CORNELL
AGRICULTURAL ECONOMICS
STAFF PAPER

PLANT LOCATION AND MONOPSONISTIC PRICING:

THE MILK INDUSTRY IN THE NORTHEAST

by

James E. Pratt

May 1989

No. 89-20

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York, 14853

Preface

James Pratt is an Assistant Professor in the Department of Agricultural Economics, Cornell University. This paper was presented to the Seventeenth Annual Meeting of the Northeast Regional Science Association, October 7-8, 1988, Cornell University, Ithaca, New York.

Computations were conducted using the Cornell National Supercomputer Facility, a resource of the Center for Theory and Simulation in Science and Engineering at Cornell University. The Center is funded in part by the National Science Foundation, New York State, and the IBM Corporation and members of the Corporate Research Institute.

Additional copies of this paper can be obtained from the author at the following address:

Department of Agricultural Economics
Cornell University
314 Warren Hall
Ithaca, New York 14853-7801

PLANT LOCATION AND MONOPSONISTIC PRICING:

THE MILK INDUSTRY IN THE NORTHEAST

by

James E. Pratt

The topic which I would like to address today might alternatively be described as "determining location differentials for Class I milk within a federal milk marketing order" or more generally described as "the spatial pricing of milk within a milkshed".

I'd like to proceed by 1) briefly reviewing the perceived problem: a) describing the spatial characteristics of the northeast dairy industry, b) outlining the argument for the perception of an inefficiently organized spatial structure, and c) briefly describing the role of federal milk marketing orders in determining the locational value of milk. Next, I'll 2) describe the elements of a general spatial micro-economic model which are relevant to the perceived problem: a) reviewing the historical evolution of the model, b) describing one of its important core elements--spatial demand, c) presenting three simple pricing systems which are derived from the spatial model, and d) making some observations about the history of spatial milk prices in the northeast. Finally, I'll 3) describe a mathematical programming model of the northeastern United States dairy sector which is used to investigate the potential impacts of implementing alternative spatial pricing systems and present results of analyzing the impacts of specifying laternative spatial pricing systems.

1. THE NORTHEAST DAIRY INDUSTRY

A. Spatial Characteristics

Figure 1 presents the relative geographic distribution of farm milk in the northeast in 1980. Based on 236 points representing single counties or aggregations of counties in a 308-county area of the northeast, it can be seen that relatively large supplies were located in northern Vermont, western/central/northern New York, in southeastern Pennsylvania/northern Maryland, and along the northern Pennsylvania tier. Smaller sources of supply were located throughout much of the area.

Figure 2 presents the relative geographic distribution of population in the same area for 1980. Based on 141 points representing single or multiple counties, it can be seen that population was concentrated in a corridor from Boston to Washington, D.C., with inland population centers along the Erie Canal, Syracuse-Rochester-Buffalo, and around Pittsburgh and Cleveland.

Three categories of dairy products are defined for this study, Classes I, II, and III (Table 1). Dairy products which are included in each class are chosen primarily along the lines of storability and weight reduction, with the least storable/least weight-reduced products in Class I and the most storable/most weight-reduced products in Class III.

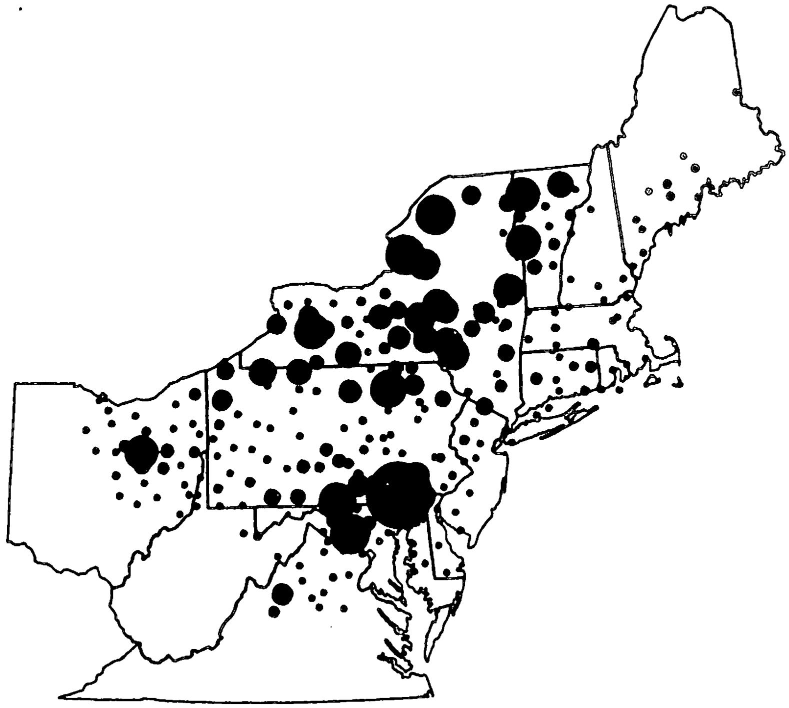

FIGURE 1: Spatial Distribution of Farm Milk Supplies, 1980.

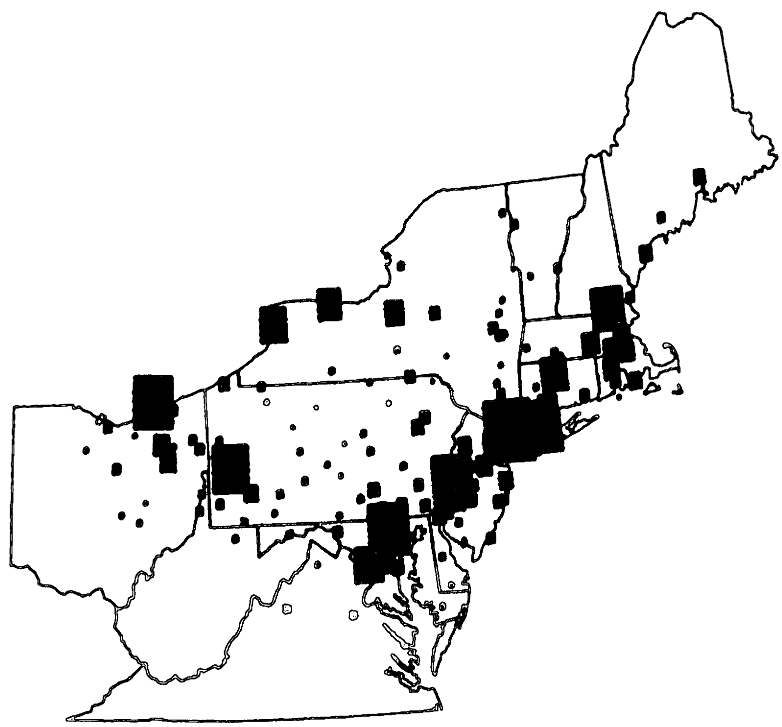

FIGURE 2: Spatial Distribution of Population, 1980.

Table 1. Products Included in Demand Categories

Category	Included Products
Class I	Fluid Whole Milk Lowfat Milk (includes 2%, skim, buttermilk, flavored milk drinks, and yogurt)
Class II	Cream (includes half and half, light cream, heavy cream, and sour cream Cottage Cheese Frozen Desserts (includes ice cream, ice milk, sherbet, and other frozen products)
Class III	Butter Total Cheese (includes American, Swiss, and Italian) Evaporated Whole Milk Condensed Skim Milk Dry Whole Milk Nonfat Dry Milk (NDM) Dry Buttermilk Whey

In 1980, 595 dairy processing facilities were identified in the 308-county area of the northeast. Each plant was classified in one of the three dairy product classes according to its major activity. Figure 3 presents the city locations for Class I, fluid milk, processing facilities. Each triangle represents the locations of cities which had at least one Class I processing facility.

These plants were combined into groups of three or more, based on their geographic proximity. With the aid of the Dairy Division of the Agricultural Marketing Service in the U.S. Department of Agriculture, various State Departments of Agriculture, and university personnel in the northeast, estimates of plant milk throughput for 80 aggregated Class I processing locations were determined. Figure 4 presents the relative geographic distribution of Class I processing activity in 1980. The general pattern of Class I processing activity follows that of population with the Boston to Philadelphia corridor, Albany to Buffalo, Baltimore-Washington, and Pittsburgh and Cleveland representing major Class I processing areas.

The same procedure was followed for Class II, soft product, processing facilities. Figure 5 presents the city locations for Class II facilities. It should be noted here that Class II processing facilities, as defined in this study, could be alternatively described as "specialized" Class II processors. Class I plants often make some Class II products (creams, cottage cheese, etc.) to: 1) provide a full line of products to customers, and 2) to balance milk component use. The plants identified here are those which specialize in Class II products.

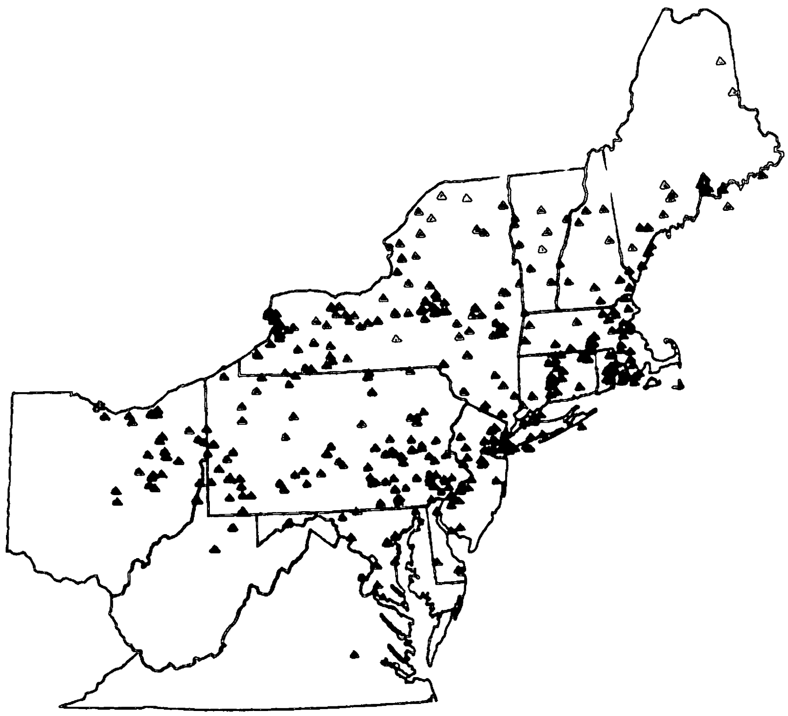

FIGURE 3: Actual City Locations of Class I Processing Facilities, 1980.

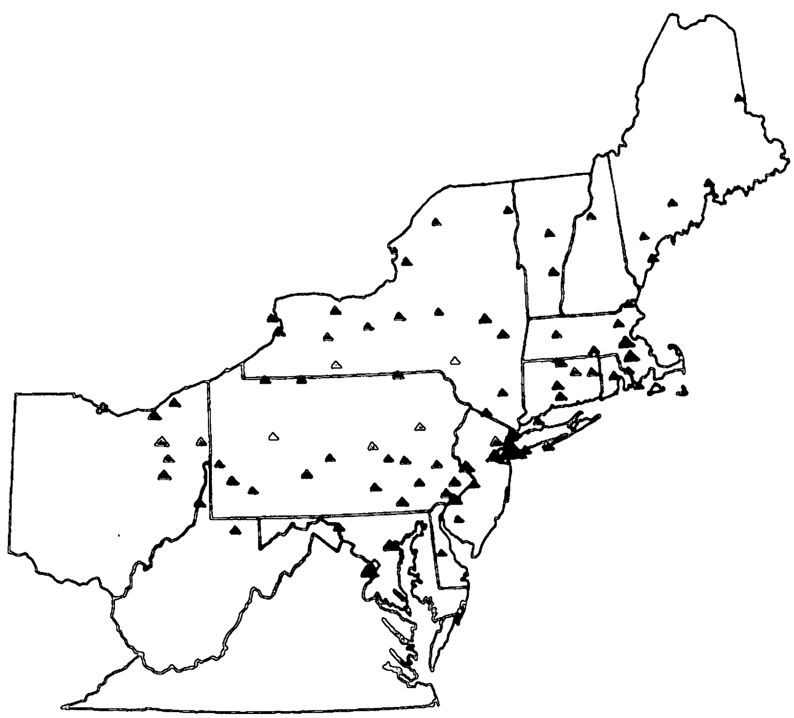

FIGURE 4: Locations of 80 Aggregated Class I Processing Centers.

