price level changes. Without price regulation, competition would assure the reflection of these changes in prices, provided a substantial number of firms and farmers continue in business.

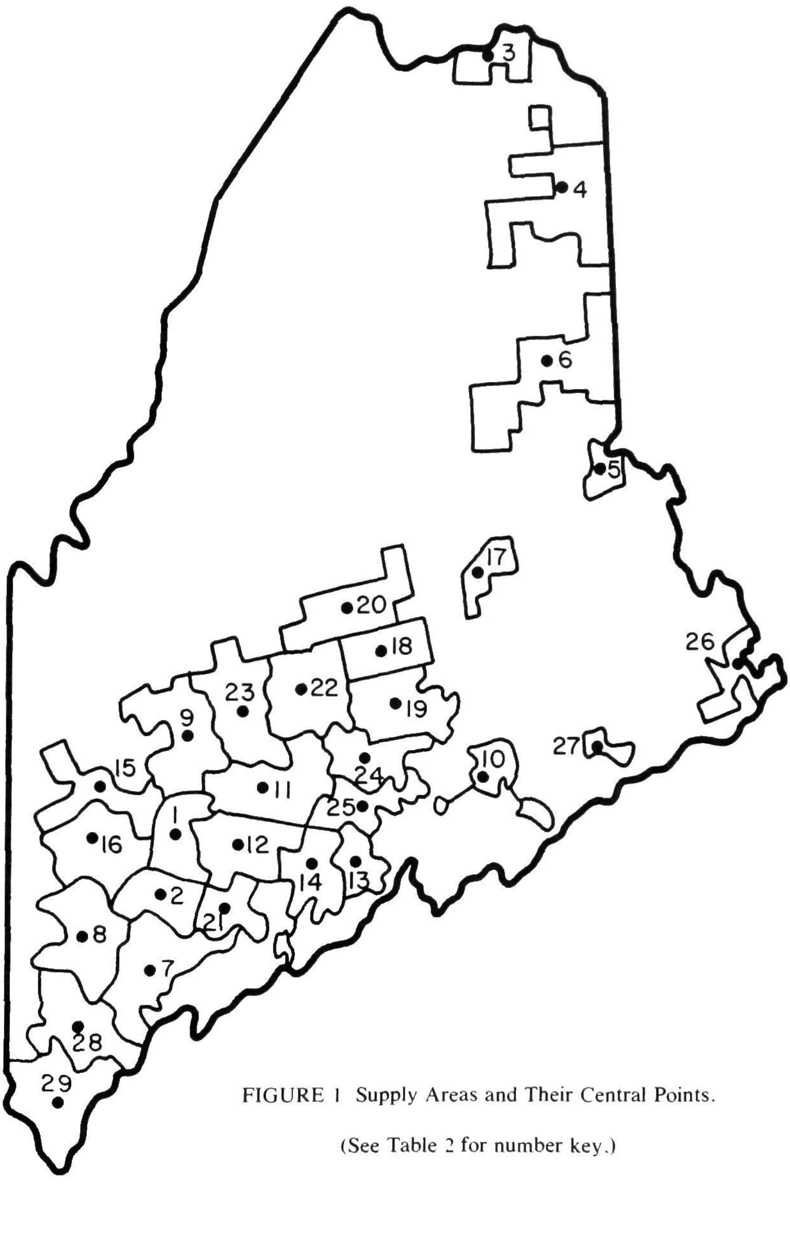

FIGURE 1 Supply Areas and Their Central Points.

(See Table 2 for number key.)

