POTENTIAL IMPLICATIONS OF FREER TRADE FOR THE UNITED STATES AND CANADIAN DAIRY SECTORS: A SPATIAL ANALYSIS

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This paper presents key results from two studies recently completed by members of the Cornell Program on Dairy Markets and Policy. The study by Maurice Doyon compares the optimal trade flows of dairy products and marginal values of raw milk that are predicted by a spatial model of the United States and Canada under conditions of free trade or current trade restrictions (Doyon). The implications of free dairy trade in North America for the viability of U.S. Federal Milk Marketing Orders (US FMMO) is explored in a study by Phillip Bishop (Bishop).

Both studies employ highly disaggregated spatial optimization models that represent the production, assembly, processing, distribution, and consumption activities characteristic of dairy market operations. Although very similar in their basic design, the models used in the two studies have significant differences. The Doyon study focuses on the adjoining regions of the Northeastern United States and the central Canadian provinces of Ontario and Quebec, with a much more aggregated representation of the rest of the United States and Canada. The Bishop model covers all of North America in more evenly proportioned detail. There are also some differences in the level of product aggregation and other details. In any case, both studies can be thought of as drawing on the same conceptual and mathematical approach to representing milk and dairy product markets. Additionally, both studies begin with establishing a baseline that is predicated on current conditions of current highly restricted trade between the two countries and include a free trade scenario. The latter does not reflect any current policy, nor does it correspond to the requirements under GATT, but it does provide an estimate of the most unrestricted scenario.

The presentation begins with the Doyon study and concludes with the Bishop study. Summary conclusions are presented at the end.

FREE TRADE BETWEEN THE UNITED STATES AND CANADA WITHOUT DOMESTIC POLICY COMPLICATIONS

Observers of the dairy sectors in the United States and Canada are well aware that both countries employ an extensive set of domestic dairy policies and that these policies differ markedly. It goes without saying that any sudden liberalization of trade between the two countries would be grossly affected by and have effects on these domestic policies. Canada would find it immensely difficult to maintain its current regime of relatively high farm prices under its milk marketing quota system and the USFMMO system would find it difficult to enforce producer prices on Canadian shipments of packaged milk to U.S. locations. The latter will be discussed later in this paper. The issue of the Canadian quota system is not studied here. In fact, we take it as a given that free trade must involve either the elimination of the quota system or changes so significant as to render it irrelevant in a free trade analysis. The key issue is, of course, achieving price equilibria in markets for raw milk and dairy products. Unlike more conventional studies that might attempt to estimate changes in production and consumption due to new price equilibria, this study approaches the question of prices as the dual solution of an optimization problem wherein the primal deals with production and consumption based on existing levels. In a sense, the study looks at the shorter term implications for price and leaves the potential impact on production and consumption for another analysis. In so doing, the study obviates any need to find appropriate supply and demand response functions, which in many cases simply do not exist at a level corresponding to the spatial and product disaggregation used in the model. The fact that previous studies of supply and demand response, as well as conventional wisdom, suggest that both behaviours are highly price inelastic helps to support the robustness of this approach.

Design of Trade Liberalization Simulations

A **Base scenario** is used as a benchmark to evaluate the magnitude of the predicted changes. In the base scenario, all dairy products, except fluid (beverage) milk, could move freely among Canadian regions, while all dairy products are allowed to move freely within the Northeast United States. No dairy product trade is allowed between the United States and Canada.

The base simulation is a benchmark, a point of reference. The effects that policy changes had on trade patterns are evaluated in terms of changes relative to the base simulation. The base simulation represented the economic optimum for the period studied, notwithstanding all other factors.

In the **Free Trade scenario**, all dairy products, as well as raw milk, are permitted to move freely across the U.S.-Canada border. Free trade is not likely to occur in the short run. However, the scenario has two desirable qualities. One is that free trade is easy to model. The second is that it represents a normative upper limit of trade liberalization. For this simulation, all constraints on the movements of dairy products between the United States and Canada are removed. Thus, Quebec and Ontario could export or import any of seven dairy products, including raw milk, to and from the Northeast. This is also the case for a Canadian aggregated excess demand point and a U.S. aggregated excess supply point, which together represent the rest of the relevant components of the United States and Canada.

Results of the Base Scenario

The simulation results are expressed as changes in quantity trade flows and shadow prices. Trade flow maps provide a pictorial view of the results. To simplify the presentation of results, the many supply, processing, and demand points in the Northeast US is disaggregated into five smaller multi-state regions. Northern New England (NNE) is comprised of Vermont, Maine and New Hampshire. Southern New England (SNE) is made up of New Jersey, Rhode Island, Connecticut, and Massachusetts. Maryland, Washington D.C. and Delaware formed the Middle Atlantic (MAT) region. New York (NY) and Pennsylvania (PA) are the two other regions. Similarly, Ontario and Quebec points are aggregated into regions defined by the two provinces—ON and PQ, respectively. The excess demand point for the rest of Canada (CAED) and the excess supply point for the rest of the United States (USES) make up the remainder of the model.

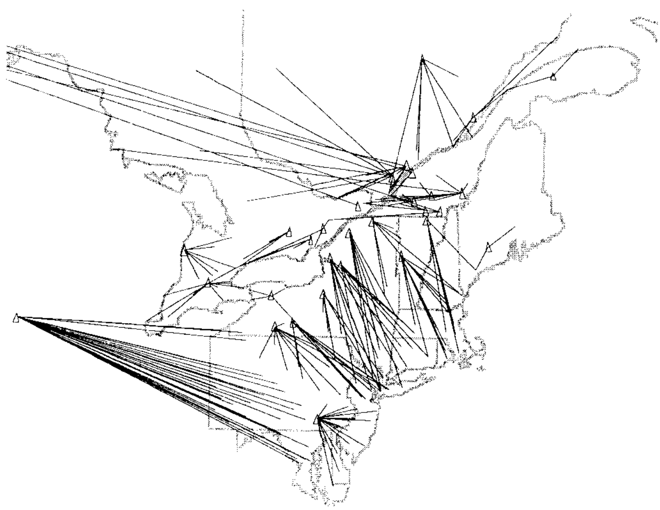
Shadow Prices. Shadow prices indicate the amount by which the objective function would be reduced if an additional unit of a milk component is made available. Two types of shadow prices are generated by the model-a supply shadow price and a processing shadow price. The supply shadow price corresponded to raw milk at the farm with a fixed ratio of butterfat to skim nonfat (SNF). Although the ratio is fixed within each region, the ratio varied from one region to the next. In contrast, the processing shadow price, reflecting values at the plant is comprised of two prices, one for butterfat and one for skim non-fat (SNF). Thus, for a particular product in a region, the shadow price for butterfat may increase while the shadow price for SNF may have decreased under trade liberalizing policies.

If a shadow price increased from one simulation to another, then the relative incentive to market milk increased and vice versa. Thus, the magnitude or the direction of a shadow price change is not relevant. Only the magnitude of a shadow price relative to those of other regions for the same product have relevance in assessing the impacts of different trade policies.

Trade Flow Maps. Trade flow maps are useful for finding cross-border movements and can be used to illustrate differences in trade flows between simulations. **Triangles** represent processing plants, and **lines** from the triangles represent product movements from plants to consumption points. The lines that represent flows are not proportional to quantities. Therefore, an insignificant flow and a large flow of a particular dairy product would be represented by lines with identical appearance.

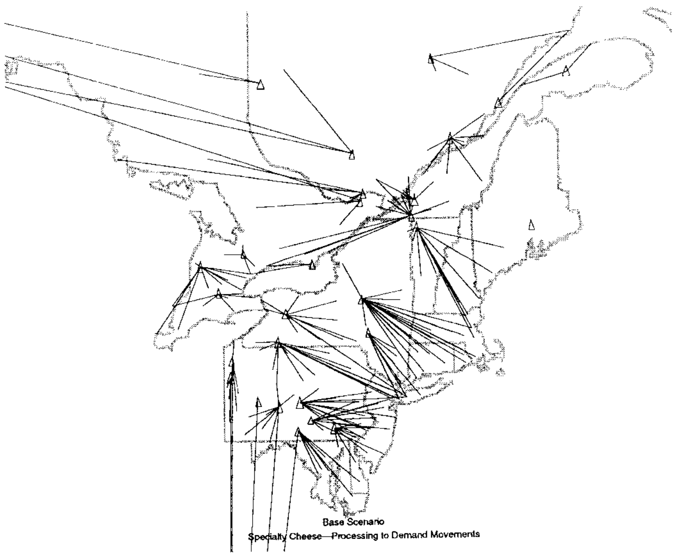
Raw Milk Movements. Because fewer raw milk movements exist relative to finished product movements and because their variability across simulations is not significant, raw milk flows will be discussed only briefly. Milk destined for fluid milk plants travelled moderate to long distances, but few milk supplies used in the production of dry and condensed milk are located far from the processing plants. Furthermore, butter plants had such short raw milk movements associated with them that no supply to processing movements are discernable. The explanation is found in the costs associated with transportation, i.e. the higher the product's distribution cost, the closer the processing plants are to the consumption points. The number of plants is also dependent on transportation costs. If a product is relatively inexpensive to transport, it is more efficient to have a few large plants located near supply points than many smaller plants located near consumption points.