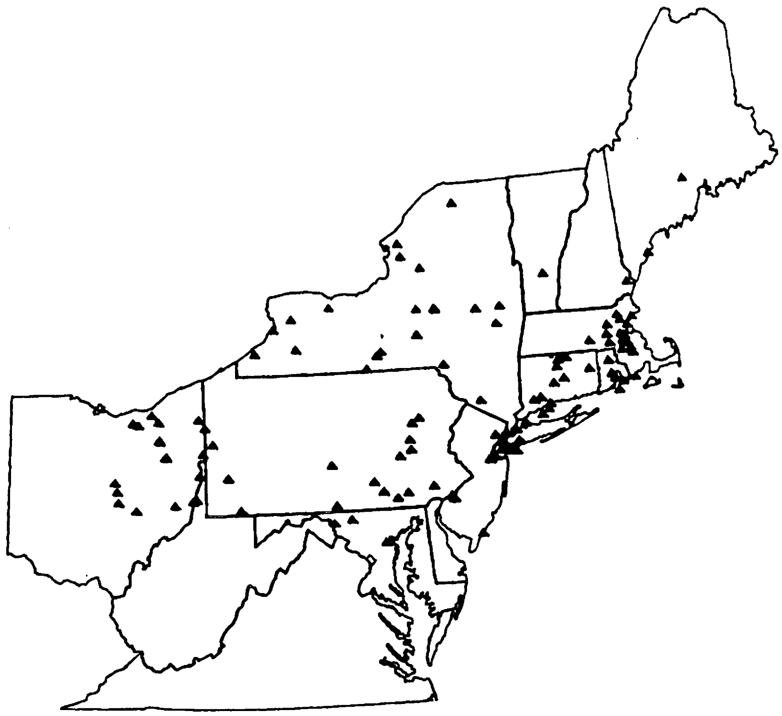

FIGURE 5. Actual City Locations of Class II Product Processing Facilities. (Each triangle represents one or more plants.)

The number of Class II plants can be seen to be distributed in the population corridor between Boston and New York City, along the Erie Canal, as well as near Cleveland, but also significant numbers of plants were located in the major supply areas of central and northern New York, southeastern Pennsylvania, and eastern Ohio.

Figure 6 presents the relative geographic distribution of Class II processing activity. There was a very wide range in individual plant activity and many smaller plants were aggregated to distant large-plant centers.

Figure 7 shows that the number of Class III processing facilities was concentrated in the major supply areas of northern Vermont, northern and western New York, southeastern Pennsylvania, and northeastern Ohio. While Class III facilities were also scattered among the major population centers, these tended to be very small plants representing small aggregate throughput, with the exceptions of central Massachusetts, New York City, and Philadelphia. Figure 8, presenting aggregate throughput, reflects this.

B. The Perceived Problem

A traditional model of location would predict that Class I milk processors, with relatively bulky and more costly transported products, would locate in areas close to population centers and obtain their farm milk supplies from the most local sources. Specialized Class II processors would locate outside these fluid milk zones, and Class III processors would locate near the sources of milk which are most distant from population centers.[1]

From the maps, it would be difficult to determine that this was not, in general, the case even though obvious exceptions existed. Discussions with state and federal officials charged with implementing various dairy industry regulatory programs, however, indicated clearly that their perceptions of an optimally organized spatial market were not met. They cited not only a judgment that much too much non-Class I processing was located near the major metropolitan areas in the study area, but also that fluid milk processors located near these centers obtained their milk from much too distant supply sources.

C. The Role of Federal Milk Marketing Orders

Federal Milk Marketing Orders (FMMOs) are legal instruments, authorized by the federal government to regulate the milk in a specific geographic area.[2] They are initiated by the Secretary of Agriculture after milk producers in the

---

[1]*Bressler, R.G. "Pricing Raw Product in Complex Milk Markets,"* *Agricultural Economic Research* *10:113-130, 1958.*

[2]*Kaiser, H.M. "A Primer on Federal Milk Marketing Orders in the United States,"* *Agricultural Economics Extension 86-15*. *Department of Agricultural Economics, Cornell University, Ithacva, N.Y., April 1986.*

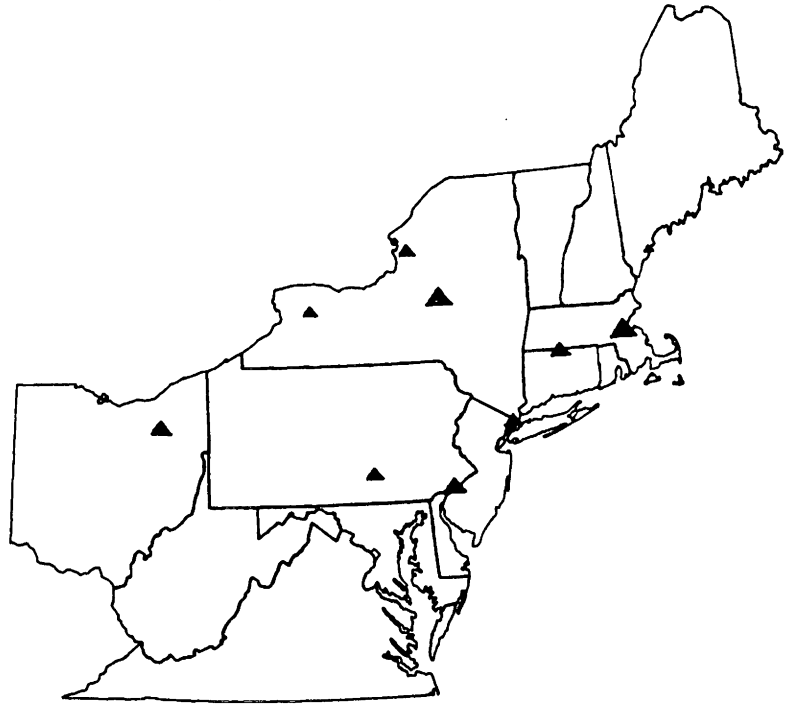

FIGURE 6. Locations of 10 Aggregated Class II Processing Centers. (Area of each triangle represents relative product processed.)

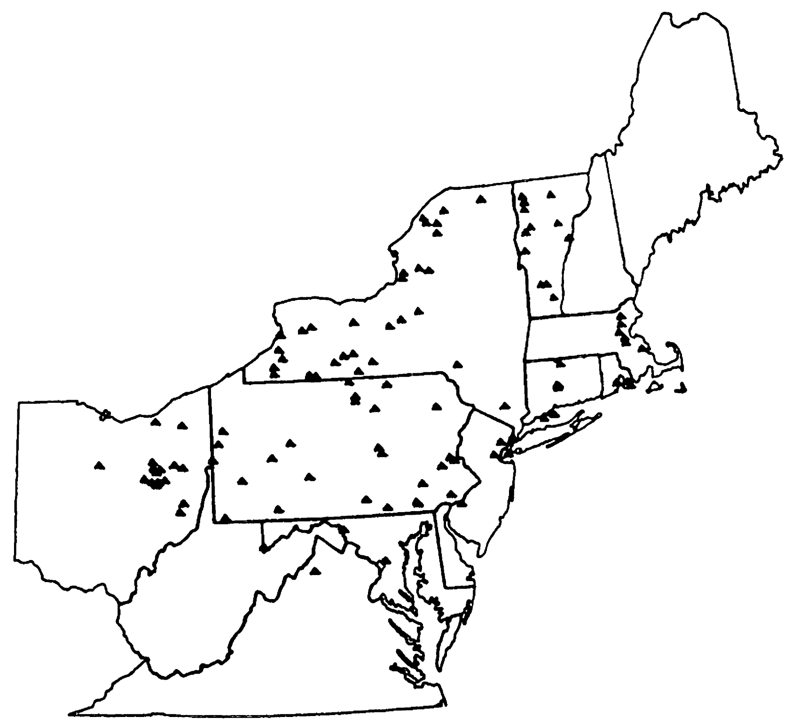

FIGURE 7. Actual City Locations of Class III Product Processing Facilities, 1980. (Each triangle represents one or more plants.)

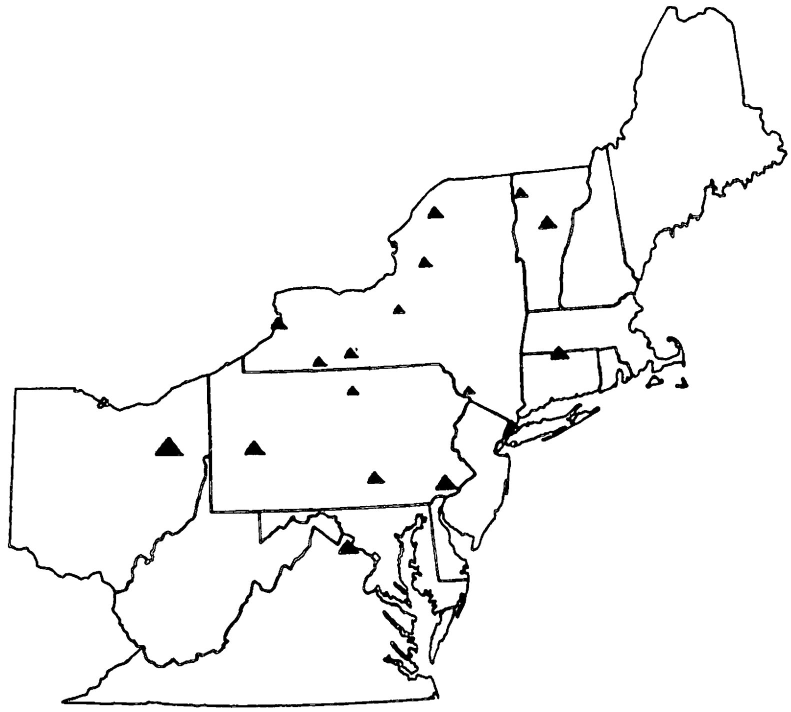

FIGURE 8. Locations of 17 Aggregated Class III Processing Centers. (Area of each triangle represents relative product processed.)

specific geographic area approve, by a two-thirds margin, a referendum calling for the establishment of an Order.

Processors are the focal point of most of the provisions which have been instituted under FMMOs. Processors are required to pay minimum prices for the milk which they purchase from farmers, based on the product classification in which the milk is used. This product-based discriminatory pricing results in Class I prices being highest and Class III prices being lowest.

Equity among farmers shipping to regulated processors is addressed through the practice of "pooling" the money receipts from regulated processors and redistributing these receipts to producers on the basis of the volumes of their respective shipments irregardless of the final class use of an individual producer's milk. In this way, each farmer receives a marketwide "blend" price, irrespective of the actual use of his milk.

Several sources of pricing differentials are used by FMMOs. Class prices paid by processors and blend prices received by producers are adjusted to reflect the butterfat content of products and of farmers' milk. Some FMMOs have instituted seasonal pricing plans to provide incentives for more efficient seasonal production patterns. Most orders implement a system of location differentials whereby adjustments are made to the minimum class prices on the basis of geographic location. These adjustments are applied to both Class I prices paid by processors and blend prices received by farmers. Class II and Class III prices are not adjusted. These location differentials provide for downward adjustments of prices paid by plants at increasing distances from the major consuming centers and they are intended to enhance competitiveness among processors and to provide an incentive for farmers to deliver milk to Class I plants located at or near market centers.