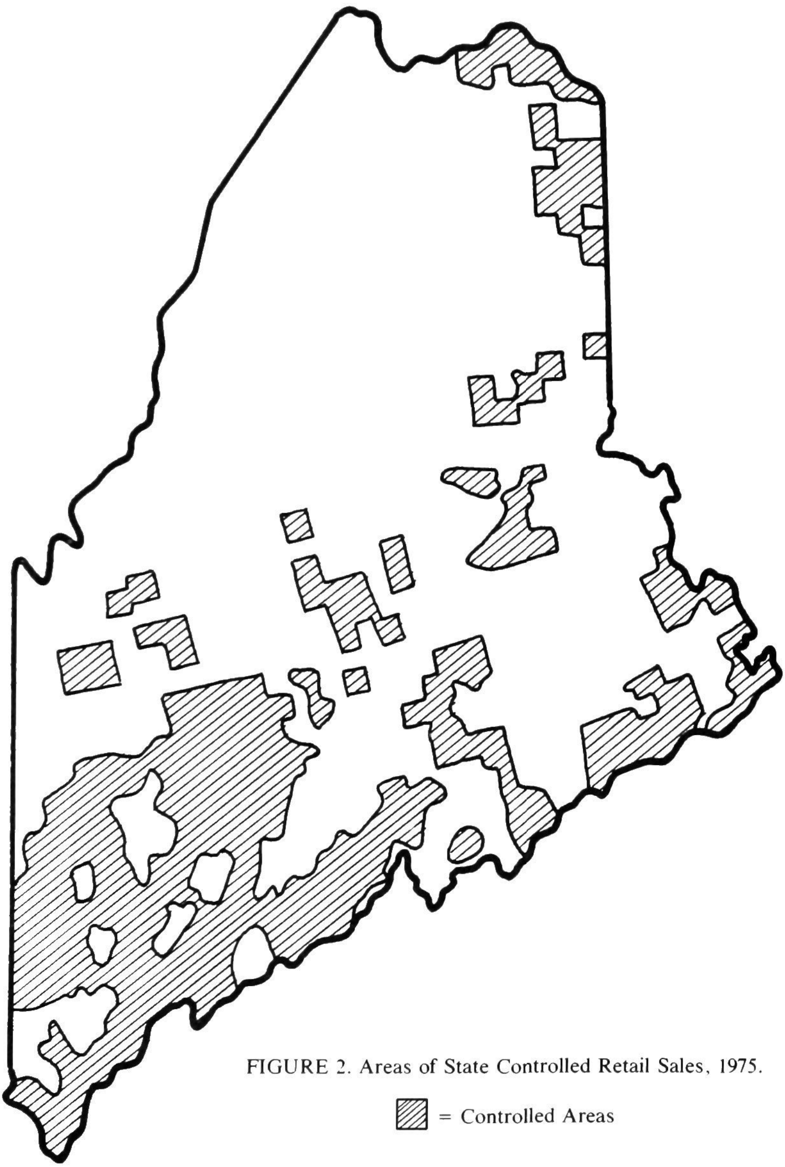

FIGURE 2. Areas of State Controlled Retail Sales, 1975.