Processing to Demand Movements. In the base simulation, Quebec shipped butter, cheddar cheese and dry and condensed milk to Ontario and the CAED. Results are illustrated for cheddar cheese in Map 1.



Map 1. Cheddar Cheese: Processing to Demand Movements

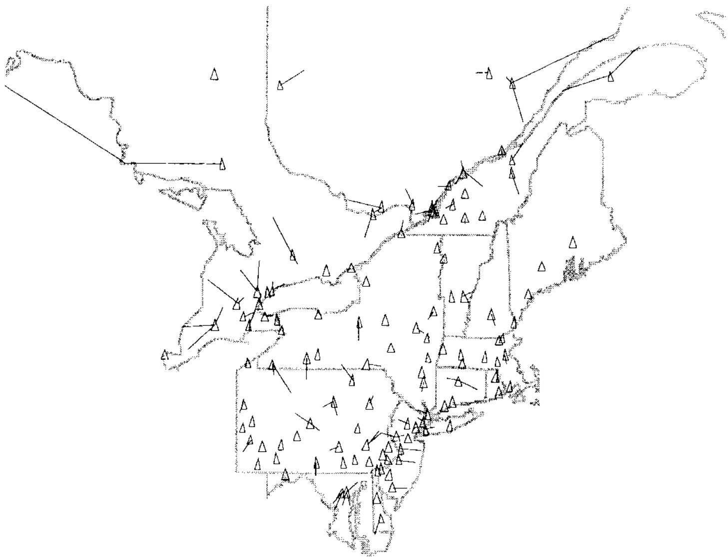
Quebec also shipped specialty cheese to the CAED, and imported yogurt and frozen dessert from Ontario. Ontario shipped frozen dessert and yogurt to the CAED and Quebec, and exported cheddar and specialty cheese to the CAED. Specialty cheese results are illustrated in Map 2.



Map 2. Specialty Cheese: Processing to Demand Movements

New York imported butter from Vermont, Pennsylvania, and Maryland in the base simulation. However, New York exported frozen dessert and yogurt to Pennsylvania, Maryland, and Vermont, and imported frozen dessert from Vermont as well. New York also exported cheddar cheese, dry and condensed milk, and specialty cheese to SNE. Pennsylvania exported butter to Maryland, New York, and New Jersey, while it imported yogurt from New York. Pennsylvania exported yogurt to the US aggregated excess demand (USED), Maryland, District of Columbia, Delaware, and New Jersey. Pennsylvania also exported cheddar cheese, dry and condensed milk and specialty cheese to New York City, SNE and MAT. Vermont exported butter and frozen dessert to New York, and frozen dessert to Maine. Vermont also exported cheddar cheese, specialty cheese and dry and condensed milk to New York, SNE, and the other NNE regions. The USES exported cheddar cheese to Western New York, Pennsylvania and SNE, while it exported dry and condensed milk to New York, Pennsylvania, SNE, and MAT.

Map 3 shows that fluid milk is a local business with short movements from plants to the consumers. The map also reveals that the optimal market structure consists of numerous plants, with plant density highest near large metropolitan areas. In contrast, butter plants are less numerous and have longer processing to consumer movements. The market structure of butter processing plants is nearly opposite that of fluid milk plants, and the results imply that there exists an economic incentive for butter plants to locate near supply points.



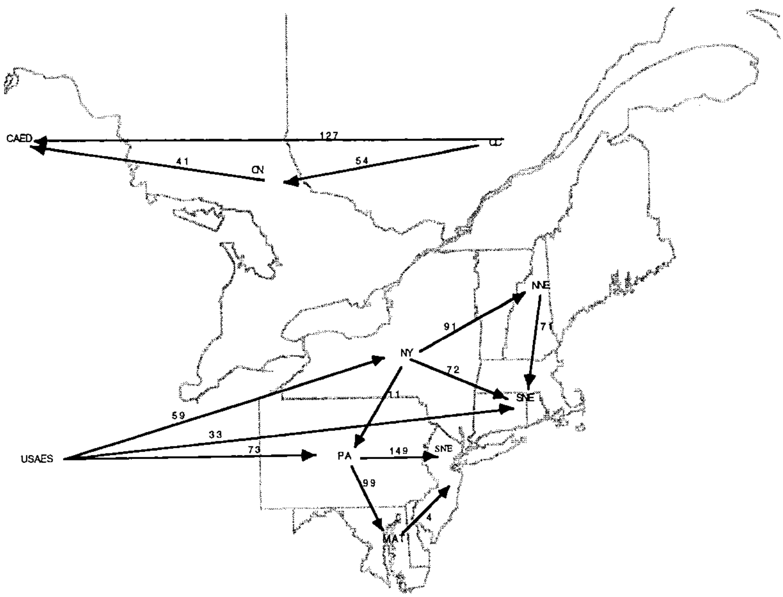
Map 3. Fluid Milk: Processing to Demand Movements

In general, lower transportation costs for a product imply fewer plants to process that product and longer movements of that product from processing to demand . For example, fluid milk is rather expensive to transport, but dry and condensed milk are relatively inexpensive to ship. The base simulation resulted in 121 plants processing fluid milk but only 9 plants processing dry and condensed milk.

The plant density shown in the preceding maps may be misleading because differences in plant size are not addressed. The size of processing plants differs significantly across regions in the base. For example, New York and SNE fluid plants are twice as big as those in the other regions. For yogurt, the plants with the highest average size are found in

Quebec, Ontario and Pennsylvania, while the smallest plants are in NNE and New York. New York and MAT ice cream plants are twice the size of the Quebec and Ontario ice cream plants. Regarding cheddar and specialty cheese plants, Pennsylvania and New York have the largest plants. On average the largest dry and condensed milk plants are in Quebec, Ontario and NNE, while the largest butter plants are in Ontario, Pennsylvania and SNE.

A summary of the net interregional trade flows for all products combined can be observed in Map 4.

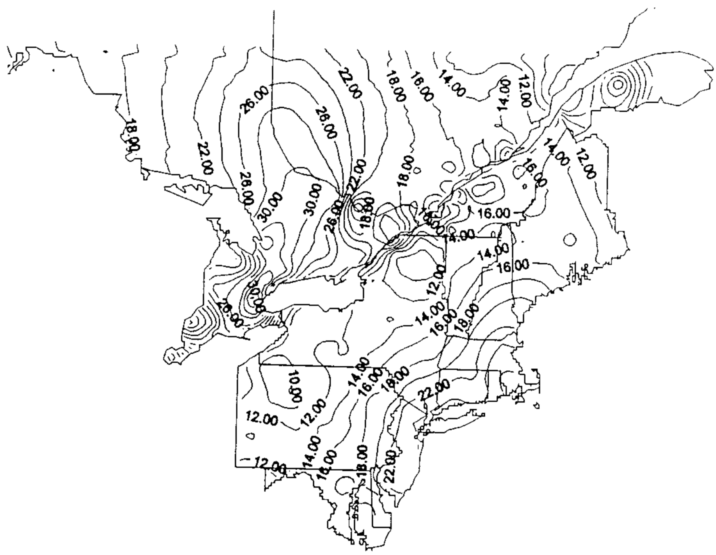


Base Simulation-Net Interregional Trade Flows
All Products

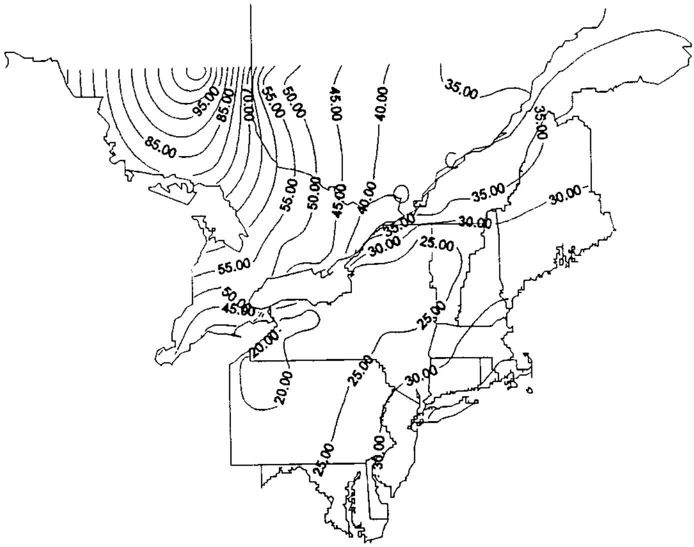
Map 4. Net Interregional Trade Flows: All Dairy Products in Million of Kilograms of Products

Map 5 presents the supply shadow prices for the base simulation. The supply shadow prices increased from the northwest to the southeast in the Northeast United States, from east to west in Quebec, and from west to east in Ontario. In general, supply shadow prices are higher in Canada than they are in the Northeast United States.