Location adjustments in FMMOs are typically linked to the cost of transporting farm milk to plants, but are most often set at rates which are less than the actual cost of transportation. Class I processors often find themselves in a position where additional payments must be made to farmers in order to attract the desired milk supplies.

II. A Spatial Micro-Economic Model

A. Evolution of the Model[3]

Building on the early work of Von Thünen and Weber and the later work of Lösch and Hoover, the "school of locational interdependence" has attempted to combine the cost-based models of economic activity and plant location with the demand-based models of market areas. They have expanded the framework to include: 1) freely moveable locations, and 2) more general forms of price reactions on the part of spatial rivals.

---

[3] *Greenhut, M.L. Plant Location in Theory and in Practice: the Economics of Space. University of North Carolina, Chapel Hill, 1956.*

B. Spatial Demand[4]

The nature of aggregate demand facing a firm operating in costly space is the point of departure for a simple spatial micro-economic model. The demand facing a firm operating in a spatial market cannot be presumed to be a horizontal summation of individual demands. In Figure 9, where

$$Q = x/b(a-(m+tD))^{1/x},$$

and where

Q = individual quantity demanded
m = the seller's mill price
t = a constant freight rate
D = buyer's distance from mill,
and a and b are positive constants,
where P = m+tD

at P^*, the elasticity of demand increases for each successively more distant buyer. When aggregated, these additional buyers increase the elasticity of aggregate demand.

In Figure 10, with a constant elasticity, at P^*, the elasticity of demand decreases for each successively more distant buyer. These decreases reduce the elasticity of the aggregate demand. Anything which causes a seller to lose or gain more distant buyers, changes aggregate demand elasticity.

C. **Three Spatial Pricing Systems**

Since a spatial market is characterized by differentiated individual demand, this provides a natural environment for the operation of a discriminating pricing system. The optimal direction of price discrimination (against nearby or distant buyers) is determined by whether or not demand schedules vanish at some finite price, and, if not, by the shape of the demand curve. If demand does vanish, discrimination is generally against nearby buyers. It is assumed in this study that discrimination is against nearby buyers.[5]

---

[4]*Greenhut, M.L., M. Hwang, and H. Ohta. "Observations on the Shape and Relevance of the Spatial Demand Function," Econometrica 43:669-682, 1975.*

Hotelling, H. "Stability in Competition," Economic Journal 39:41-57, 1929.

Smithies, A. "Optimum Location in Spatial Competition," Journal of Political Economy 49:423-439, 1941.

[5]*Greenhut, M. and H. Ohta. The Theory of Spatial Pricing and Market Areas. Duke University Press, Durham, N.C., 1975.*

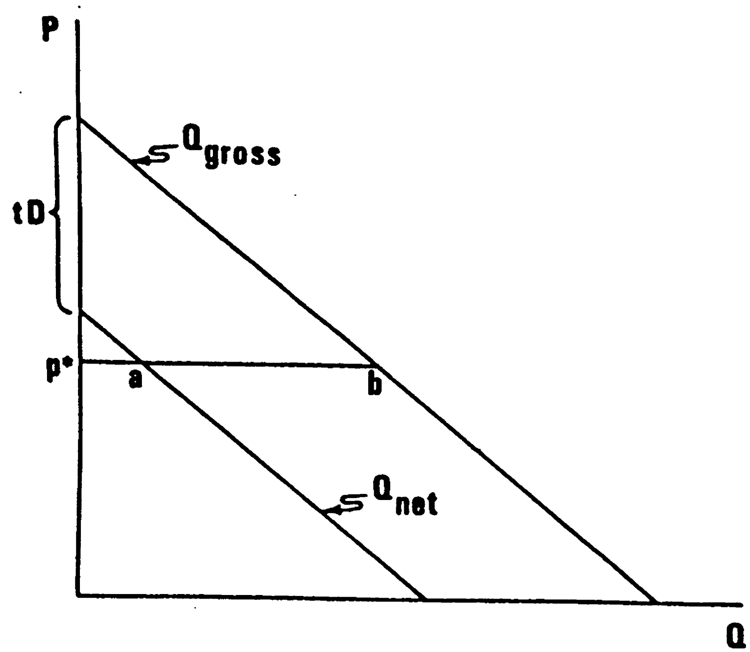

Figure 9. Individual Gross and Net Demand and Changing Elasticity; X=1

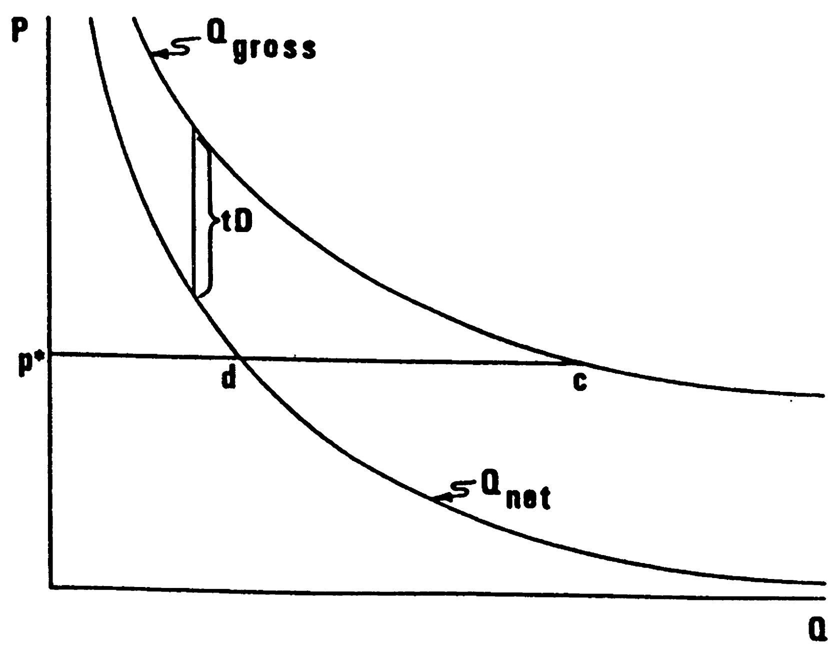

Figure 10. Individual Gross and Net Demand and Changing Elasticity; X= - 1/2

Solving for the optimal discriminatory price schedule[6] for a profit-maximizing spatial monopolist reveals that the price which the firm will charge each buyer will be independently chosen to equate marginal cost and marginal revenue for the net demand of each buyer. This will involve a degree of freight absorption. (For linear demand schedules, the firm will absorb 50% of the freight to each customer.)

A second spatial pricing system is one in which a firm quotes a single price which is effective at the firm's location, the familiar uniform mill pricing. For the profit-maximizing monopolist, the optimal mill price is dependent on the firm's costs, transportation costs, individual demand, and the spatial distribution of buyers. As with discriminatory pricing, the uniform mill pricing monopolist finds it advantageous to absorb some freight costs. (For linear demand, the firm will absorb 50% of the freight to the average distance customer.)

Finally, a spatial pricing system in which a firm quotes equal delivered prices to all buyers within the extent of his market may be described as uniform delivered pricing. Again, the profit-maximizing monopolist will determine this delivered price on the basis of his costs, transportation costs, individual demand, and the spatial distribution of buyers. He will again find it advantageous to absorb freight. (For linear demand, the firm will again absorb 50% of the freight to the average distance customer making this system identical to uniform mill for this special case.)

In each of these three general spatial pricing systems, the local monopolist finds it advantageous to quote prices, either mill or delivered, which reflect his willingness to absorb some portion of freight costs involved in delivering a good/service to his distant customers. Similar results are obtained for a spatial monopsonist.

D. Observations on the History of Transportation and Spatial Pricing of Milk in the Northeast

Price discrimination in milk markets is nothing new to the dairy industry. Classified pricing is fundamentally a discriminatory pricing system which is widely accepted and at least partially understood by many of the participants in the marketing of milk. Spatial discriminatory pricing in milk markets has an even longer history.

In their "Economic History of Milk Marketing and Pricing--1800-1933" (a detailed history of milk marketing in the northeast), Leland Spencer and Charles Blanford point out that from about 1840-1897, it was customary for the railroads to charge a uniform rate per 40-quart can without regard to distance shipped. At this same time, processors were offering uniform prices.

---

[6] *Hsu, S. Contributions to Spatial Price Theory. Ph.D. thesis, University of Pennsylvania, 1981.*

"When all milk shipments to New York originated within 80 miles or so of the market, it did not seem unreasonable to charge a uniform freight rate without regard to distance. When the railroads extended their milk shipping service to more distant areas without additional charge, however, producers in nearby counties complained that they were being exposed to unfair competition. After several years of agitation, the Interstate Commerce Commission was persuaded, in 1897, to establish a four-zone system of graduated rates.

"At the time the four-zone system of freight rates was established (in 1897), little milk was being shipped from points more than 200 miles from the city. As we have seen, however, the railroads continued to extend their milk shipping service to more distant areas, up to 400 miles or so from the market. By 1916, great quantities of milk were being shipped from the territory lying 200 to 400 miles from New York. Consequently, producers in the areas closer to the market demanded that the rate schedule be revised to provide for lower charges on milk shipped from nearby districts and higher charges on milk shipped from distant sources. The ICC responded to those demands by conducting an investigation and finally issuing an order which established a 10-mile zone system of rates, effective in October 1917."[7]

These 10-mile zones are still used in the northeast FMMOs.

As the ICC moved to eliminate, or at least diminish, the discriminatory practices of the railroads toward milk shippers, New York City metropolitan dealers began pricing systems which were no longer uniform, but were differentiated by a shipper's location.

The considerable market power possessed by fluid milk processors versus individual farmers in local markets was one of the primary issues which led to the promulgation of the FMMO system during the 1930s.

III. The Northeast Dairy Sector Simulator

The Northeast Dairy Sector Simulator (NEDSS)[8] was constructed under the auspices of the NE-126 Regional Research Committee to provide a means of analyzing changes in the spatial organization of the dairy industry in the northeast.