▨ = Controlled Areas

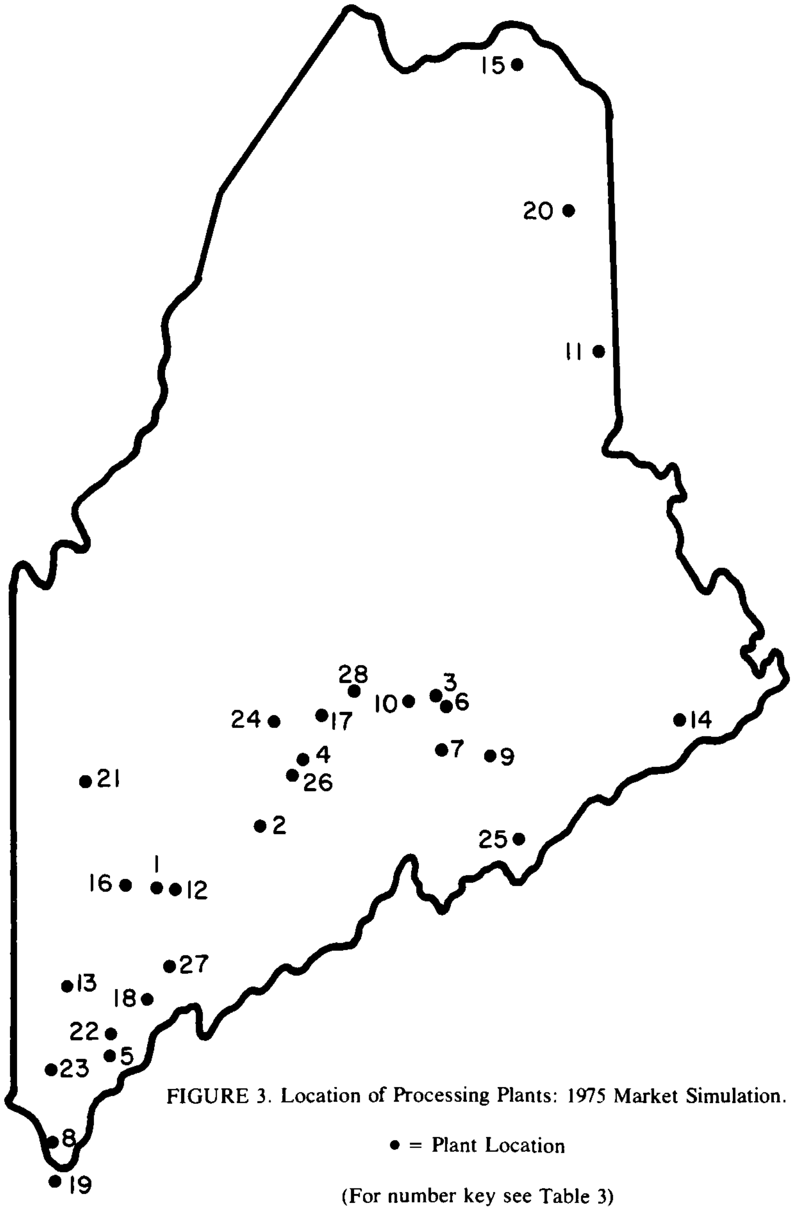

FIGURE 3. Location of Processing Plants: 1975 Market Simulation.

• = Plant Location

(For number key see Table 3)

TABLE 1
Estimated Milk Production by County
Maine, 1975

County	Milk Production* (cwt)
Androscoggin	585,211
Aroostook	478,952
Cumberland	476,863
Franklin	165,458
Hancock	21,054
Kennebec	1,097,209
Knox	66,873
Lincoln	163,694
Oxford	297,222
Penobscot	728,463
Piscataquis	138,877
Sagadahoc	99,937
Somerset	696,016
Waldo	393,933
Washington	56,090
York	534,548
TOTAL	6,000,000

*May not sum to total due to rounding errors

TABLE 2
Supply Areas and Estimated Quantity of Milk Produced in 1975

Name of Supply Area	Key to Figure 1	Raw Milk Production (cwt)*
Northern Androscoggin	1	357,843
Southern Androscoggin	2	227,369
Northern Aroostook	3	77,250
North Central Aroostook	4	88,916
Southern Aroostook	5	8,193
South Central Aroostook	6	306,949
East Cumberland	7	338,465
West Cumberland	8	138,398
Franklin	9	165,458
Hancock	10	21,054
Northern Kennebec	11	841,695
Southern Kennebec	12	255,518
Knox	13	66,873
Lincoln	14	163,694
Northern Oxford	15	94,206
Southern Oxford	16	203,015
Central Penobscot	17	5,176
Northern Penobscot	18	455,762
Southern Penobscot	19	267,524
Piscataquis	20	138,877
Sagadahoc	21	99,937
East Somerset	22	357,600
West Somerset	23	338,415
Northern Waldo	24	320,807
Southern Waldo	25	72,725
East Washington	26	19,305
West Washington	27	34,428
Northern York	28	307,315
Southern York	29	227,233
TOTAL		6,000,000

*May not sum to exact total due to rounding errors

TABLE 3
Initial Milk Demand by Location of Plant;
Number of Plants for Milk Commission
Regulated Areas, 1975

Location Of Plant	Key For Figure 3	Number Of Processing Plants	Volumn Of Sales (cwt)*
Auburn	1	2	35,352
Augusta	2	1	67,434
Bangor	3	1	325,312
Benton	4	1	48,816
Biddeford	5	1	56,892
Brewer	6	1	183,665
Bucksport	7	1	11,033
Eliot	8	1	11,684
Ellsworth	9	1	24,109
Hermon	10	1	109,589
Houlton	11	1	56,574
Lewiston	12	1	82,263
Limington	13	1	232,831
Machias	14	1	36,106
Madawaska	15	1	12,569
Mechanic Falls	16	1	19,642
Pittsfield	17	1	9,644
Portland	18	2	955,625
Portsmouth, N.H.	19	1	30,608
Presque Isle	20	1	92,074
Rumford	21	1	30,982
Saco	22	1	5,944
Sanford	23	2	75,737
Skowhegan	24	1	84,415
Southwest Harbor	25	1	22,744
Winslow	26	1	62,635
Yarmouth	27	1	136,705
SUB TOTAL CLASS I			2,821,184
New England Federal Order Markets Transshipment via Newport	28	—	2,614,579
Class II Demand	—	—	564,237
TOTAL			6,000,000

*May not sum to exact total due to rounding errors

TABLE 4
Determination of the Initial 1975 Retail Milk Price Per Hundredweight Based Upon Maine Milk Commission Minimum Retail Price

Whole Milk Container Size	Milk Commission[1] Minimum Retail Price ($/pkg)	Volume Of[2] Whole Milk Processed 1,000 quarts/year	Percent Of Volume Processed	Milk Commission Minimum Retail Price($/cwt)
Quart[3]	$0.409	9,210	10.6	$19.02
Half Gallon[4]	0.792	36,186	41.8	18.42
Gallon[5]	1.583	41,216	47.6	18.41
TOTAL	—	86,612	100.0	—
Weighted Average	.397[6]	—	—	18.48

[1]Including mandatory minimum 2 cents per quart markup.
[2]Metzger (26:40).
[3]Paper Quarts.
[4]Paper and plastic half gallon and paper twin quarts.
[5]Paper and plastic gallons and paper twin half gallons.
[6]Price in $/quart.