A fluid milk shadow price is calculated using the butterfat and SNF processing shadow price generated by the model. Fluid milk is chosen for the processing shadow price contour maps, because it is the most consistent product across regions and is present in significant quantities in all regions. Map 6 presents the processing (fluid milk) shadow price for the base simulation. In the Canadian regions, shadow prices increased from east to west, while in Northeast United States they increased from northwest to southeast. Processing shadow prices are much higher in Canada than in the United States regions, the highest values occurring in Northeastern Ontario.



Map 5. Supply Shadow Prices: Canadian Dollars per Hectoliter



Map 6. Processing Shadow Prices: Canadian Dollars per Hectoliter

Free Trade Simulation

Raw Milk Movements. In the Free Trade simulation, all dairy products and raw milk could move freely between the Canadian and U.S. regions. The results indicate that no movements of fluid milk between the United States and Canada occurred in the Free Trade simulation. This result is a consequence of the transportation cost structure of fluid milk and raw milk. Raw milk is less expensive to transport than fluid milk. Thus, it is not surprising to observe cross-border movements of raw milk to fluid milk plants but no cross-border movements of fluid milk.

Based on relative marketing costs, some cross-border movements of raw milk are evident in the Free Trade simulation. Raw milk moved from New York to Ontario and Quebec fluid milk plants, and raw milk from Quebec went to Vermont specialty cheese plants. Although a limited amount of raw milk moved from Canada to the U.S. and vice versa, in the short run more U.S. milk would be pulled North due to lower U.S. raw milk price. Factor price equalization would put that down toward the levels suggested by the model in the longer run.

Quebec increased net exports of raw milk for cheddar and specialty cheeses and for ice cream by 7, 13, and 7 points, respectively. At the same time, Quebec increased its net imports of raw milk for fluid milk processing by 8 percentage points. Similarly, Ontario increased its net raw milk imports for fluid milk, ice cream and cheddar cheese by 34, 7, and 3 percentage points, respectively. New York shifted from being a net importer of raw milk for fluid processing in the base simulation to being a net exporter in the Free Trade simulation.

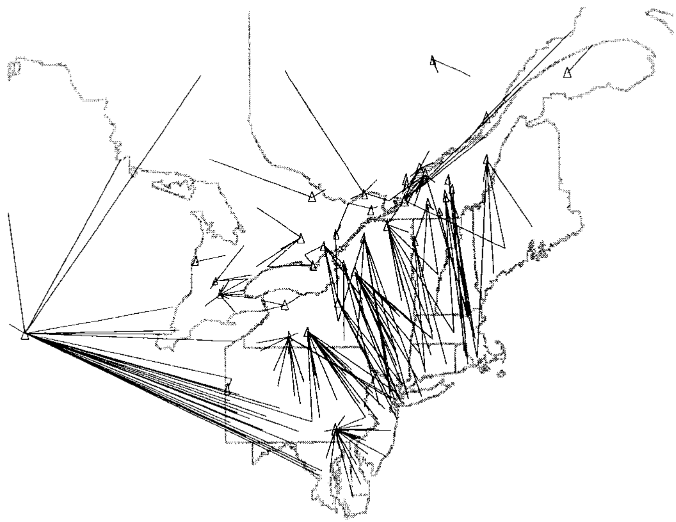
The decrease in net imports of raw milk for dry and condensed milk of 2,650 points in NNE resulted from the combined effect of eliminating raw milk imports from New York and diverting local supply to a dry and condensed milk plant.

Processing to Demand. The number of plants that received raw milk for a particular product as shown in supply to processing movements maps does not necessarily correspond to the number of plants that effectively processed that product, shown in processing to demand movements maps. This apparent discrepancy resulted from interplant movements. Some plants received raw milk and redirected butterfat and SNF to other plants without performing any processing activities.

Under the conditions imposed by the Free Trade simulation, Quebec lost market share for all dairy products except cheddar cheese and ice cream. Quebec significantly increased its net exports of cheddar and shifted from a net importer of ice cream to a net exporter (Table 1). Small losses for fluid milk and specialty cheese are also predicted. The loss of the CAED butter market and part of the Ontario butter market to USES resulted in a 33 point decrease in Quebec's net butter exports. The effect of the lost market share is somewhat mitigated by Quebec's butter exports to Maine, Vermont, and New York.

Predicted exports of dry and condensed milk to Maine did not compensate for the loss of the CAED and Ontario dry and condensed markets to USES. Moreover, Ontario, and to a lesser extent USES, penetrated part of Quebec's domestic market for nonfat dry and condensed milk. As a result, Quebec is expected to lose 4 dry and condensed milk plants and shift from being a net exporter to being a net importer of dry and condensed milk. Quebec also shifted from being a net exporter to being a net importer of yogurt. This is partially due to new exports to Maine and Northern New York. Quebec became a net exporter of ice cream and exported to Vermont and New York. Quebec significantly increased exports of cheddar cheese under the Free Trade simulation trade conditions.

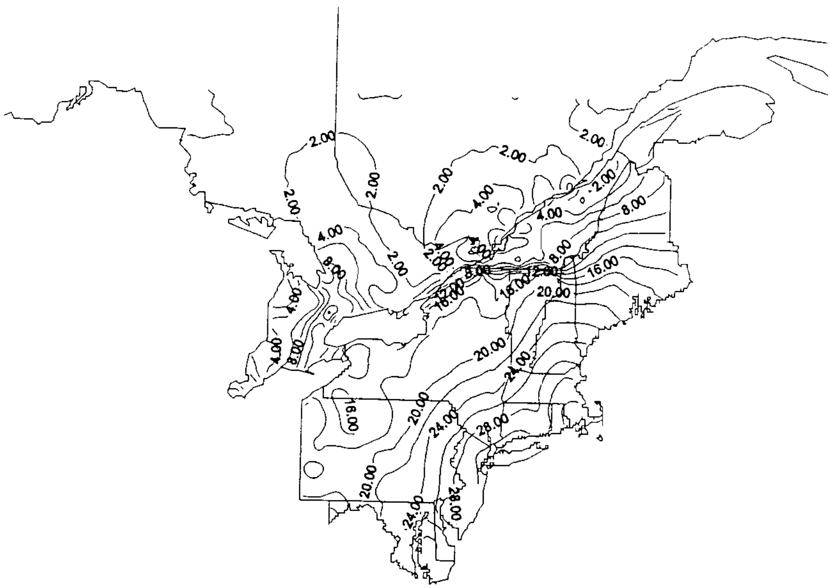
A comparison of Maps 1 and 2 with Maps 7 and 8 shows new trade dynamics for cheese. **Traditional East to West movements in Canada are replaced by North to South movements**. Quebec lost its CAED and Ontario cheese market to USES and New York, but exports to New England more than compensated for the lost market. However, Quebec's farm and plant values for milk components declined greatly in the Free Trade simulation (Maps 5, 6, 9, and 10).



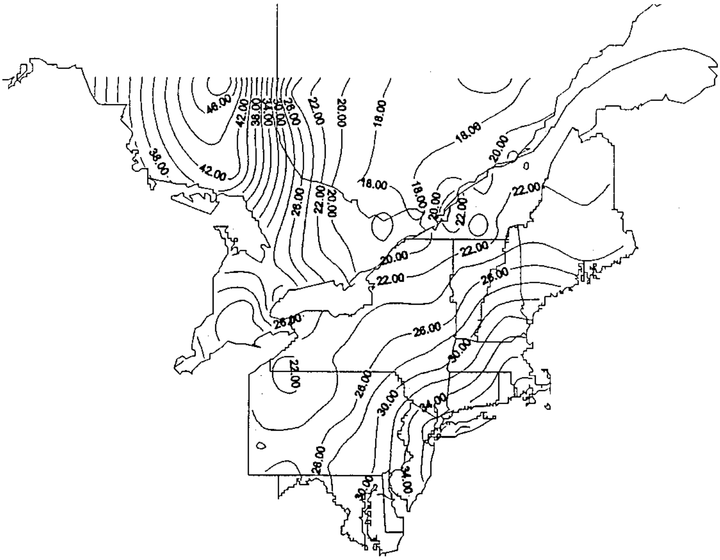
Map 7. Cheddar Cheese: Processing to Demand Movements

Map 8. Specialty Cheese: Processing to Demand Movements

Ontario increased its net exports for all dairy products except yogurt and specialty cheese. Net imports of specialty cheese slightly increased. Ontario shifted from being a net exporter of yogurt to being a net importer, and from being a net importer of cheddar cheese to being a net exporter. Ontario's loss of the CAED cheddar cheese market to USES is more than compensated by cheddar cheese exports to New York. Ontario also reduced net imports of butter and dry and condensed milk by 17 points and 117 points, respectively. The reduction in dry and condensed milk net imports is explained by new exports to Quebec, New York and SNE. As a result, the Western Ontario dry and condensed plant is replaced by a larger plant in Eastern Ontario. Significant decreases in the value of Ontario farm milk and plant milk components also occurred in the Free Trade simulation. Maps 9 and 10 and Table 1 illustrated the implications for calculated milk values.