---

[7] *Spencer, L. and C. Blanford. An Economic History of Milk Marketing and Pricing: 1800-1933. Grid, Inc., Columbus, Ohio, 1977.*

[8] *Pratt, J., A. Novakovic, G. Elterich, D. Hahn, B. Smith, and G. Criner. "An Analysis of the Spatial Organization of the Northeast Dairy Industry," Search: Agriculture. Cornell University Agricultural Experiment Station, Ithaca, N.Y., No. 32, 1986.*

NEDSS is a transshipment and plant location model that combines network flow and facilities location methods. The model draws on the plant location formulation described by King and Logan[9] in 1964 and on spatial dairy models of Beck and Goodin,[10] Boehm and Conner,[11] Buccola and Conner,[12] Kloth and Blakley,[13] McDowell,[14] and Thomas and DeHaven.[15] It also builds on the plant location work of Fuller et al.[16] and on the dairy sector work of Babb et al.[17] and Novakovic et al.[18]

---

[9]*King, G. and S. Logan. "Optimum Location, Number and Size of Processing Plants with Raw Product and Final Product Shipments," Journal of Farm Economics 46:904-108, 1964.*

[10]*Beck, R. and J. Goodin. "Optimum Number and Location of Manufacturing Milk Plants to Minimize Marketing Costs," Southern Journal of Agricultural Economics, 103-108, 1980.*

[11]*Boehm, W. and M. Conner. "Technically Efficient Milk Assembly and Hard Product Processing for the Southeastern Dairy Industry," Res. Div. Bul. 120, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1976.*

[12]*Buccola, S. and M. Conner. "Potential Efficiencies Through Coordination of Milk Assembly and Milk Manufacturing Plant Location in the Northeastern United States," Res. Div. Bul. 149, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1979.*

[13]*Kloth, D. and L. Blakley. "Optimum Dairy Plant Location with Economies of Size and Market Share," American Journal of Agricultural Economics 53: 461-466, 1971.*

[14]*McDowell, F. Technically Efficient Dairy marketing in the Southeast. M.S. thesis, Department of Agricultural Economics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1978.*

[15]*Thomas, W. and R. DeHaven. "Optimum Number, Size, and Location of Fluid Milk Processing Plants in South Carolina," Bulletin No. 603, South Carolina Agricultural Experiment Station, Clemson University, Clemson, South Carolina, 1977.*

[16]*Fuller, S., P. Randolph, and D. Klingman. "Optimizing Subindustry Marketing Organizations: A Network Analysis Approach," American Journal of Agricultural Economics 58:425-436, 1976.*

[17]*Babb, E., D. Banker, O. Goldman, D. Martella, and J. Pratt. Economic Model of Federal Milk Marketing Order Policy Simulator - Model A, Station Bulletin No. 158, Department of Agricultural Economics, Purdue University, Lafayette, Indiana, 1977.*

[18]*Novakovic, A., E. Babb, D. Martella, and J. Pratt. "An Economic and Mathematical Description of the Dairy Policy Simulator," A.E. Res. 80-21, Cornell University Agricultural Experiment Station, Ithaca, N.Y., 1980.*

NEDSS differs from its predecessors in the degree of its spatial disaggregation. It is highly disaggregated. Typically, dairy plant location models have been forced to seriously restrict the size of the problems which they analyzed. This usually resulted in severely limiting the number of possible supply or processing points to be considered or limiting the analysis to only one of the storability classes. In many previous analyses, the movements of processed products to consumption locations were ignored.

The northeast dairy industry is viewed at three market levels in NEDSS: supply, processing, and consumption. The farm milk supply is assumed to be homogenous with respect to quality and composition and suitable as input for any processed dairy product. At the processing level, milk is assumed to be processed into one of the three dairy product classes previously defined. All three product groups are assumed to be consumed at the retail level.

The problem solved by NEDSS can be described as a transshipment problem in which there are supply, demand, and transshipment nodes having positive, negative, and zero supply, respectively. In NEDSS, there are directed arcs connecting nodes which are assigned appropriate non-negative costs and capacities.

Figure 11 depicts the network structure of NEDSS. Local raw milk is aggregated at the farm level to 236 geographic centers previously shown in Figure 1. These centers correspond to the supply nodes in the transshipment model. A single non-local supply node is also used which gives a total of 237 sources of farm milk. As in the case of farm milk supplies, dairy processing plants are grouped into processing centers which were previously depicted in Figures 4, 6, and 8. Each product class forms a subset of the transshipment nodes and each processing center may be limited as to the amount of raw milk which may be processed. When solved in an unconstrained, uncapacitated mode, processing of each class of product is allowed to take place at any of 284 local and one non-local geographic points.

Consumption of each product class is also grouped geographically into 141 centers previously depicted in Figure 2. These centers correspond to the consumption nodes in Figure 11 with each center consuming amounts of each of the three product classes.

Transportation costs associated with shipments of farm milk to processors, as well as with shipments of the finished products to consumption centers were estimated for 1980. Processing costs associated with each processing center, by product type, were also estimated, as were production and consumption quantities at supply and consumption centers.

NEDSS is solved when a set of shipments for farm milk and processed products is found which satisfies the supply, consumption, and processing (if any) restrictions, while minimizing transportation and processing costs.

For the network, there are a total of 324,705 arcs and 2,370 nodes, a very large problem. A special purpose algorithm, which was a modification of a

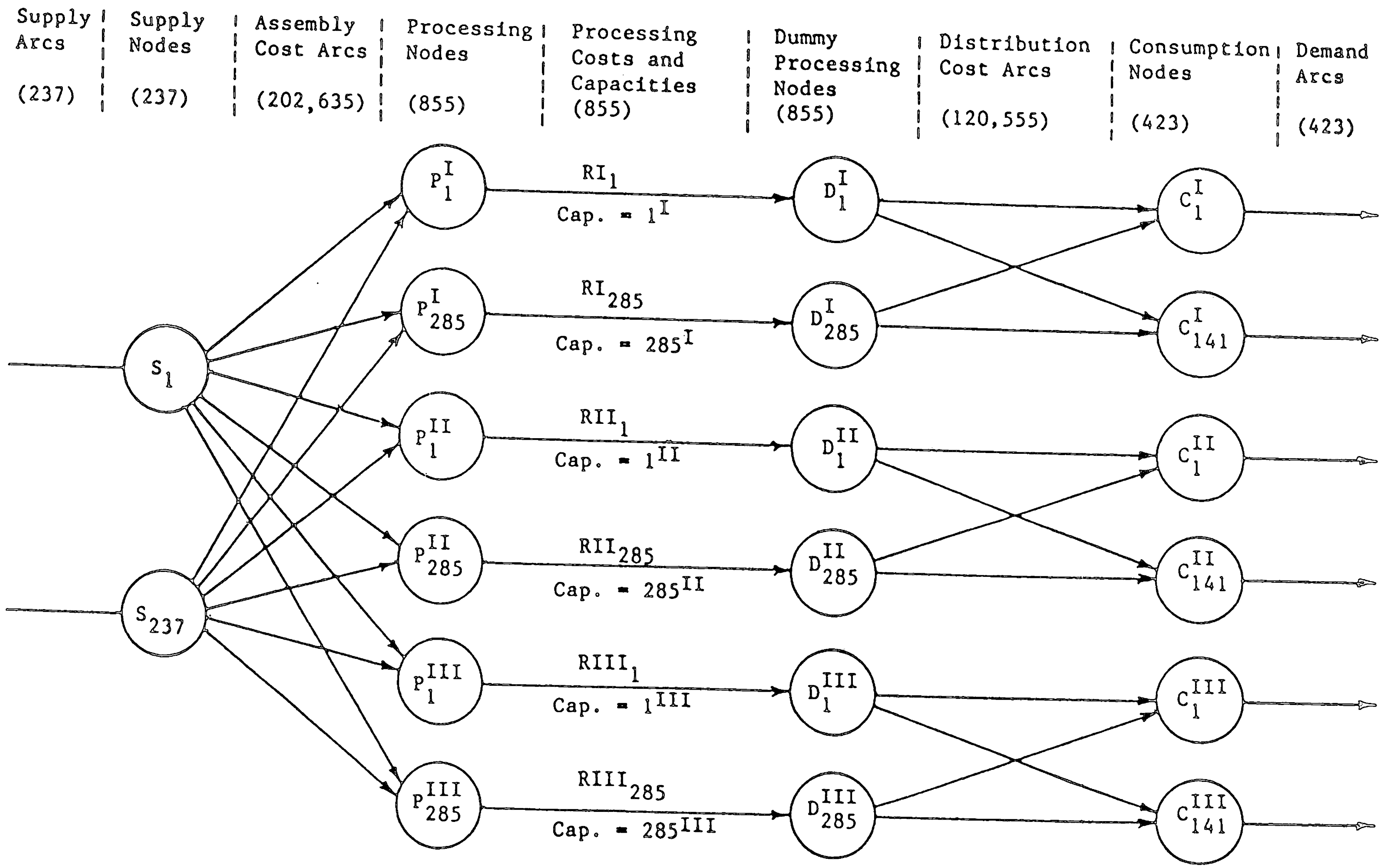

Figure 11. Network Representation of NEDSS

network flow algorithm, was developed by David Jensen[19]. It takes advantage of the network structure of NEDSS, the unique structure of this application (four bipartite networks), and the small percentage of uncapacitated arcs.

To provide a standard of comparison, a total cost minimizing solution is determined. In this problem, the markets for all three storability classes are assumed to function in concert to minimize total marketing costs. Table 2 reports total marketing cost by class and by market function and Figures 12-17 depict the flows of milk and processed products and the locations of processing facilities predicted by this cost-minimizing solution. The consumption orientation of Class I processing is apparent from the relatively large number of processing sites and distinct farm milk assembly movements and fewer Class I product distribution movements. Class II and Class III plants locate at a distance from the major consuming areas, toward the major sources of milk supplies, minimizing the number and distance of relatively expensive milk assembly movements.

To model the three alternative spatial pricing scenarios discussed earlier, the costs of farm milk movements to Class I plants is modified. In the case of discriminatory pricing, the cost of milk assembly which is actually faced by Class I processors, i.e., the costs on the supply to Class I processing arcs in NEDSS, is taken as a fixed percent of actual transportation costs. The calculated actual marketing costs results of a scenario, where Class I processors make decisions on the basis of a discriminatory price with 30% freight absorption, are presented in Table 2. Milk and product flows are depicted in Figures 18-23. The 30% rate is close to the difference between actual transportation costs and the location differentials in effect in the northeast in 1980, where the differentials reflected only 70% of actual costs and Class I processors would need to make up the difference to encourage farmers, who pay the milk haulers to transport their milk, to ship.

Relative to the base solution, discriminatory pricing with a 30% rate of absorption resulted in more Class I processing locations with longer assembly distances and shorter distribution distances, which are reflected in the increased assembly and slightly decreased distribution costs when compared to the base solution.

Class II markets experienced drastically reduced distribution costs and slightly reduced assembly costs and Class III markets experienced slightly reduced distribution with nearly equal assembly costs.

Figure 21, when compared to Figure 15 depicting specialized Class II plant locations and milk assembly movements, demonstrates why Class II costs changed. Under the discriminatory pricing scenario, Class II processors are given incentives to move closer to the major metropolitan areas and assemble local milk, thus reducing their distribution costs without incurring higher assembly costs.

---

[19] *Jensen, D. <u>Coloring and Duality: Combinatorial Augmentation Methods</u>. Ph.D. thesis, Cornell University, 1985.*

Table 2. Total Marketing Cost Comparison: Three Spatial Pricing Scenarios

Pricing Scenario	PROCESSING Classes I	II	III	TOTAL	ASSEMBLY Classes I	II	III	TOTAL	DISTRIBUTION Classes I	II	III	TOTAL	TOTAL
							($1,000)						
Base	40,105	5,892	9,522	55,519	7,782	584	1,972	10,338	39,644	898	2,329	42,871	108,728
Discriminatory	40,329	5,899	9,517	55,745	10,275	566	1,985	12,826	38,961	495	2,306	41,762	110,333
(% of Base)	100.6	100.1	99.9	100.4	132.0	97	100.7	124.1	98.3	55	99.0	97.4	101.5
Uniform Mill	40,132	5,762	9,629	55,523	9,156	465	2,216	11,837	39,602	909	2,235	42,746	110,106
(% of Base)	100.1	97.8	101.7	100.0	117.7	80	112.4	114.5	99.9	101	96.0	99.7	101.3
Uniform Delivered	40,333	5,879	9,472	55,684	9,805	553	2,208	12,566	39,104	803	2,312	42,219	110,469
(% of Base)	100.6	99.8	99.5	100.3	125.0	95	112.0	121.6	98.6	89	99.3	98.5	101.6

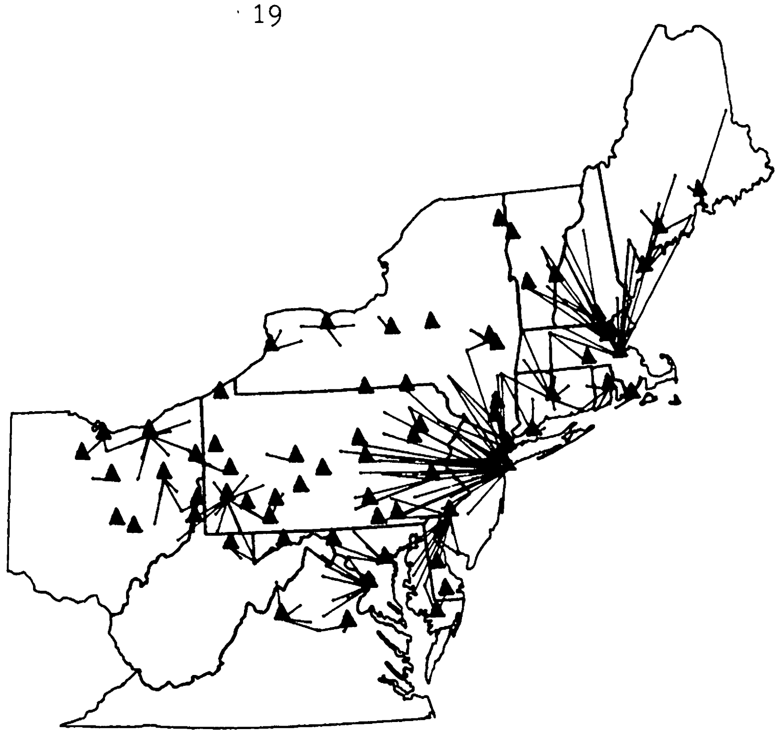

FIGURE 12. Class I Assembly Movements: Base.