TABLE 5
Retailing Cost Percentages for the Processing Plants
Present in the 1975 Marketing Situation

Location of Processing Plants	Number Of Processing Plants	Retailing Cost Percentage
Auburn	2	25.12
Augusta	1	27.32
Bangor	1	27.82
Benton	1	27.02
Biddeford	1	27.18
Brewer	1	27.82
Bucksport	1	23.32
Eliot	1	23.65
Ellsworth	1	25.91
Hermon	1	27.92
Houlton	1	27.17
Lewiston	1	27.46
Limington	1	27.88
Machias	1	26.64
Madawaska	1	23.90
Mechanic Falls	1	25.42
Pittsfield	1	22.63
Portland	2	27.99
Portsmouth, N.H.	1	26.38
Presque Isle	1	27.53
Rumford	1	26.70
Saco	1	19.22
Sanford	2	26.69
Skowhegan	1	27.48
Southwest Harbor	1	25.78
Winslow	1	27.26
Yarmouth	1	27.72

TABLE 6
Estimated Constants and Coefficients for the Retail Price Demand Functions for Maine Demand Markets 1975

Location of Plant	Constant (a_j)	Coefficient (b_j) (10^{-3})
Auburn	128.04	3.10
Augusta	125.51	1.59
Bangor	127.94	- 0.34
Benton	128.06	2.25
Biddeford	126.59	1.90
Brewer	126.37	0.59
Bucksport	126.36	9.79
Eliot	124.84	8.97
Ellsworth	127.88	4.54
Hermon	125.33	0.98
Houlton	80.26	1.09
Lewiston	125.52	1.30
Limington	125.36	4.59
Machias	127.79	3.03
Madawaska	125.53	8.52
Mechanic Falls	128.22	5.59
Pittsfield	124.88	-11.04
Portland	125.07	0.11
Portsmouth, N.H.	128.26	3.59
Presque Isle	129.12	1.20
Rumford	127.83	3.53
Saco	126.63	-18.22
Sanford	127.45	1.44
Skowhegan	126.95	1.29
Southwest Harbor	128.38	4.84
Winslow	126.32	1.72
Yarmouth	142.26	- 0.91

TABLE 7
Effects of Rising Transportation Cost On the Transportation Cost Function

Percentage Increase In Cost	Maine Determined Assembly Cost Function	
	Intercept	Coefficient
0	0.2689700	0.002420000
25	0.3350004	0.003046509
50	0.3966673	0.003666661
75	0.4649970	0.004269779
100	0.5341635	0.004829620

TABLE 8
Demand Quantities for the Initial Marketing Conditions and the 1975 Spatial Equilibrium Utilizing All Maine Determined Parameters

Plant Location	Number of Plants	Initial Quantity* Demanded (cwt)	Spatial Equilibrium Quantity* Demanded (cwt)
Auburn	2	35,352	36,099
Augusta	1	67,434	68,861
Bangor	1	325,312	331,407
Benton	1	48,816	49,779
Biddeford	1	56,892	58,186
Brewer	1	183,665	187,198
Bucksport	1	11,033	11,248
Eliot	1	11,864	12,119
Ellsworth	1	24,109	24,561
Hermon	1	109,599	111,755
Houlton	1	56,574	58,366
Lewiston	1	82,263	84,068
Limington	1	232,831	238,179
Machias	1	36,106	36,734
Madawaska	1	12,569	12,818
Mechanic Falls	1	19,642	20,058
Pittsfield	1	9,644	9,841
Portland	2	955,635	977,578
Portsmouth, N.H.	1	30,608	31,226
Presque Isle	1	92,074	93,471
Rumford	1	30,982	31,614
Saco	1	5,944	6,079
Sanford	2	75,737	77,310
Skowhegan	1	84,415	86,078
Southwest Harbor	1	22,744	23,170
Winslow	1	62,635	63,974
Yarmouth	1	136,705	139,259
Newport (Out of State)		2,614,579	2,614,579
Class II (Unassigned)	-	564,237	504,450
TOTAL	30	6,000,000	6,000,000

*May not total due to rounding errors.