Map 9. Supply Shadow Prices: Canadian Dollars per Hectoliter



Map 10. Processing Shadow Prices: Canadian Dollars per Hectoliter

Table 1. Changes in Shadow Prices for Supply, Butterfat and SNF for Various Dairy Products Relative to the Base Scenario, Free Trade Simulation.

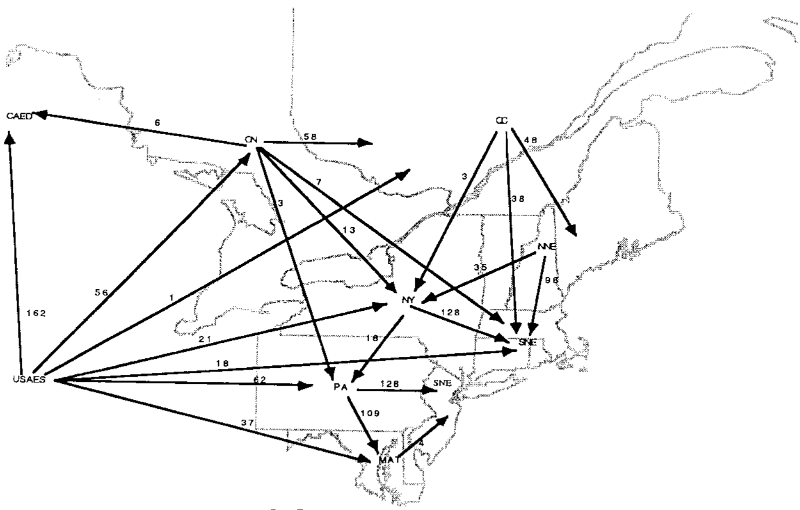
	SNE			NNE			NY			ON		
	Supply	Fat	SNF	Supply	Fat	SNF	Supply	Fat	SNF	Supply	Fat	SNF
Fluid	25%	36%	-6%	31%	32%	-18%	37%	40%	-6%	-73%	-57%	-24%
Butter	0%	64%	-10%	0%	0%	0%	0%	68%	-32%	0%	-51%	-95%
Ice cream	0%	33%	-1%	45%	28%	-12%	47%	41%	-2%	-82%	-55%	-18%
Yogurt	46%	13%	-6%	15%	-5%	-8%	28%	-10%	-18%	-87%	-58%	-47%
Cheddar cheese	0%	0%	0%	25%	0%	0%	51%	31%	1%	-78%	-43%	-66%
Specialty cheese	0%	0%	0%	28%	2%	-16%	48%	22%	-3%	-80%	-48%	-66%
Dry & Condensed	0%	0%	0%	25%	41%	-28%	30%	0%	0%	-85%	-56%	-48%
Total Effect	26%	36%	-5%	30%	29%	-20%	45%	38%	-5%	-78%	-55%	-30%

	PA			QC			MAT		
	Supply	Fat	SNF	Supply	Fat	SNF	Supply	Fat	SNF
Fluid	39%	36%	-5%	-74%	-51%	0%	36%	37%	-6%
Butter	0%	72%	-19%	0%	-46%	-99%	0%	71%	-10%
Ice cream	48%	39%	-7%	-78%	-49%	63%	42%	44%	-7%
Yogurt	57%	20%	-3%	-79%	-54%	-2%	0%	0%	0%
Cheddar cheese	34%	25%	-1%	-70%	-41%	-23%	0%	0%	0%
Specialty cheese	46%	20%	-3%	-77%	-52%	-32%	0%	0%	0%
Dry & Condensed	56%	41%	-7%	-75%	-51%	-28%	0%	0%	0%
Total Effect	42%	35%	-5%	-74%	-50%	-4%	37%	39%	-6%

For New York, imports of yogurt and nonfat dry and condensed milk decreased by 50 and 343 percentage points, respectively. Cheddar cheese exports decreased by 2 percentage points, and specialty cheese exports are reduced by 8 percentage points. In the Free Trade simulation New York lost its only dry and condensed plant. However, values of plant milk components and farm milk values improved greatly relative to the base.

By decreasing net imports of butter and increasing net exports of specialty cheese and dry and condensed milk, NNE gained exports in hard products. The gain in butter resulted from exports to Quebec. Exports of specialty cheese and dry and condensed milk to New York and SNE accounted for the export gains. However, NNE significantly increased its net imports of yogurt, and shifted from being a net exporter of ice cream and cheddar cheese to being a net importer of these two products. Although NNE farm milk values and plant component values did not increase as much as those in other Northeast states, they nonetheless increased significantly.

The trading patterns of the other regions is relatively unaffected. All Northeast U.S. supply and processing shadow prices increased in the Free Trade simulation. International flows are summarized in Map 11. For each of the Canadian and U.S. regions, butter supply shadow prices are zero (Table 1). This is explained by a non-binding supply of raw milk for butter, and the placement of butter plants at supply point locations.



Free Trade Simulation-Net Interregional Trade Flows
All Products

Map 11. **Net Interregional Trade Flows: All Dairy Products in Million of Kilograms of Products**

Summary of U.S.-Canada Free Trade

Although free trade may place downward pressure on prices, it has the advantage of opening alternative markets over time for both countries. It also would result in significant gains in transportation efficiency. Free trade creates possibilities for growth and spreads the negative price effects for Canadians across the industry, instead of concentrating the hardships in a few sectors, as would be the case with liberalizing trade on a product sub-sector by sub-sector basis as some have proposed.

Physical trade in New York and NNE are impacted somewhat by free trade; the trade levels of the other Northeast U.S. regions are not notably affected. The USES gained the majority of new exports to Canada in the Free Trade simulation. Most of the USES exports are, however, directed to the CAED point. That is, the western US tends to serve western Canada. Nevertheless, all regions in the Northeast United States, especially New York and Pennsylvania, registered a significant increase in shadow prices in the Free Trade simulation.

One interesting finding is that fluid milk processing and distribution are minimally affected by either trade scenario. It appears that marketing costs alone are enough to essentially insulate fluid milk from free trade. The Dairy Farmers of Canada have estimated that approximately 3 percent of the Canadian fluid milk consumption in 1991 could be attributed to U.S. cross-border shipments. This occurs now because fluid milk supply and demand are equilibrated independently in the two countries. Since that time, this estimate has been lowered due to a weaker Canadian dollar. From the model results and cross-border purchase estimates, 3 percent to 5 percent is probably the upper limit on Canadian importation of fluid milk. This bound should remain effective despite variations in the exchange rate. Therefore, a Canadian trade policy negotiator would be advised to drop significantly the tariff level on fluid milk in exchange for concessions on the level of tariff placed on other dairy products.

Another implication of the study is that the Canadian regions consistently do well with regards to cheese when trade is allowed between United States and Canada. Quebec cheese processors have a competitive advantage which enables them to ship cheddar and specialty cheese to New England. Ontario cheese processors also have a competitive advantage and ship cheese to New York. These competitive advantages are robust and resistant to changes in marketing costs. On the other hand, the USES has a clear competitive advantage for the delivery of cheese in Western Canada. In spite of the loss of the Canadian market, Quebec and Ontario more than compensate with cheese exports to the Northeast United States.

The Canadian competitive advantage for cheddar and specialty cheese should not be underestimated or ignored by Canadian policy negotiators. The results suggest that the current tariff level of more than 300 percent is not necessary to protect the Canadian cheese industry. Papillon (1995) found that a tariff level of 30 percent to 40 percent would be as effective as a 300 percent tariff level. Thus, it would be to Canada's advantage to lower Canadian tariffs on cheese in exchange for greater access to U.S. markets.

The results suggest that geographic proximity is an important factor in determining trade impact on regions. Thus, Pennsylvania and the MAT states are not active players in the model, while New York and NNE are the most active players. Similarly, the USES and the CAED points, which are relatively close to each other, have a significant amount of interaction.