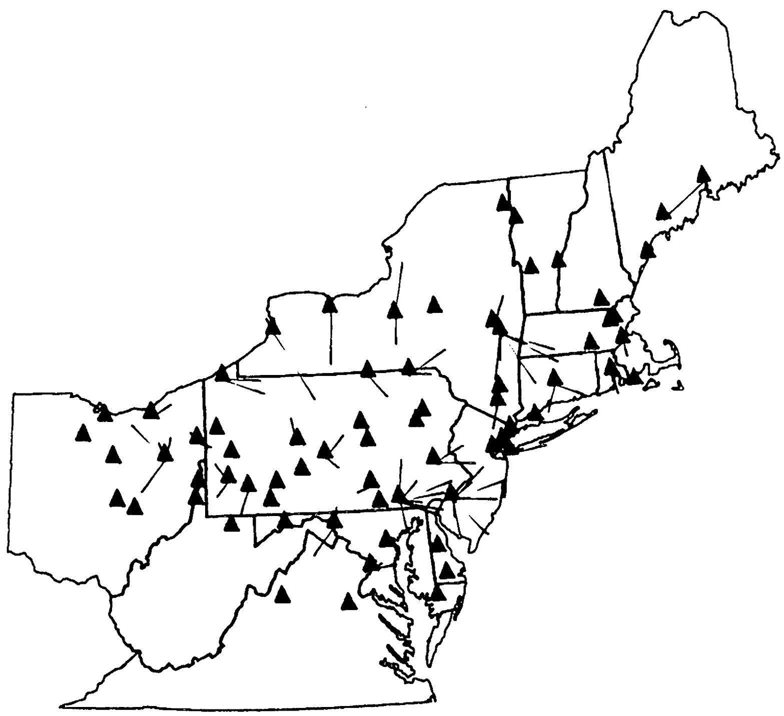

FIGURE 13. Class I Distribution Movements: Base.

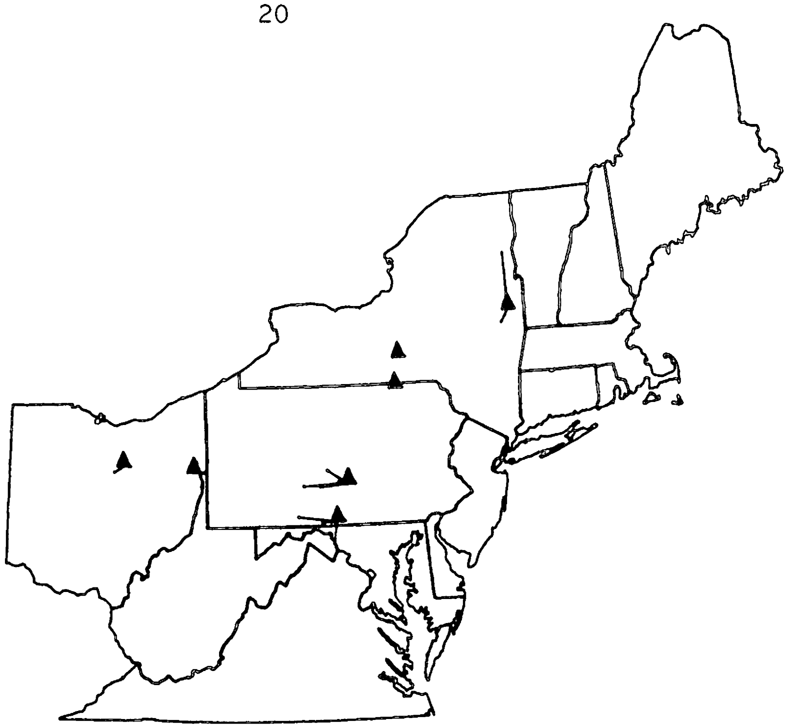

FIGURE 14. Class II Assembly Movements: Base.

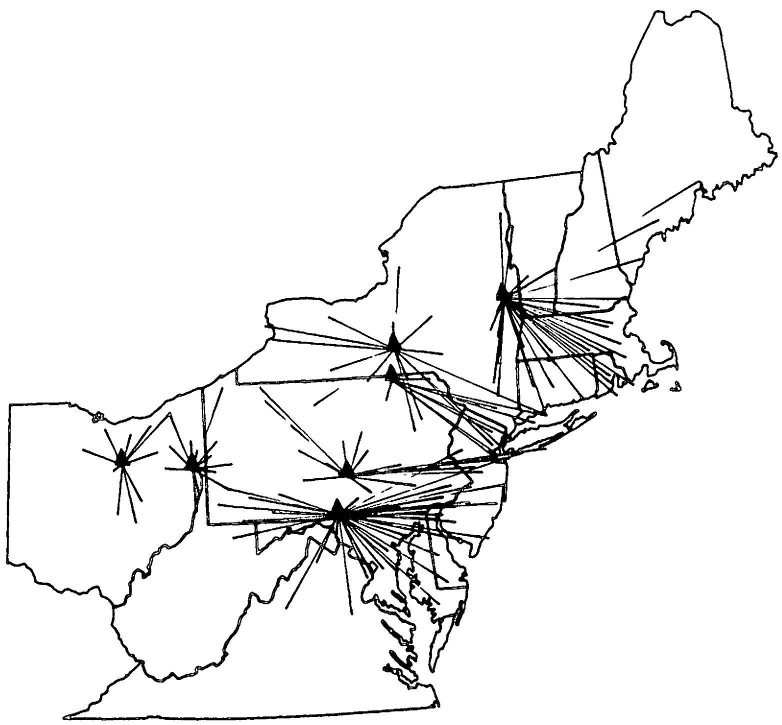

FIGURE 15. Class II Distribution Movements: Base.

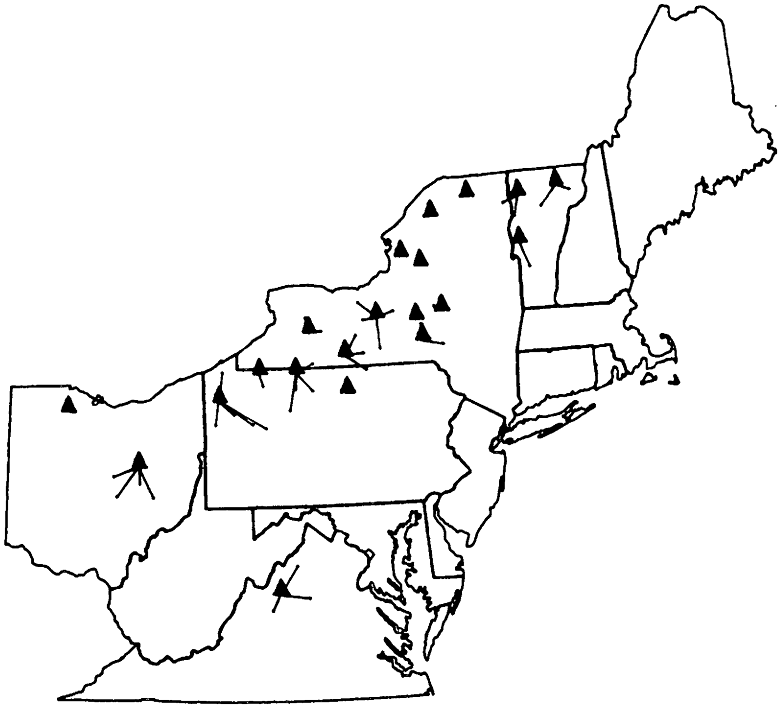

FIGURE 16. Class III Assembly Movements: Base.

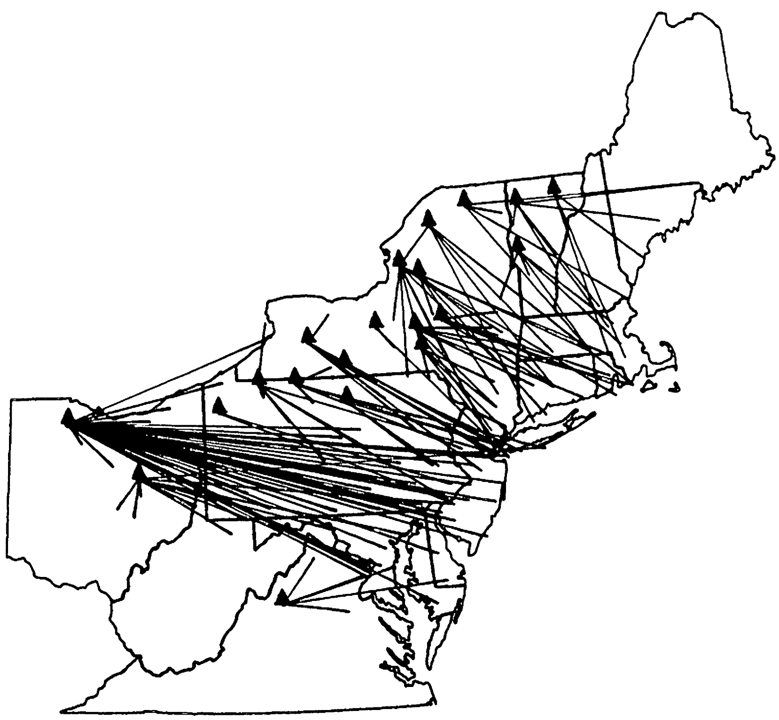

FIGURE 17. Class III Distribution Movements: Base.

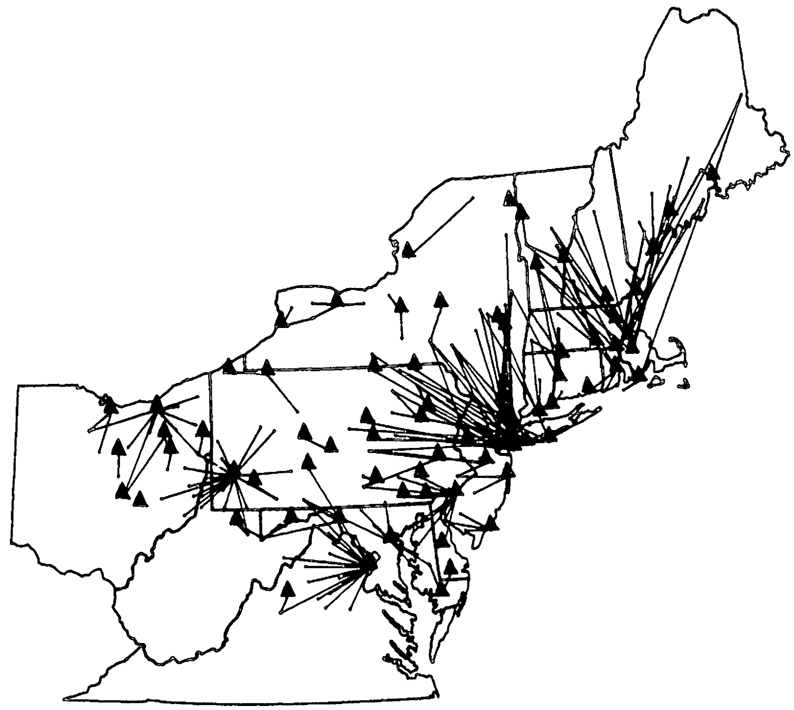

FIGURE 18. Class I Assembly Movements: Discriminatory Pricing.