TABLE 9
Processing and Retailing Characteristics for the Initial Marketing Conditions
and the 1975 Spatial Equilibrium Utilizing All Maine Determined Parameters

		Cost Or Price In Dollars Per Hundredweight By Marketing Conditions					
Plant Location	Number of Plants	Initial Processing Cost	Spatial Equilibrium Processing Cost	Initial Retailing Cost	Spatial Equilibrium Retailing Cost	Initial Retail Price	Spatial Equilibrium Retail Price
Auburn	2	$3.26	$3.25	$4.46	$4.02	$18.48	$16.01
Augusta	1	2.85	2.85	5.05	4.40	18.48	16.11
Bangor	1	2.74	2.74	5.16	4.55	18.48	16.28
Benton	1	2.91	2.90	4.99	4.37	18.48	16.19
Biddeford	1	2.88	2.88	5.02	4.32	18.48	15.91
Brewer	1	2.76	2.76	5.14	4.53	18.48	16.29
Bucksport	1	3.59	3.58	4.31	3.79	18.48	16.27
Eliot	1	3.53	3.52	4.37	3.81	18.48	16.11
Ellsworth	1	3.11	3.11	4.79	4.22	18.48	16.29
Hermon	1	2.80	2.80	5.10	4.50	18.48	16.28
Houlton	1	2.88	2.88	5.02	4.54	18.48	16.69
Lewiston	1	3.83	2.82	5.07	4.40	18.48	16.03
Limington	1	2.75	2.75	5.15	4.44	18.48	15.93
Machias	1	2.98	2.98	4.92	4.38	18.48	16.43
Madawaska	1	3.49	3.47	4.42	3.89	18.48	16.26
Mechanic Falls	1	3.21	3.20	4.70	4.07	18.48	16.01
Pittsfield	1	3.72	3.70	4.18	3.67	18.48	16.23
Portland	2	2.73	2.73	5.17	4.62	18.48	15.94
Portsmouth, N.H.	1	3.03	3.02	4.87	4.25	18.48	16.11
Presque Isle	1	2.82	2.81	5.09	4.58	18.48	16.63
Rumford	1	3.02	3.02	4.88	4.25	18.48	16.10
Saco	1	4.35	4.32	3.55	3.06	18.48	15.90
Sanford	2	2.97	2.96	4.93	4.29	18.48	16.08
Skowhegan	1	2.82	2.82	5.08	4.46	18.48	16.21
Southwest Harbor	1	3.14	3.13	4.75	4.19	18.48	16.26
Winslow	1	2.86	2.86	5.04	4.40	18.48	16.16
Yarmouth	1	2.78	2.78	5.12	4.42	18.48	15.94
Newport (Out of State)	—	—	—	—	—	—	—
Class II (Unassigned)	—	—	—	—	—	—	—
TOTAL	30	—	—	—	—	—	—
WEIGHTED AVERAGE	—	$2.81	$2.81	$5.08	$4.43	$18.48	$16.10

TABLE 10
Supply Area Shipments and Prices for the Initial Marketing Conditions
Utilizing Maine Determined Parameters

Supply Area Name	Plant Locations[1] Shipped To	Quantity[2] Shipped (cwt)	Net Supply Area Price ($/cwt)
Northern Androscoggin	Portland	357,843	$ 10.16
Southern Androscoggin	Limington	124,122	10.17
Southern Androscoggin	Portland	78,894	10.16
Northern Aroostook	Portsmouth, N.H.	30,608	9.28
Northern Aroostook	Eliot	11,864	9.30
Northern Aroostook	Sanford	22,209	9.36
Northern Aroostook	Madawaska	12,569	10.27
North Central Aroostook	Presque Isle	88,916	10.28
Southern Aroostook	Bangor	8,193	10.06
South Central Aroostook	Sanford	53,130	9.58
South Central Aroostook	Brewer	40,061	10.00
South Central Aroostook	Bangor	145,017	10.00
South Central Aroostook	Houlton	56,574	10.24
East Cumberland	Presque Isle	3,157	10.15
East Cumberland	Portland	201,760	10.27
East Cumberland	Yarmouth	136,705	10.28
West Cumberland	Limington	108,709	10.25
West Cumberland	Class II	29,689	7.68
Franklin	Newport	165,458	8.51
Hancock	Ellsworth	21,054	10.27
Northern Kennebec	Newport	730,240	8.55
Northern Kennebec	Benton	48,816	10.27
Northern Kennebec	Winslow	62,635	10.28
Southern Kennebec	Newport	60,994	8.49
Southern Kennebec	Portland	127,090	10.15
Southern Kennebec	Augusta	67,434	10.28
Knox	Newport	44,129	8.51
Knox	Southwest Harbor	22,745	10.16
Lincoln	Newport	34,662	8.49
Lincoln	Ellsworth	3,055	10.11
Lincoln	Brewer	125,977	10.11
Northern Oxford	Sanford	388	10.05
Northern Oxford	Biddeford	56,892	10.06
Northern Oxford	Saco	5,944	10.08
Northern Oxford	Rumford	30,982	10.28
Southern Oxford	Limington	124,122	10.18
Southern Oxford	Portland	78,894	10.16
Central Penobscot	Bangor	5,176	10.18
Northern Penobscot	Newport	455,762	8.61
Southern Penobscot	Bangor	157,925	10.27
Southern Penobscot	Hermon	109,599	10.29
Piscataquis	Newport	138,877	8.58
Sagadahoc	Portland	99,937	10.20
East Somerset	Newport	347,956	8.61
East Somerset	Pittsfield	9,644	10.27