Through shadow prices, the model confirmed that any degree of trade liberalization will change the intrinsic value of raw milk, especially in Canada. Although the price effects on raw milk were not directly estimated, the supply shadow prices, which represent the value of an extra unit of raw milk at a supply point, still allow one to make conclusions. Using the average net milk price at the farm for Quebec and New York in May 1995 and the changes in supply shadow price from the base simulation to the two trade scenarios, a price effect could be estimated. In Quebec, dairy farmers received an average of $51.00 per hectoliter in May 1995. That amount is reduced to $39.00 per hectoliter with the implementation of free trade conditions. New York dairy farmers received an average of $40.50 (Canadian) per hectoliter in May 1995. Under free trade conditions, the average price in New York for raw milk at the farm rose to $46.00 per hectoliter. These price effects should be seen as the first step in a price adjustment process following a shock to the market structure. The final equilibrium should imply a smaller price decrease for Quebec, and a smaller price increase for New York.

The model also suggested that consumers will be affected by trade liberalization in the dairy sector through consumer price variations. A look at the processing shadow price provides some instruction as to how the simulation might affect consumer prices of dairy products. Thus, Canadian consumers should experience significant price decreases under free trade. In contrast, Northeast U.S. consumers should realize price increases in the Free Trade simulation.

THE IMPLICATIONS OF TRADE LIBERALIZATION WITH U.S. FEDERAL MILK MARKETING ORDERS

Background

For almost sixty years, Federal Milk Marketing Orders (FMMOs) have regulated the terms and conditions under which grade A milk is purchased from U.S. farmers. At the heart of the program is a complementary system of classified pricing, which values milk according to its end use, and the pooling of revenues arising from the sale of milk products. An immediate problem raised by the spectre of trade liberalization concerns the ability of FMMOs to maintain the integrity and performance of classified pricing and pooling when barriers to trade are either removed or relaxed. Federal regulation replaced state regulation in the early days of marketing orders because the prevalence of interstate commerce in milk rendered state authority ineffective. At issue now is whether international commerce will similarly reduce the effectiveness of federal orders. Marketing orders regulate milk processors, not farmers nor processor's customers, and do so through the use of minimum price regulation. Because it is fluid handlers who are required to pay a higher price, it is they for whom trade liberalization provides an incentive to avoid regulation. For example, it is easy to imagine a fluid milk processor located just across the U.S. border processing milk purchased either locally or from nearby U.S. farmers, and then selling class I products in regulated U.S. markets. Such a handler, by virtue of being located in another country and regardless of whether it is U.S. or foreign owned, would avoid the class I pool obligations to the order in which it makes its sales. Quite simply, the potential to profitably engage in this type of arbitrage, within the scope of any particular order, depends on the extent to which the increased milk assembly and distribution costs are outweighed by the difference between the class I price and the prevailing blend price.

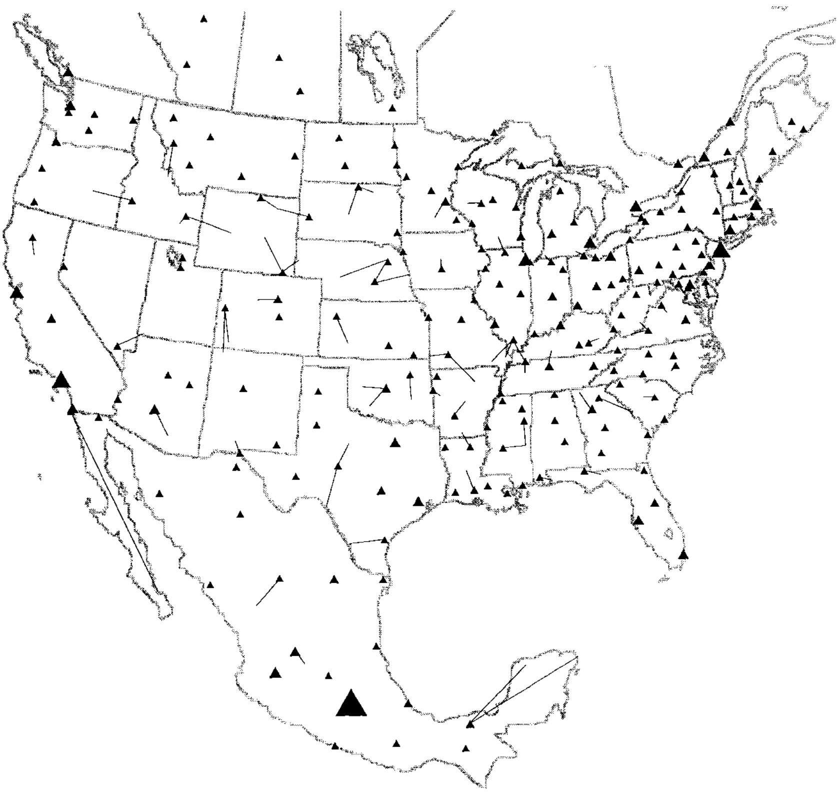
This study is restricted to factors directly impacting the integrity or performance of FMMOs as an agent for achieving economic performance objectives in the U.S. dairy sector. The implications of freer trade for price levels, export opportunities, or other factors that are of importance to the dairy sector but which do not have particular and direct implications for FMMOs are not addressed. Although this study is primarily concerned with federal milk marketing orders, the impact of trade liberalization on similar state marketing programs is also analysed.

The Base Solution

In order to perform any analysis of a new policy or market environment, it is necessary to first establish a base from which to make comparisons. This section describes the base solution used for such comparisons in this study. The base solution is designed to simulate the economic activity and policy settings in the U.S. dairy sector, particularly as it relates to marketing orders. Therefore, some imports, primarily of cheese, occurs subject to quotas; some exporting, particularly NDM to Mexico, takes place; and grade A milk is priced under federal or state regulations.

An overall impression of the base solution can be gained from viewing the thematic maps in Maps 12 and 13. These maps represent, respectively, the flows of raw milk from farms, or supply points, to fluid milk processing plants, and flows of fluid milk from plants to demand areas. The **solid triangles** represent plants and their size gives a relative indication of the level of activity. Thus, in Map 12, the triangles denote the destination end of the flows which are depicted by the lines, while in Map 13, the triangles denote the origin of the flows. A **triangle without a line** radiating from it implies that the supply or demand activity is located in the same area as the processing activity. These conventions will apply to all subsequent thematic maps presented throughout this report.

Map 12. Raw Milk Flows from Supply Points to Fluid Milk Processing Plants, Base Solution



Map 13. Fluid Milk Distribution Flows from Processing Plants to Consumption Areas, Base Solution

Immediately noticeable from these maps is that fluid processing plants tend to be located near the demand areas and further away from the raw milk supply areas. Indeed, the simple average length of raw milk shipments to fluid plants, originating in the United States, is 76.3 miles while for packaged milk distribution movements terminating in the United States it is 25.3 miles. This phenomenon is consistent with both economic theory and other studies (Bressler, 1958; Francis, 1992), and general observation. There are 190 U.S. fluid plants receiving a total of almost 60.2 billion pounds of farm milk in the base solution. 55.9 billion pounds of packaged milk are distributed from these plants to U.S. demand areas. In addition, these fluid plants also shipped out significant quantities of cream for use by other types of plants.

Based upon actual North American interregional trade, the only permissible base case cross-border movements are between the United States and Mexico. While the model found an optimal solution without making any flows from the United States to Mexico of either raw milk or packaged milk, there are U.S. shipments of manufactured products to Mexico in the base solution.

Although this model has been constructed with structural simplicity in mind, there remains ample opportunity for misspecification that can lead to results which do not conform to expectations. The base solution, however, is entirely consistent with expectations. Based on the model's output, we estimate there to be about 140 billion pounds of regulated grade A milk received at plants; roughly 113 by federal orders and about 27 under state programs. Adding to this another billion or so pounds of unregulated grade A sales, approximately 2 billion pounds of direct sales by suppliers, and about 6 or 7 billion pounds of grade B milk, yields the 149.1 billion pounds of milk actually marketed in 1993.