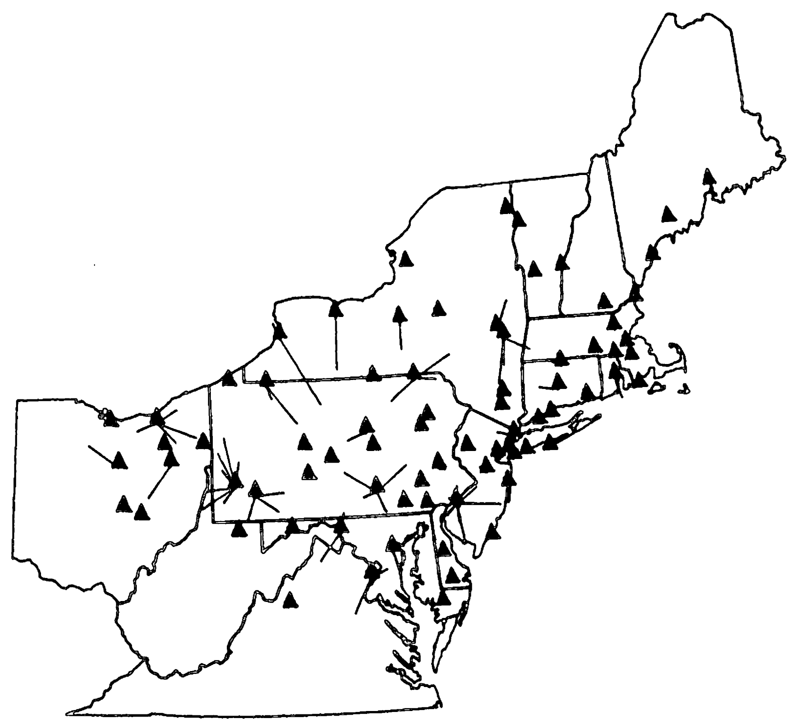

FIGURE 19. Class I Distribution Movements: Discriminatory Pricing.

FIGURE 20. Class II Assembly Movements: Discriminatory Pricing.

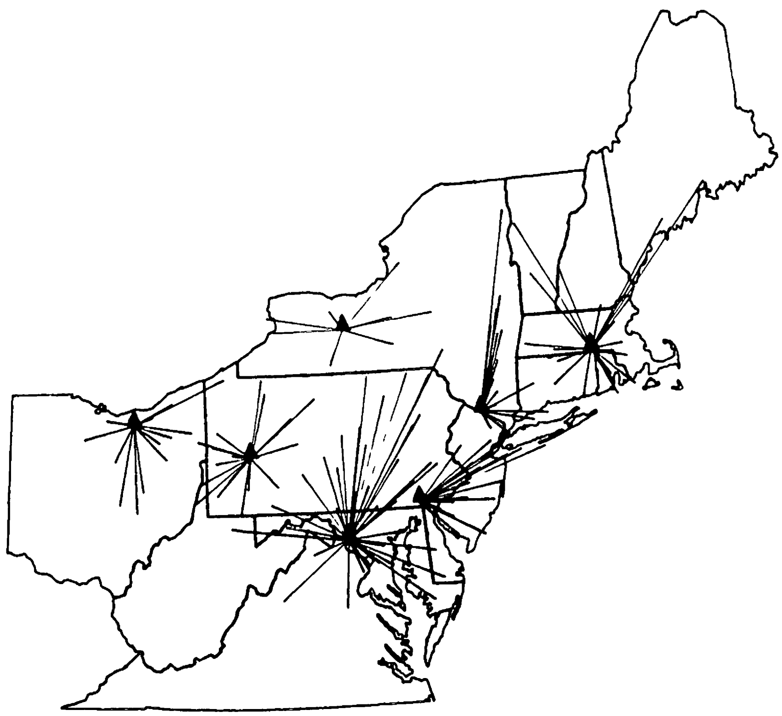

FIGURE 21. Class II Distribution Movements: Discriminatory Pricing.

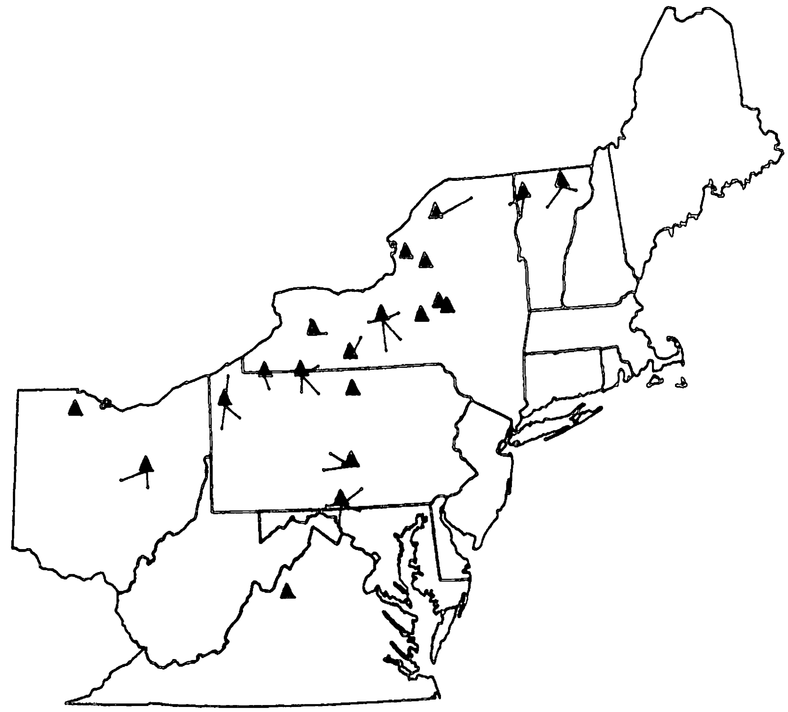

FIGURE 22. Class III Assembly Movements: Discriminatory Pricing.

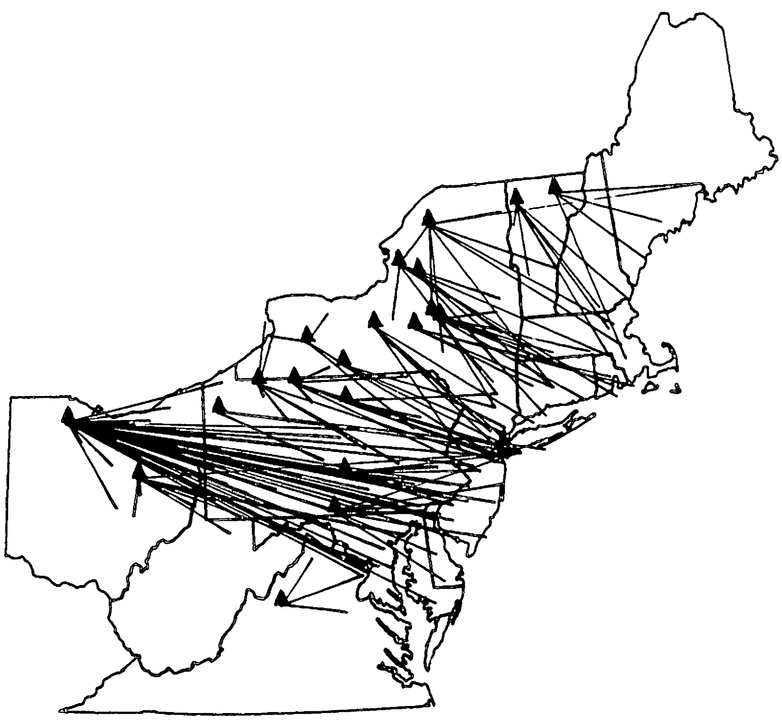

FIGURE 23. Class III Distribution Movements: Discriminatory Pricing.

In the case of uniform mill pricing, Class I transportation costs are again modified, in this case, to reflect a spatial pricing scenario where Class I processors will bear a constant amount of the transportation costs. To facilitate comparisons, a constant level of +129¢ is chosen. For this level, total marketing costs for the uniform mill pricing solution approximates that of the 30% freight absorbing discriminatory solution. Each Class I farm milk movement is the minimum of actual costs or $1.29. A solution is generated, and the actual marketing costs of this system are calculated and reported in Table 2 and Figures 24-29.

Uniform mill pricing with a $1.29 constant rate of absorption results in lower assembly costs for Class I and Class II and higher costs for Class III relative to the discriminatory, 30% freight absorption solution. Class I processors locate near major population centers as in the base and discriminatory solutions and Class II processors locate in areas more closely resembling the base rather than the discriminatory solution, Figure 27. Class III processors again locate near the major supply centers.

For uniform delivered pricing, Class I transportation costs are modified to reflect a spatial pricing system whereby Class I processors will again bear a constant amount of the transportation costs. In this case, each Class I farm milk movement is the maximum of zero or actual costs minus 60¢. A solution is generated and the actual marketing costs of this system are calculated and reported in Table 2 and Figures 30-35.

Relative to discriminatory pricing with 30% absorption, uniform delivered pricing with 60¢ absorption results in slightly lower assembly costs for Class II and lower assembly costs for Class I. Higher assembly costs result for Class III. Class I and Class III distribution costs are slightly higher and Class II distribution costs are much higher. Figure 33 shows that Class II processing locations are much the same as base and uniform mill pricing.

All three pricing scenarios result in increased Class I assembly costs over the base, cost-minimizing solution. This is not surprising given that Class I processors remain consumption center oriented under each pricing scenario. These increased costs are all results of increased assembly distances, i.e., more distant supplies for Class I processors. Class III processors remain supply center oriented under all pricing scenarios, but, under discriminatory pricing, Class II processors find it possible and advantageous to locate inside the milk assembly regions of Class I processors.

Freight absorbing spatial pricing is a natural occurrence in monopsonistic spatial markets. Specifying alternative pricing scenarios which involve freight absorption on the part of Class I processors all result in higher Class I assembly costs than in a cost-minimizing case, reflecting expanded milk supply areas for these processors. For the case of discriminatory pricing, which most closely resembles the actual pricing rules used in FMMOs, Class II processors also find it advantageous to move closer to the major consumption centers. This matches the perception of "inefficient" organization noted by industry observers.

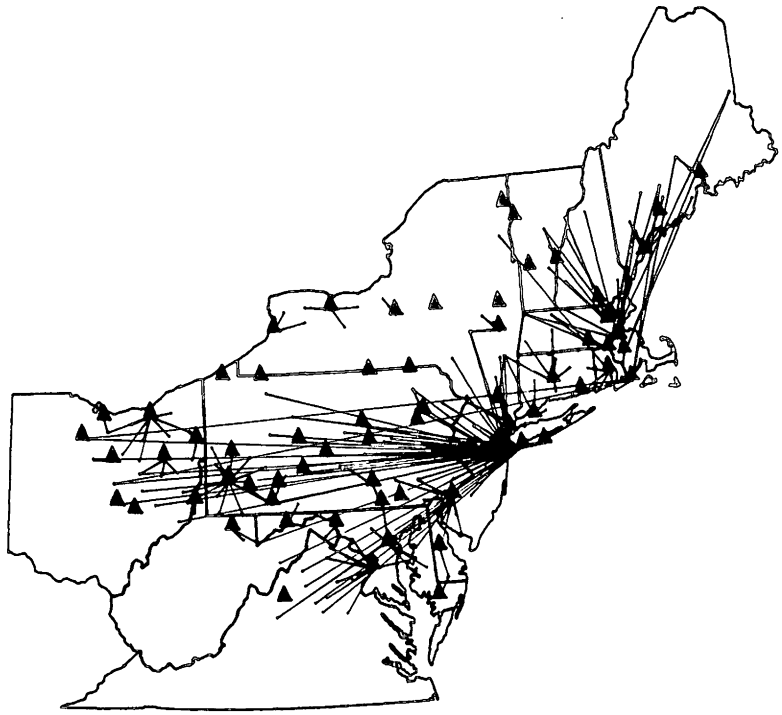

FIGURE 24. Class I Assembly Movements: Uniform Mill Pricing.