Supply Area Name	Plant Locations[1] Shipped To	Quantity[2] Shipped (cwt)	Net Supply Area Price ($/cwt)
West Somerset	Newport	254,001	8.55
West Somerset	Skowhegan	84,415	10.27
Northern Waldo	Newport	309,774	8.55
Northern Waldo	Bucksport	11,033	10.21
Southern Waldo	Newport	72,725	8.59
West Washington	Machias	1,678	10.22
West Washington	Brewer	17,627	10.03
East Washington	Machias	34,428	10.23
Northern York	Class II	307,315	7.68
Southern York	Class II	227,233	7.68
TOTAL	—	6,000,000	—
AVERAGE	—	109,091	$ 9.24

[1] Class II indicated this quantity remained in Supply Area and was destined for Class II utilization.
[2] May not total due to rounding errors.

TABLE 11
Supply Area Shipments and Prices for the 1975 Spatial Equilibrium Utilizing Maine Determined Parameters

Supply Area Name	Plant Locations[1] Shipped To	Quantity[2] Shipped (cwt)	Net Supply Area Price ($/cwt)
Northern Androscoggin	Portland	357,842	$ 8.33
Southern Androscoggin	Mechanic Falls	20,058	8.42
Southern Androscoggin	Skowhegan	23,429	8.48
Southern Androscoggin	Class II	159,528	7.68
Northern Aroostook	Madawaska	12,818	8.60
Northern Aroostook	Class II	64,432	7.68
North Central Aroostook	Presque Isle	88,916	8.94
Southern Aroostook	Bangor	8,193	8.47
South Central Aroostook	Houlton	58,366	8.95
South Central Aroostook	Presque Isle	4,554	8.81
South Central Aroostook	Class II	244,028	7.68
East Cumberland	Portland	306,408	8.44
East Cumberland	Yarmouth	32,056	8.49
West Cumberland	Limington	138,398	8.41
Franklin	Newport	165,459	8.51
Hancock	Ellsworth	21,053	8.65
Northern Kennebec	Newport	727,998	8.55
Northern Kennebec	Benton	49,779	8.58
Northern Kennebec	Winslow	63,914	8.60
Southern Kennebec	Newport	176,816	8.49
Southern Kennebec	Augusta	68,861	8.56
Southern Kennebec	Pittsfield	9,841	8.45