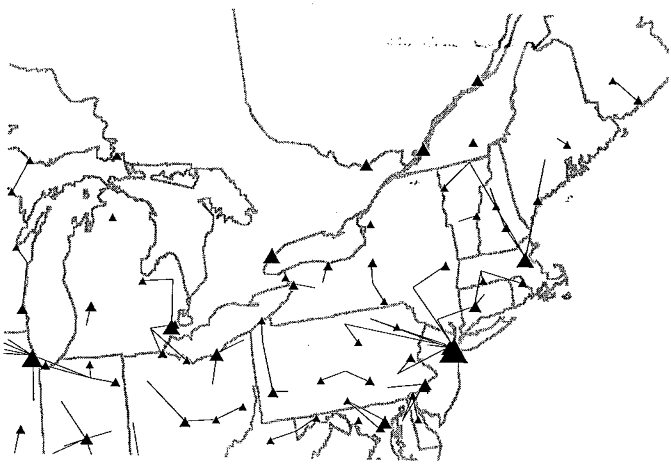
Trade Liberalization Without Regulation of Foreign Plants

This simulation examines the impact on FMMOs when trade policies are liberalized and fluid milk processors located outside the United States are not legally able to be regulated under the terms and provisions of federal orders. This is not to say that the products such processors might ship to the United States do not have to meet the necessary sanitary and phytosanitary standards or conform to the identity standards of the particular product being shipped. It simply assumes that the administrators of federal orders have no jurisdiction to require plants located outside of the United States to abide by the rules of the order in the marketing area to which they plan to sell class I products. In particular, such plants do not have to pay producers the blend price, nor do they have to contribute to the order's producer settlement fund. To the extent that class I differentials more than cover the extra cost of transporting raw milk and/or final fluid milk additional distances, plants in Canada and Mexico will thus have an incentive to ship fluid milk to the United States, using as an input either local raw milk or raw milk procured in the United States.

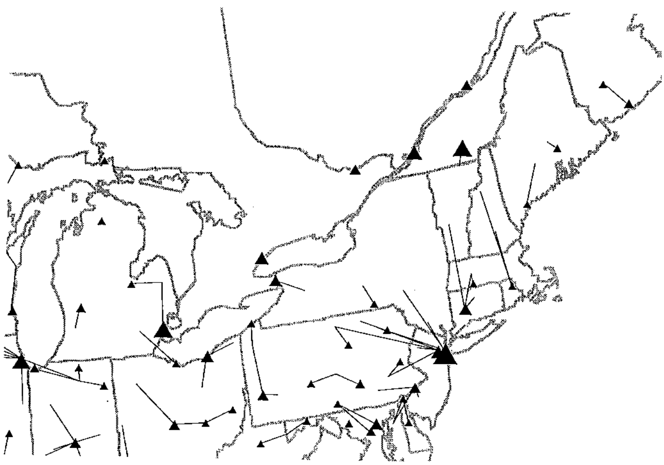
The degree of trade liberalization included in this particular scenario is quite extensive. In fact, complete free trade among the NAFTA countries in raw milk, intermediate products, and final products, both fluid and manufactured, is permitted. The quantity of imports able to enter any of the NAFTA countries from the rest of the world is left at the base case levels. It has already been argued that such trade would not involve fluid products and would therefore have no bearing on the performance of FMMOs. The supply of raw milk displaced by increased imports of manufactured products would, over time, diminish or continue to be utilized as a class III use. Either way, while there could well be competitive implications for the U.S. dairy sector, they are unrelated to the operation and performance of FMMOs so are of no concern to this study. The blend price in any particular order might well decrease as a result of increased imports of manufactured products but this does not in and of itself imply a problem with the functioning of federal orders.

Before proceeding, it is helpful to briefly review some of the underlying factors upon which this and subsequent solutions are predicated. First, the focus of the analysis is on the potential first round impacts and what they suggest about the incentive to circumvent marketing orders' regulations under liberalized trade. Indeed, because the model features no price response on either the supply or the demand side so it would be incorrect to interpret the results as being the long run equilibrium outcome. If the consequences of trade liberalization for marketing orders are severe, one would logically expect some kind of policy response to mitigate these affects. Secondly, although free trade with Canada is assumed, this of course is not the current policy. Nor is there any agreement as yet to even begin phasing in such a policy. However, many analysts believe that it is just a matter of time before dairy trade with Canada dramatically increases so analysing this scenario is beneficial. Along the Mexican border, the restrictions on dairy trade are already being relaxed under the terms of the NAFTA agreement, and will continue to do so at an accelerating pace. Finally, all uses of milk other than class I are assumed to be priced at the class III price. The implications of such an approximation are minimal because such prices are similar to class III prices anyway and the quantity of milk they utilize is relatively small.

Because for much of the North American region the outcome of this simulation looks much like the base case, there is little to be gained by viewing maps of the entire region. Rather, Maps 14 and 15 contrast the present trade liberalization scenario with the base case for those areas where substantial differences exist. Specifically, these figures compare raw milk assembly and fluid milk distribution movements in the vicinity of the northern U.S. border east of Michigan and along the border with Mexico. The former is our focus for this paper, but results are also presented for the Mexican results, in part to contrast the differences.

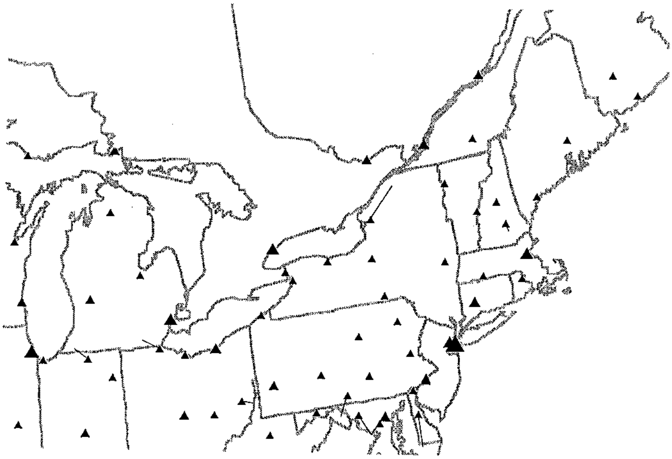


Base



Trade Liberalization

Map 14. Raw Milk Flows from Supply Points to Fluid Milk Processing Plants in the Northeast, Base and Trade Liberalization Solutions



Base

Trade Liberalization

Map 15. **Fluid Milk Distribution Flows from Processing Plants to Consumption Areas in the Northeast, Base and Trade Liberalization Solutions**

Consistent with expectations, class I differentials provide a substantial arbitrage opportunity, the exploitation of which requires that both raw and packaged milk be hauled longer distances. An indication of this is the average distance that raw milk from U.S. supply points must be hauled which increases by 3 miles over the base case. More significant is the increase of almost 14 miles to 39.2 for the average distance that packaged milk destined for U.S. markets must be transported. This suggests two things; first, supplies of U.S. farm milk are being shipped across the border only if they are located close to the border, and second, Canada and Mexico are diverting significant quantities of their own raw milk supplies to fluid plants for use in the production of packaged milk destined for U.S. markets. Moreover, these shipments of packaged milk are moving a considerable distance into the interior of the United States. There are 169 plants processing fluid milk in the United States, down from 190 in the base solution.

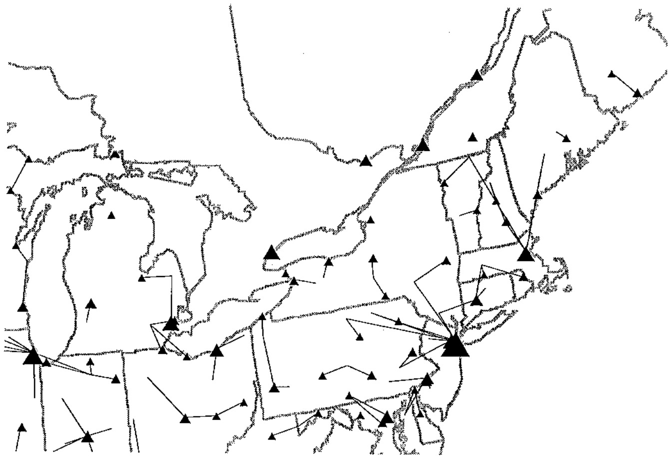
Interestingly there are no cross-border movements aimed at circumventing price regulation taking place in the Northwest. Several explanations can be offered for this. First, the fat-adjusted class I differential in the Pacific Northwest order at $1.25/cwt. is considerably lower than in the marketing areas located in the Northeast and Southwest. Hence, there is an insufficient incentive created by the class I differential to warrant shipping raw milk from the United States to Canadian fluid plants and back again as packaged milk. Second, the western part of Canada is a milk deficient area so there is simply no Canadian milk available for the production of packaged milk for U.S. markets. Moreover, the supplies of raw milk that do exist are a considerable distance from the major northwestern US markets. Finally, class I utilization in the Pacific Northwest order, at around 32 percent, together with the relatively low class I differential would imply a lower blend price than in areas such as the Northeast or Southwest. Thus, the incentive to avoid regulation under the order would necessarily be lower.