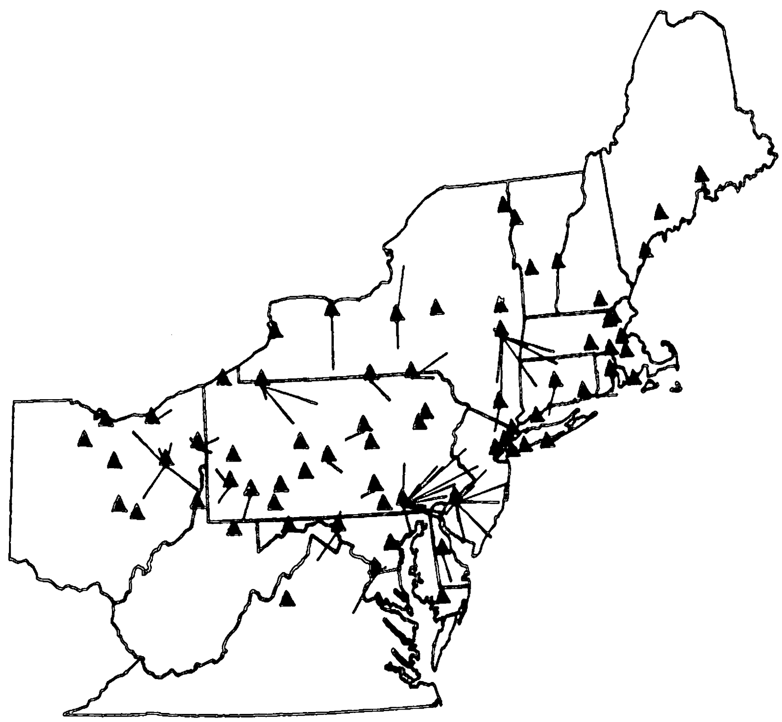

FIGURE 25. Class I Distribution Movements: Uniform Mill Pricing.

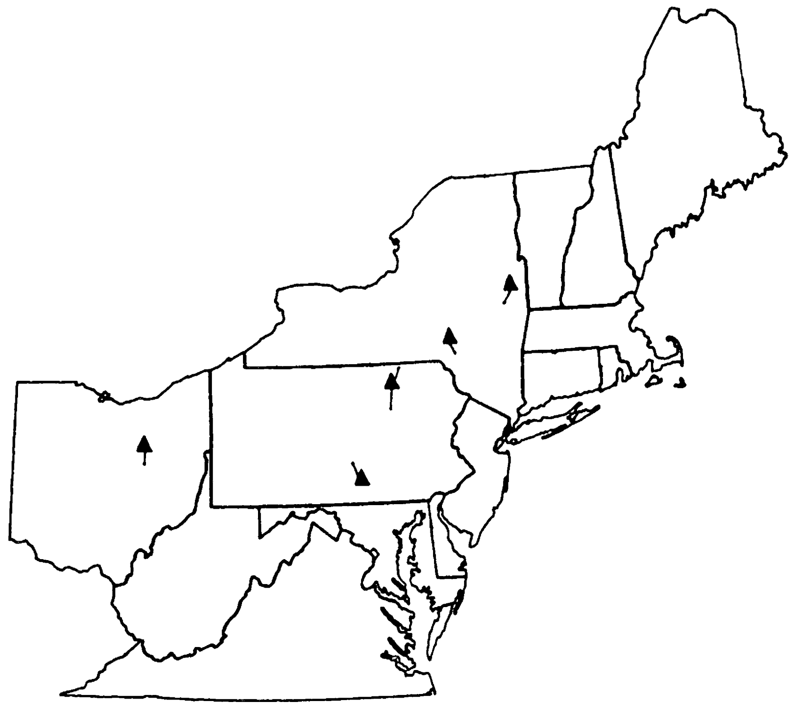

FIGURE 26. Class II Assembly Movements: Uniform Mill Pricing.

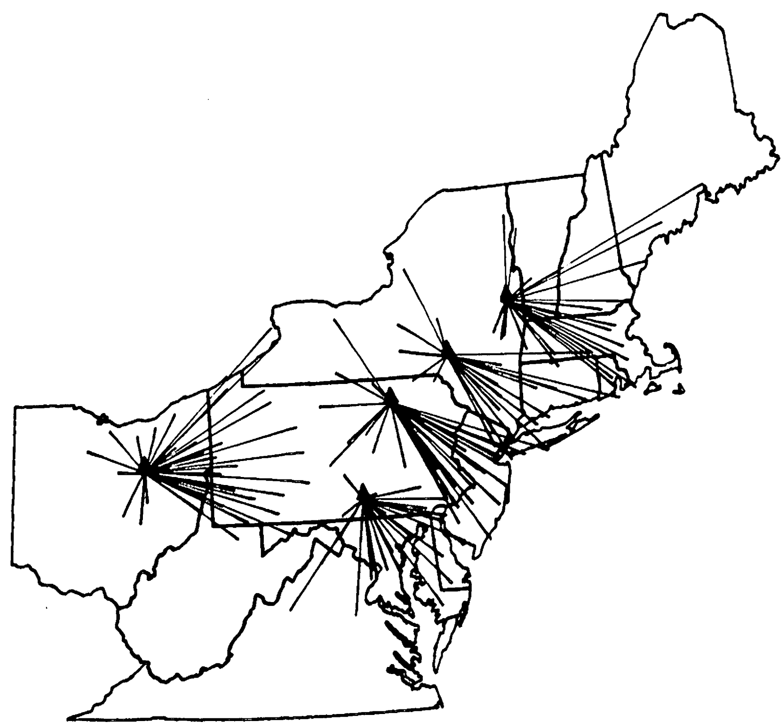

FIGURE 27. Class II Distribution Movements: Uniform Mill Pricing.

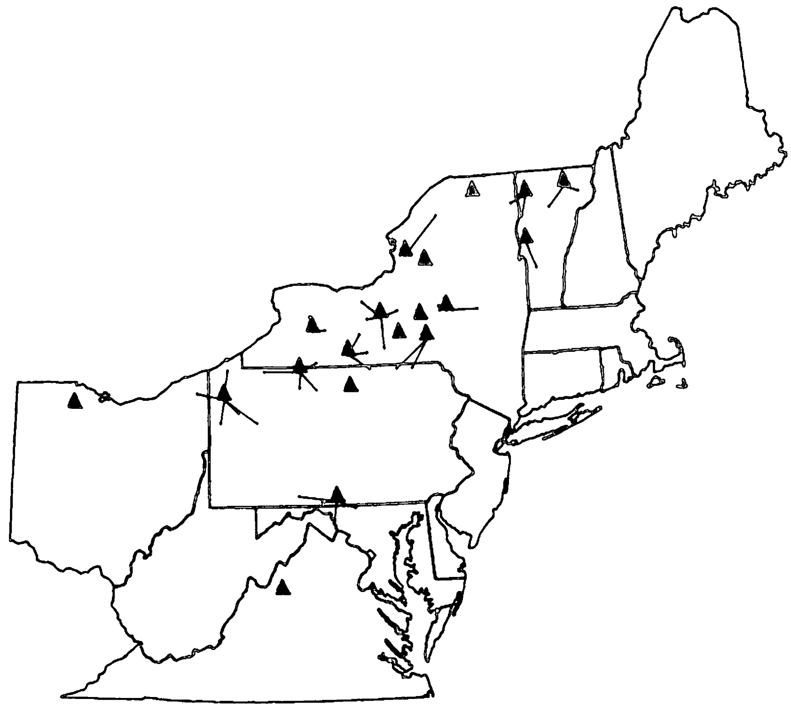

FIGURE 28. Class III Assembly Movements: Uniform Mill Pricing.

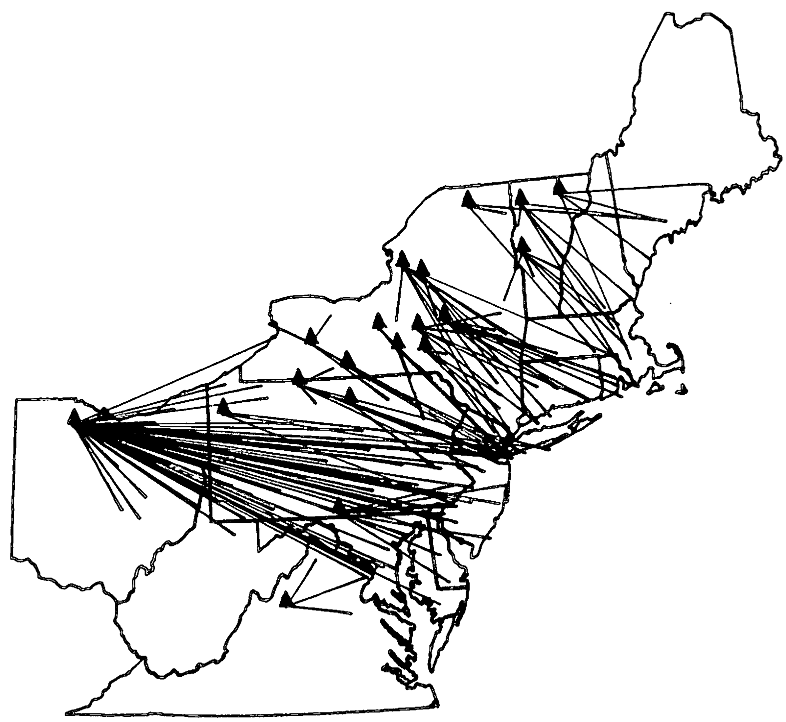

FIGURE 29. Class III Distribution Movements: Uniform Mill Pricing.

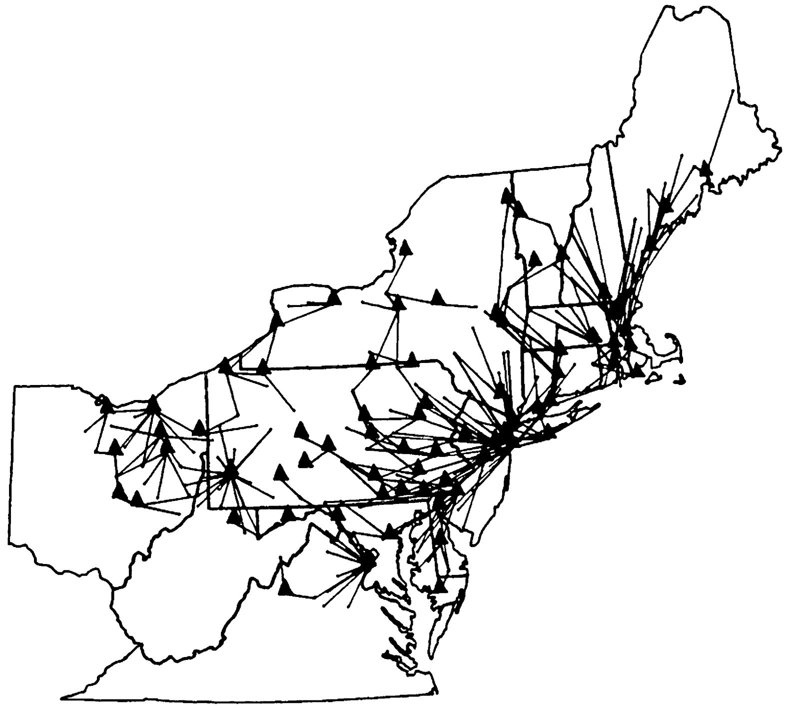

FIGURE 30. Class I Assembly Movements: Uniform Delivered Pricing.