Supply Area Name	Plant Locations[1] Shipped To	Quantity[2] Shipped (cwt)	Net Supply Area Price ($/cwt)
Knox	Bucksport	11,248	8.50
Knox	Southwest Harbor	9,678	8.52
Knox	Brewer	45,947	8.52
Lincoln	Newport	163,694	8.49
Northern Oxford	Rumford	31,614	8.54
Northern Oxford	Skowhegan	62,592	8.51
Southern Oxford	Mechanic Falls	20,058	8.42
Southern Oxford	Skowhegan	23,429	8.48
Southern Oxford	Class II	159,528	7.68
Central Penobscot	Bangor	5,176	8.60
Northern Penobscot	Newport	455,762	8.60
Southern Penobscot	Bangor	155,769	8.68
Southern Penobscot	Hermon	111,755	8.69
Piscataquis	Newport	138,877	8.58
Sagadahoc	Portland	99,937	8.37
East Somerset	Newport	357,600	8.60
West Somerset	Newport	338,359	8.55
West Somerset	Skowhegan	57	8.62
Northern Waldo	Newport	17,289	8.55
Northern Waldo	Brewer	141,250	8.61
Northern Waldo	Bangor	162,269	8.60
Southern Waldo	Newport	72,725	8.59
West Washington	Ellsworth	3,507	8.45
West Washington	Southwest Harbor	13,492	8.42
West Washington	Machias	2,306	8.72
East Washington	Machias	34,428	8.74
Northern York	Limington	99,781	8.42
Northern York	Portland	207,534	8.41
Southern York	Portsmouth, N.H.	31,226	8.50
Southern York	Eliot	12,119	8.46
Southern York	Sanford	77,310	8.52
Southern York	Biddeford	58,182	8.35
Southern York	Saco	6,079	8.19
Southern York	Portland	5,856	8.37
Southern York	Class II	36,461	7.68
TOTAL	—	6,000,000	—
AVERAGE	—	109,263	$ 8.46

[1]Class II indicated this quantity remained in Supply Area and was destined for Class II utilization.

[2]May not total due to rounding errors.

TABLE 12
Summary of Costs and Revenues for the Initial Marketing Conditions and the 1975 Spatial Equilibrium Utilizing All Maine Determined Parameters

	INITIAL MARKETING CONDITIONS			SPATIAL EQUILIBRIUM		
Summary Factor	Cost Or Revenue ($)	Factor In Dollars Per Dollars Of Total Revenue	Factor In Dollars Per Dollars Of Total Cost	Cost Or Revenue ($)	Factor In Dollars Per Dollar Of Total Revenue	Factor In Dollars Per Dollar Of Total Cost
Total Assembly Cost	2,096,944	0.03	0.09	1,960,624	0.03	0.09
Total Processing Cost	7,935,622	0.10	0.32	8,097,587	0.11	0.35
Total Retailing Cost	14,357,029	0.18	0.59	12,773,652	0.17	0.56
Total Cost	24,389,596	0.31	1.00	22,831,864	0.31	1.00
Total Value at Farm[1] of Class I Sales	51,086,066	0.64	†	46,897,704	0.64	†
Total Value at Farm of Class II Sales	4,333,340	0.05	†	3,874,180	0.06	†
Total Value of All Sales at Farm[2]	55,419,406	0.69	†	50,771,884	0.69	†
Total Value at Plant of Class I Sales[1]	53,183,012	0.67	†	48,858,328	0.62	†
Total Value of Retail Class I Sales[3]	75,475,664	0.95	†	69,729,568	0.95	†
Total Revenue	79,809,002	1.00	†	73,603,748	1.00	†

[1] Includes out-of-state sales through Newport.
[2] Includes Class I and Class II and out-of-state sales.
[3] Represents out-of-state sales and retail Class I sales.
†Computation of this figure would be meaningless.

TABLE 13
Summary of Supply Area Shipments and Net Revenues For All 1975 Initial and Spatial Marketing Simulations

Marketing Simulation	Average Shipment Per Supply Area (cwt)	Average Net Supply Area Revenue ($/cwt)
Initial — All Maine Parameters	109,091	$ 9.24
Spatial — All Maine Parameters	105,263	8.46
Initial — Optimal Assembly Cost Parameter	111,111	9.29
Spatial — Optimal Assembly Cost Parameter	107,143	8.46
Initial — Optimal Processing Cost Parameter	109,091	9.14
Spatial — Optimal Processing Cost Parameter	103,448	8.41
Initial — Optimal Assembly and Processing Cost Parameters	109,091	9.20
Spatial — Optimal Assembly and Processing Cost Parameters	109,091	8.41
Initial — 0% Assembly Cost Increase	109,091	9.24
Initial — 25% Assembly Cost Increase	109,091	9.15
Initial — 50% Assembly Cost Increase	109,091	9.07
Initial — 75% Assembly Cost Increase	109,091	8.98
Initial — 100% Assembly Cost Increase	109,091	8.89
Spatial — 0% Assembly Cost Increase	105,263	8.46
Spatial — 25% Assembly Cost Increase	107,143	8.41
Spatial — 50% Assembly Cost Increase	115,385	8.39
Spatial — 75% Assembly Cost Increase	105,263	8.44
Spatial — 100% Assembly Cost Increase	107,143	8.42

TABLE 14
Summary of Costs and Revenues For All 1975 Initial and Spatial Marketing Simulations