Class I Credit

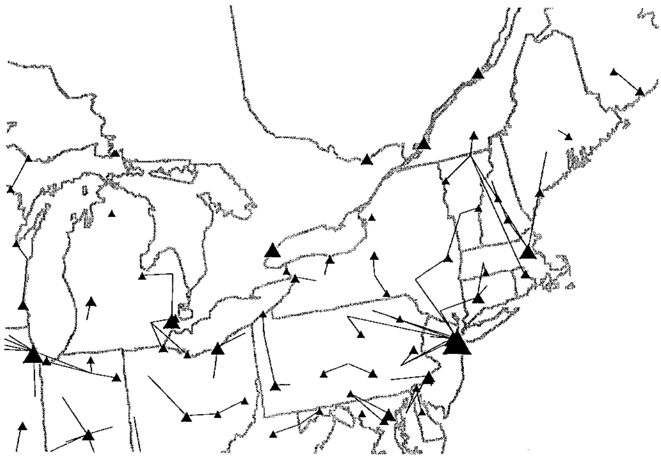
The final of the three principal simulations is referred to as the class I credit scenario. The motivation for this experiment stems from the concerns of regulators in markets near the Mexican border who, already, are proposing policy responses to the difficulties faced by marketing orders when trade is liberalized. In a nutshell, this simulation allows fluid plants in a predefined zone along the border to procure milk at less than the class I price. In fact, such plants would be able to purchase farm milk at the blend price and thereby remain competitive with unregulated plants located across the border. The mechanism by which a scheme such as this allows eligible plants to purchase grade A milk for class I use at less than the class I price would be to award a monthly credit equal to the difference between that month's class I and blend prices. The benefit is that the processing activity remains based in the United States and the portion of the revenue over and above the basic formula price is pooled, but the cost manifests itself as a lower price for producers. There is clearly some flexibility available in defining the class I credit zone. While a more inclusive zone is better able to prevent arbitraging of the class I differentials, this must be weighed against the resulting diminution of the blend price.

It is envisioned by advocates of this type of arrangement that the zone of plants eligible to receive the class I credit would be defined geographically. For example, all counties contiguous to the border, or a 50 mile wide district along the border, would encompass all eligible plants. While the model used in this study is very disaggregated, it does not include every single plant location in the country. Thus, the class I credit simulation is implemented as follows. First, all marketing areas receiving shipments of class I products from outside the United States under the previous free trade simulation are identified. They are then assigned a class I differential of zero and the free trade simulation is run again. In other words, any U.S. fluid plant can serve those markets and can procure the necessary raw milk to do so on an equal footing with foreign plants. The consumption area represented in the model by the city of Portland, ME is also assigned a zero class I differential even though that market was not served by Canadian-based processors in the free trade case.

As expected, the solution to this scenario looks much like the base case as far as the class I sector is concerned. In the north, only one shipment of raw milk from the United States to a fluid plant in Canada occurred; from Newport VT to Sherbrooke in Quebec. However, unlike in the free trade case, no shipments of packaged milk came into the United States from Canada. Along the Mexican border, there are small volumes of raw milk crossing the border in both directions, destined for plants of all types, while a small amount of packaged fluid milk is shipped from Mexico to the United States. All of these shipments are between points close to the border. Maps 15 and 16 illustrate the assembly and distribution pattern under this scenario in the same way as was presented for the free trade case.

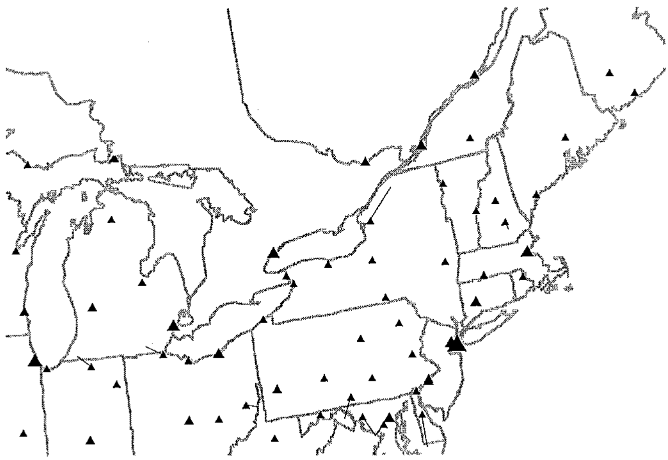


Base

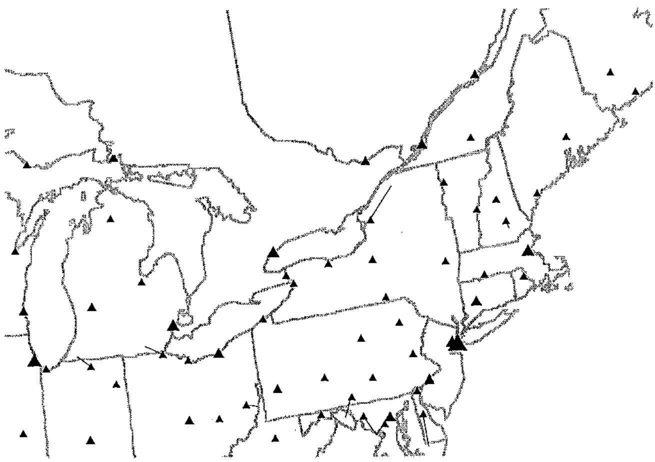


Class I Credit

Map 16. Raw Milk Flows from Supply Points to Fluid Milk Processing Plants in the Northeast, Base and Class I Credit Solutions



Base



Class I Credit

Map 17. Fluid Milk Distribution Flows from Processing Plants to Consumption Areas in the Northeast, Base and Class I Credit Solutions

Once again, the average distance that raw milk is assembled and packaged milk is distributed conforms with both expectations and theory when compared with the previous two simulations. Removing trade barriers and precluding the hauling of milk long distances solely to avoid class I differentials has the aggregate effect of allowing fluid processing plants to be located even closer to the markets they serve. Compared with the base case, the average distance that packaged milk is transported to U.S. markets falls slightly from 25.3 to 24.9 miles. Concomitant with this the average distance that U.S. farm milk gets hauled to fluid plants increases from 76.3 to 78.3 miles. Note that in the case of both assembly and distribution, these distances are less than for the previous free trade scenario where the incentive to avoid class I differentials existed.

Summary of Results

While the impression gained from the thematic maps is perhaps one of some change but nothing too drastic, this particular scenario causes a significant reallocation of milk among plant types, and across countries. In general, the United States ships less milk to fluid plants and more to manufacturing plants while in Canada and Mexico the reverse is true. In fact, the United States ships an incredible 17.8 percent less milk to its own fluid plants. This magnitude of change is surely significant and, moreover, as will be seen shortly, it is felt entirely in the Northeast and Southwest. There is no doubt that the reduction in the class I utilization that this implies for the affected orders will result in much lower blend prices for producers in those areas.

The raw milk diverted away from U.S. fluid plants is either sent to fluid plants in Canada and Mexico; or it gets shipped to manufacturing plants in either the United States, Canada, or Mexico. Fluid plants in Canada and Mexico draw in additional supplies of raw milk not only from the United States but from local areas as well. In fact, Canada increases deliveries of its own raw milk to fluid plants by a staggering 42.8 percent while Mexico does the same to the tune of 7.7 percent. The proportion of milk diverted from fluid plants in the United States to fluid plants in Canada equates to almost 3 percent of the quantity assembled at U.S. fluid plants in the base solution while for the Mexico, the same proportion is 8.2 percent. Finally, taking total deliveries to both fluid and manufacturing plants together, the United States suffers an overall loss of almost 5.2 percent in the level of activity at the processing sector. Of course, under such a scenario as this, those new or expanded plants in Mexico and Canada might well be U.S. owned but that would be of little comfort to U.S. producers receiving a much lower price for their milk.

The distribution side of the ledger is consistent with what has just been described with respect to raw milk assembly. Notably, fluid plants in the United States distribute 18 percent less packaged milk with the shortfall being made up of shipments arriving from Canada and Mexico. Canada now supplies 8.3 percent of U.S. fluid needs while Mexico supplies over 9.6 percent. Of the packaged milk that Canada now ships to the United States, a much lower proportion is produced from raw milk procured in the United States than is the case for Mexico. In fact, on a strictly volume basis, raw milk procured from the United States is 91.6

percent of the packaged milk that Mexico distributed to the United States whereas the same proportion in the case of Canada is only 38.5 percent. This disparity has implications for the way U.S. producer prices will be impacted and these will be discussed shortly.

The total cost of transporting milk and milk products after trade is liberalized increases by over 16 percent with only a modest increase in raw milk assembly costs but a staggering 220 percent increase in the cost of distributing packaged milk. These changes are consistent with the earlier finding of trade liberalization leading to milk being hauled a similar distance when assembled at plants but much further when distributed. It is apparent that the ability of foreign plants to avoid the higher class I price when procuring milk means that they have an incentive to both procure U.S. milk if it's near the border, and distribute to U.S. markets that are a considerable distance from the border.