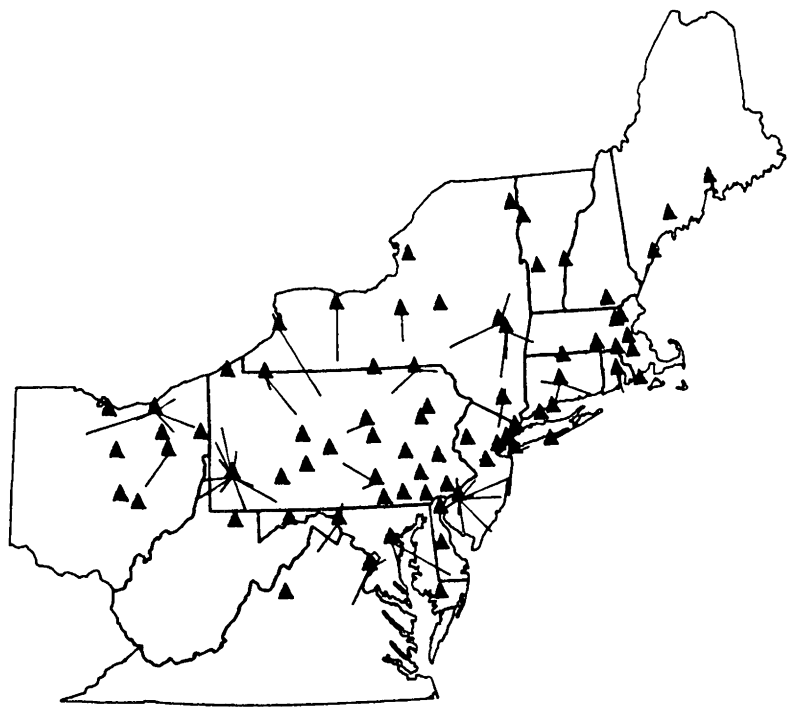

FIGURE 31. Class I Distribution Movements: Uniform Delivered Pricing.

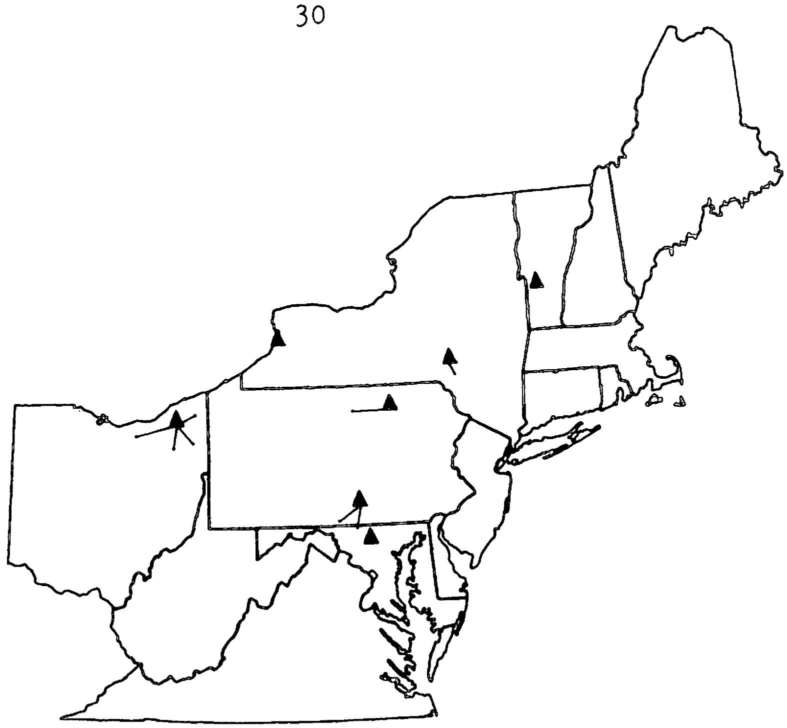

FIGURE 32. Class II Assembly Movements: Uniform Delivered Pricing.

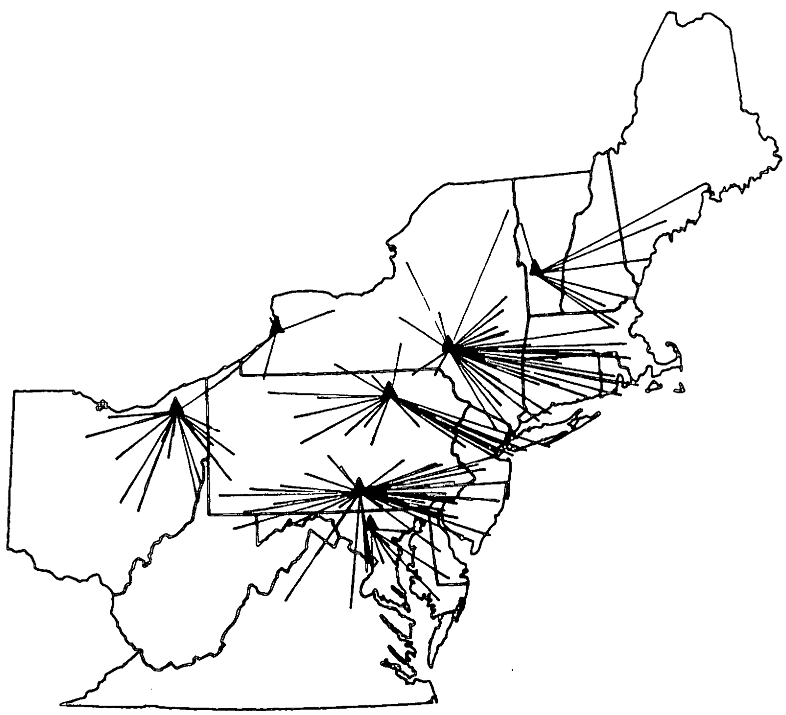

FIGURE 33. Class II Distribution Movements: Uniform Delivered Pricing.

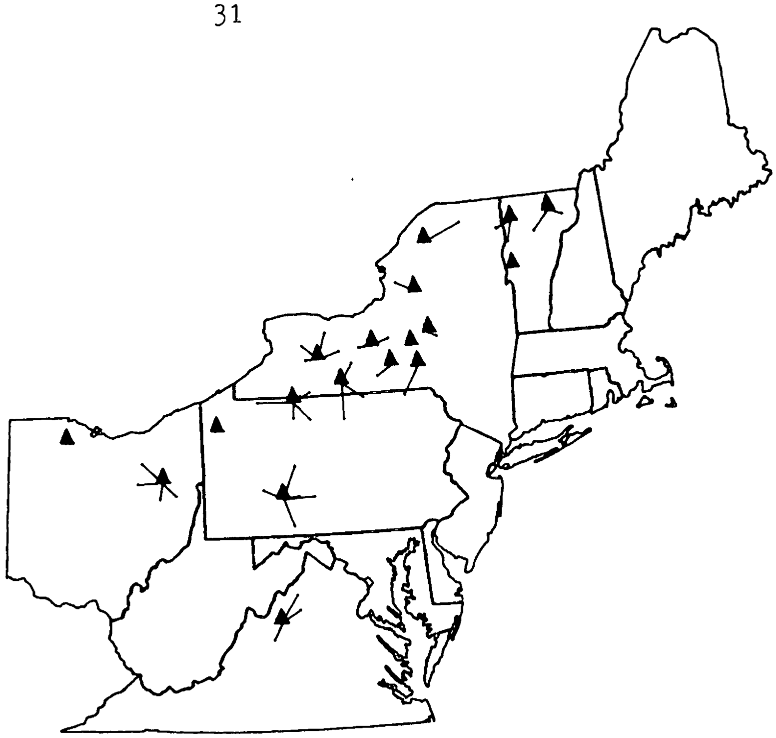

FIGURE 34. Class III Assembly Movements: Uniform Delivered Pricing.

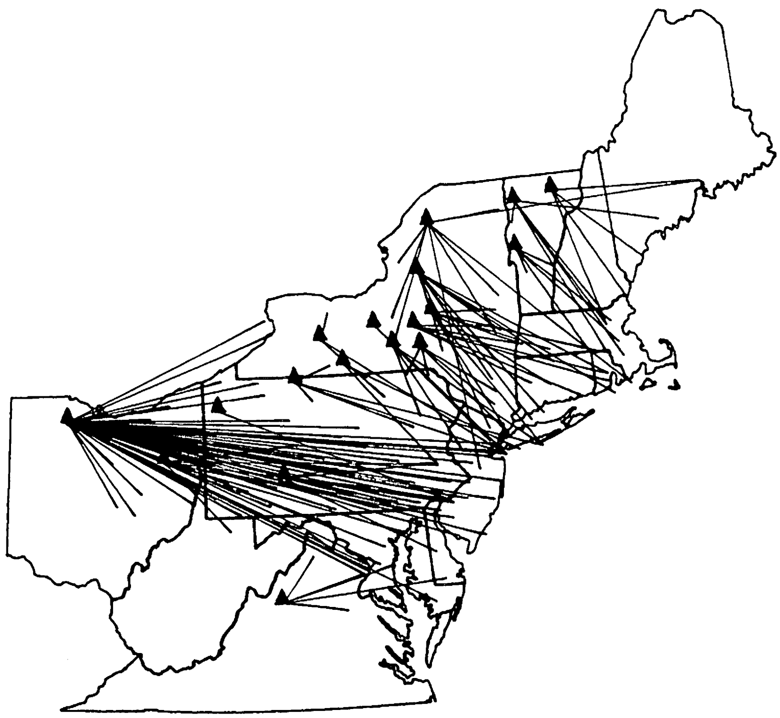

FIGURE 35. Class III Distribution Movements: Uniform Delivered Pricing.

Other Agricultural Economics Staff Papers

No. 89-8a	Implications of Seasonal Milk Production in New York and Seasonal Price Incentive Plans	H. Kaiser
No. 89-9	Biocarbon: A Model of Energy Use, Forestation, and Climate Change	T. Drennen D. Chapman
No. 89-10	The Role of Credit in Agricultural and Rural Development	J. Brake
No. 89-11	Use of State Farm Record Data for Studying Determinants of Farm Size	G. Casler
No. 89-12	Managerial Factors That Affect New York Dairy Farm Profitability	G. Casler
No. 89-13	Milk Production Costs: Where's the Milk and Why? A New York and Northeast Perspective	W. Knoblauch
No. 89-14	Models of the Variability of Future Prices: Specifications and Evaluation	D. Streeter W. Tomek
No. 89-15	Survey of Firms/Agencies Employing Cornell Graduates With Bachelors Degrees in Applied Economics and Business Management	W. Knoblauch G. German
No. 89-16	Geographic Price Relationships in the U.S. Fluid Milk Industry. A Mathematical Programming Analysis	J. Pratt M. Keniston A. Novakovic
No. 89-17	An Analysis of Changes in Milk Production Per Cow by State, 1950-87	A. Weersink L. Tauer
No. 89-18	Testimony on Draft Underwriting and Repayment Standards for the Federal Agricultural Mortgage Corporation	E. LaDue
No. 89-19	Water Allocation Under a Riparian System Taking into Account Surface and Groundwater Interactions -- The Case of Irrigation Development in the Headwaters of the Susquehanna River	T. Steenhuis D. Allee