Marketing Simulation	Total Revenue ($)	Total Farm Revenue ($)	Total Cost ($)	Total Assembly Cost ($)	Total Processing Cost ($)	Total Retailing Cost ($)
Initial — All Maine Parameters	79,809,002	55,419,406	24,389,596	2,096,944	7,935,622	14,357,029
Spatial — All Maine Parameters	73,603,748	50,771,884	22,831,864	1,960,624	8,097,587	12,773,652
Initial — Optimal Assembly Cost Parameter	79,809,002	55,747,817	24,061,185	1,768,533	7,935,622	14,357,029
Spatial — Optimal Assembly Cost Parameter	73,285,493	50,778,245	22,507,249	1,707,796	8,106,326	12,693,127
Initial — Optimal Processing Cost Parameter	79,817,011	54,848,010	24,969,001	2,096,944	9,784,850	13,087,207
Spatial — Optimal Processing Cost Parameter	74,125,104	50,449,157	23,675,947	1,958,612	9,927,118	11,790,216
Initial — Optimal Assembly and Processing Cost Parameters	79,817,011	55,176,422	24,640,590	1,768,533	9,784,850	13,087,207
Spatial — Optimal Assembly and Processing Cost Parameters	73,837,913	50,468,272	23,369,640	1,705,443	9,935,407	11,728,790
Initial — 0% Assembly Cost Increase	79,809,002	55,419,406	24,389,596	2,096,944	7,935,622	14,357,029
Initial — 25% Assembly Cost Increase	79,809,002	54,896,116	24,912,886	2,620,235	7,935,622	14,357,029
Initial — 50% Assembly Cost Increase	79,809,002	54,398,212	25,410,790	3,118,138	7,935,622	14,357,029
Initial — 75% Assembly Cost Increase	79,809,002	53,868,560	25,940,442	3,647,790	7,935,622	14,357,029
Initial — 100% Assembly Cost Increase	79,809,002	53,345,713	26,463,289	4,170,635	7,935,622	14,357,029
Spatial — 0% Assembly Cost Increase	73,603,748	50,771,884	22,831,864	1,960,624	8,097,587	12,773,652
Spatial — 25% Assembly Cost Increase	73,858,381	50,438,783	23,419,598	2,490,470	8,090,496	12,838,632
Spatial — 50% Assembly Cost Increase	74,355,926	50,355,970	23,999,959	2,958,128	8,076,975	12,964,856
Spatial — 75% Assembly Cost Increase	75,317,807	50,648,411	24,669,396	3,407,607	8,051,850	13,209,939
Spatial — 100% Assembly Cost Increase	75,818,573	50,531,832	25,286,706	3,913,024	8,038,118	13,335,564

TABLE 15
Summary of Processing and Demand Characteristics For All 1975
Initial and Spatial Marketing Simulations

Marketing Simulation	Class II Assign-ment (cwt)	Average Processing Cost ($/cwt)	Average Retailing Cost ($/cwt)	Average Retail Price ($/cwt)
Initial — All Maine Parameters	564,237	$2.81	$5.08	$18.48
Spatial — All Maine Parameters	504,450	2.81	4.43	16.10
Initial — Optimal Assembly Cost Parameter	564,237	2.81	5.08	18.48
Spatial — Optimal Assembly Cost Parameter	501,225	2.81	4.40	15.98
Initial — Optimal Processing Cost Parameter	564,237	3.46	4.64	18.48
Spatial — Optimal Processing Cost Parameter	509,644	3.45	4.10	16.30
Initial — Optimal Assembly and Processing Cost Parameters	564,237	3.46	4.64	18.48
Spatial — Optimal Assembly and Processing Cost Parameters	506,714	3.45	4.07	16.19
Initial — 0% Assembly Cost Increase	564,237	2.81	5.08	18.48
Initial — 25% Assembly Cost Increase	564,237	2.81	5.08	18.48
Initial — 50% Assembly Cost Increase	564,237	2.81	5.08	18.48
Initial — 75% Assembly Cost Increase	564,237	2.81	5.08	18.48
Initial — 100% Assembly Cost Increase	564,237	2.81	5.08	18.48
Spatial — 0% Assembly Cost Increase	504,450	2.81	4.43	16.10
Spatial — 25% Assembly Cost Increase	507,068	2.81	4.46	16.20
Spatial — 50% Assembly Cost Increase	512,059	2.81	4.51	16.38
Spatial — 75% Assembly Cost Increase	521,333	2.81	4.61	16.75
Spatial — 100% Assembly Cost Increase	526,406	2.81	4.66	16.94

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