The cost of assembling milk at manufacturing plants increases noticeably. This follows from foreign fluid plants, especially in Canada, drawing in much more local milk and thus depriving nearby manufacturing plants of their supplies. Consequently, those plants have to seek milk from further away, including from the United States.

Turning now to the specific orders impacted by trade liberalization, there are 11 such orders and the degree of impact is quite severe. These orders are those that border Mexico. The orders that border Quebec and Ontario and the Ohio Valley Order, which is close enough to Windsor, Ontario to be affected, even though it does not strictly border Ontario. Three of these are state rather than federal milk marketing orders. Although operating under different legal authority, the implication for state orders is no different from that for federal orders. In the case of Western New York and Southern California, the fluid processing industry is totally displaced. The State of California operates a statewide pool so the implication for the blend price will be muted somewhat. Nevertheless, these results portend significant price declines.

While three of these areas are not encompassed by federal orders, there exists something identical or akin to a class I differential in all cases. With lower quantities of class I milk being pooled in these areas under liberalized trade, the blend price will surely decline. However, competitive pressure for the supply of milk in the area may result in class III processors having to offer a higher price than they otherwise would simply to elicit an adequate supply so it is not really clear just how low the producer price would go. Even the least affected order, Ohio Valley with a 14.3 percent reduction in fluid milk distributed from U.S. plants, is materially impacted. With an actual class I utilization currently around 57 percent, this scenario would see that drop to 49.1 percent and at current prices, the result would be a 17 cents/cwt. reduction of the blend price. This amount would be sufficient to stress some producers.

An obvious question that follows from this outcome concerns the nature of the flow-on effect, if any, that occurs in nearby orders. Surprisingly, the answer appears to be that there is no such effect. For all affected orders, the nearby areas maintain the same pattern of assembly movements to fluid plants and distribution movements from those plants. All of the adjustment following trade liberalization appears to manifest itself through either the relocation of fluid processing, or through changes in the manufacturing sector at both the assembly and distribution levels. A further part of the explanation as to why the impact is limited to the border areas may have to do with the regional variation in the composition of raw milk. The problem of assembling milk at plants, processing it into final products, and distributing those products to demand areas is constrained not only by the cost of transportation but also by the availability of milk components in a given area. It simply may not be economical to substitute one supply area for another only slightly further away if the composition of the milk is such that a greater volume of milk must be acquired, and thus a higher cost incurred, just to obtain the same quantity of components.

Another question of interest in the face of trade liberalization relates to how the price surface changes. That is, how does the location value of milk to be used at fluid plants change under liberalized trading conditions. Very little change in the price surface is noticeable in areas far from the impacted regions. Hence, only the Northeast and Southwest sections for both the base case and the present scenario are displayed in Maps 8 and 9. Immediately obvious is that following trade liberalization, the price surface levels out as one moves across the border, especially in the Northeast. For example, southern Quebec and Ontario have a value in the range of 2 to 4 in the base case while just across the border in New York and New England the value is 12 to 14. The lower panel of Map 8 reveals that in these same areas, the value of milk at fluid plants increases in Canada and decreases in the United States. Similarly, the pronounced "U" shape to the contours along the Texas-Mexico border in the upper panel of Map 9 is opened up as trade is liberalized indicating a levelling out of the price surface. In general, these maps reveal that in the affected areas, the value of raw milk at fluid plants decreases as trade is liberalized and marketing orders are unable to regulate the purchase of as much of the grade A milk.

Finally, Table 1 reveals the extent to which the blend price is reduced in those orders impacted by trade liberalization. The procedure used to compute the blend price changes is an approximation and in some sense it represents a worst case scenario. That is, it assumes that the milk diverted from U.S. fluid plants as a result of trade liberalization will be priced at the class III price. This will indeed be the case if the milk gets used at a U.S. manufacturing plant. However, if the milk is procured by a plant, of any type, in either Canada or Mexico it would presumably be purchased at the blend price rather than the lower class III price. No supply would be forthcoming if foreign plants didn't offer producers the blend price. A number of other assumptions are also implicit in these computations; in particular, it is assumed that plants are regulated under only one order and that cross-hauling does not occur.

Actual class I utilization in each of the affected areas is noted for 1993, the year represented by the data. The change in the quantity of fluid milk distributed by U.S. plants into each of these areas is then used to calculate the class I utilization after trade is liberalized. With this information, and the assumptions just described, it is a straightforward calculation to arrive at the resulting blend price changes.

The range of price reductions varies from a low of 17 cents/cwt. in the New York-New Jersey and Ohio Valley orders to a high of over 90 cents in Western New York and

New England. The magnitude of these price changes is such that a good number of producers could reasonably be expected to go out of business or at least suffer severe financial stress. There is a greater variation in the severity of the price decreases in the Northeast compared with the Southwest although for producers in both regions, such an observation is of little consequence.

Federal Orders Under Liberalized Trade With Regulation of Foreign Plants

Under this scenario, the presumption is made that all the necessary legal mechanisms are in place to allow administrators of federal orders to regulate plants located outside the United States in cases where such plants ship class I products to U.S. markets. In essence, the simulation is set up to be identical to the previous trade liberalization scenario except that now, shipments of fluid milk from plants in Canada and Mexico incur the class I differential applicable at the demand markets that they serve. In other words, those plants are pooled under the orders in which they sell class I products.

Improbably, this simulation implies that raw milk procured from outside the United States, as well as that procured from within the United States, is subject to regulation if the plant in question ships any fluid milk products to regulated U.S. markets. There is no compelling reason to believe that federal orders would be at all concerned with the price at which foreign plants procure raw milk from local producers, even though such milk might be used to produce class I products for U.S. markets. However, there is no way in the model to discriminate between milk from different sources being assembled at an arbitrary plant when that plant is also able to ship to both foreign and U.S. markets. This point illustrates the difficulty that market administrators would face under this type of scenario. When a single facility comprising a multi-product plant located outside the United States is procuring milk from multiple sources, and that milk is commingled before being used to produce the variety of product types, it would be practically impossible for U.S. auditors to determine whether or not raw milk from the United States is used in the production of fluid milk destined for the United States, or if it is instead used to produce soft products, say, for the foreign market in which the plant operates. Recall too that the rules of origin clauses in the NAFTA treaty do not deem this to be illegal because those rules only require that raw materials be procured from a NAFTA country, as opposed to locally.

Despite this conceptual difficulty, the simulation is performed and results are obtained that differed only slightly from the base case. In other words, the ability to regulate foreign plants almost entirely mitigates the impact of trade liberalization that would be felt in the absence of such regulatory capability. In the Northeast, there are no shipments of fluid milk from Canadian plants to U.S. markets as there were in the previous trade liberalization scenario. In the Southwest there are 3 such shipments from Mexico to the United States; 354,000 cwt from Nogales to Tucson, AZ in the Central Arizona order, 567,400 cwt from Nuevo Laredo to Laredo, TX in the Texas order, and 538,700 cwt from Ciudad Juarez to Las Cruces, NM in the New Mexico-West Texas order. These quantities represent, respectively, 3.3, 1.7, and 8.5 percent of the total fluid milk distributed in these orders. Given the conceptual difficulty of formulating this simulation, such quantities would represent a very conservative lower bound under such a scenario. That is, if milk procured from outside the United States could be kept separate, for auditing purposes, from that procured within the United States, then one would expect that the amount of fluid milk entering the United States would, at the very least, be no less, and would in fact probably be greater than the amount suggested here.

Under this scenario, no U.S. raw milk is assembled at Canadian fluid plants while 1,854,092 cwt of U.S. raw milk is shipped to Mexican fluid plants. This amount is almost 400,000 cwt less than the amount of fluid milk that Mexico shipped to the United States implying that some of it is distributed as fluid milk within Mexico. There is also a single shipment of raw milk from Ciudad Juarez, Mexico to a fluid plant in Las Cruces, NM. A small amount of raw milk also crossed borders, both Mexican and Canadian, and in both directions, to be assembled at manufacturing plants.

CONCLUSIONS

In the short run, without or before prices equilibrate across countries:

- immediate free trade would be very hard on Canadian farmers; but
- not as hard on Mexican farmers;
- price pressures will force cost-reducing structural change.

Free trade, after prices re-equilibrate:

- will likely result in various combinations of commerce between the United States and Canada; but
- trade with Mexico is likely to be larger in total and more dominated by specific products.

Free Trade between United States and Canada tends to:

- turn domestic flows of west-to-east in United States and east-to-west in Canada into
- north-to-south flows in the East and south-to-north flows in the West.

U.S. Class I differentials:

- distort trade incentives along both borders; but
- the impacts are isolated to border areas.

Partial trade liberalization (e.g., specific products):

- may/will lead to further trade distortion; and
- is not a good strategy for transition to free trade.

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