

# **Potential Implications of Freer Trade for the US and Canadian Dairy Sectors: A Spatial Analysis**

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This paper presents key results from a study of the optimal trade flows of dairy products and marginal values of raw milk that are predicted by a spatial model of the US and Canada under conditions of free trade or current trade restrictions (Doyon).

The study employs highly disaggregated spatial optimization model that represents the production, assembly, processing, distribution, and consumption activities characteristic of dairy market operations. It focuses on the adjoining regions of the Northeastern US and the central Canadian provinces of Ontario and Quebec, with a much more aggregated representation of the rest of the US and Canada. Analytically, the study compares a baseline predicated on current conditions of current highly restricted trade between the two countries with 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.

## **Analysis of Trade Between the US and Canada Without Domestic Policy Complications**

Observers of the dairy sectors in the US 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 each province would have a slightly different set of challenges to their provincial programs. The US Federal Milk Marketing Order system would find it difficult to enforce producer prices on Canadian shipments of packaged milk to US locations. A few states have programs that would be impacted similarly. The implications of North American trade for Milk Marketing Orders will be discussed elsewhere in this conference, based on Bishop's work.

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 behaviors are highly price inelastic helps to support the robustness of this approach.

## Scenarios

The results of policy changes on trade patterns are evaluated relative to a base scenario. The Base scenario chosen for this study represents pre-NAFTA and pre-GATT trade conditions. Therefore, the Canadian regions are not allowed to export dairy products to the U.S., and the U.S. is not allowed to export dairy products to the Canadian regions in the Base scenario. The Base scenario is a benchmark, a point of reference. The effects that policy changes have on trade patterns are evaluated in terms of changes relative to the Base. This needs to be understood with the proviso that the Base results represent the economic optimum for the period studied, notwithstanding all other factors. To the extent that the current status of Canadian and U.S. markets deviate from the Base, which it does to some extent, the magnitude of “predicted” impacts of free trade are altered.

In the Free Trade scenario, all dairy products, as well as raw milk, are permitted to move freely across the US-Canada border. Free trade is not likely to occur in the short run. However, it 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 US 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 US aggregated excess supply point, which together represent the rest of the relevant components of the US and Canada.<sup>2</sup>

## Results

The simulation results can be expressed as changes in quantity trade flows and shadow prices. Trade flow maps provide a pictorial view of the results. Three aggregated regions comprised of Northeast U.S. states are defined to simplify the presentation of some of the results. Northern New England (NNE) is comprised of Vermont, Maine and New

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An intermediate scenario in which the US is allowed to export yogurt and ice cream to Canada is included in the original study but is not reported here. This scenario is based on the results of a GATT dispute that was adjudicated in favor of the US but which continues to be resisted by Canada.

Hampshire, states having excess supply. Southern New England (SNE) is comprised of the usual Rhode Island, Connecticut and Massachusetts, plus New Jersey. This region is grouped because it represents states having significant excess demand. Maryland, Washington DC and Delaware formed the Middle Atlantic (MAT) region. New York and Pennsylvania are not aggregated.

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 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 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.

### Base Scenario

A summary of the net interregional trade flows for all products under the Base Scenario is presented in Map 1.

*CAED=Canadian Aggregated Excess Demand*

*USAES=U.S. Aggregated Excess Supply*

*NNE=Northern New England*

*SNE=Southern New England*

*MAT=Middle Atlantic*

### **Map 1. Net Interregional Trade Flows: Base Scenario-All Dairy Products, in Million Kilograms of Products (milk equivalent).**

In the base scenario, Quebec exports butter, cheddar cheese and nonfat dry plus condensed milk (NFDC) to Ontario and the CAED. Quebec also exports specialty cheese to the CAED, and imports yogurt and frozen dessert from Ontario. Ontario exports frozen dessert and yogurt to the CAED and Quebec, and exports cheddar and specialty cheese to the CAED.

New York imports butter from Vermont, Pennsylvania and Maryland in the Base scenario. However, New York exports frozen dessert and yogurt to Pennsylvania, and

Maryland, and imports frozen dessert from Vermont. New York also exports cheddar cheese, NFDC milk and specialty cheese to SNE

Pennsylvania exports butter to Maryland, New York and New Jersey, while it imports yogurt from New York. Pennsylvania exports yogurt to the USAED, Maryland, DC, Delaware and New Jersey. Pennsylvania also exports cheddar cheese, NFDC milk and specialty cheese to New York city, SNE and MAT. Vermont exports butter and frozen dessert to New York, and frozen dessert to Maine. Vermont also exports cheddar cheese, specialty cheese and NFDC milk to New York, SNE and the other NNE regions. The USAES exports cheddar cheese to Western New York, Pennsylvania and SNE, while it exports NFDC milk to New York, Pennsylvania, SNE and MAT.

In Northeast U.S. the supply (farm value) shadow prices increase from the Northwest to the Southeast under the Base scenario. In Quebec, shadow prices increase from East to West, but increase from West to East in Ontario. Basically, the shadow prices are higher towards the large metropolitan centers of Toronto and Montreal. In general, supply shadow prices are higher in Canada than in the Northeast U.S.

In the Canadian regions, processing (plant value) shadow prices increase from East to West; whereas in Northeast U.S. they increase from Northwest to Southeast. Processing shadow prices are much higher in Canada than in the U.S. regions, and milk is valued highest in Northeast Ontario.

### **Free Trade Scenario**

Movements of fluid milk between the U.S. regions and Canada are not optimal under Free Trade. This is a consequence of the considerable difference between the transportation cost of fluid milk and raw milk.

Based on relative marketing costs, some cross-border movements of raw milk are evident in the Free Trade scenario. Raw milk moves from New York to Ontario and Quebec fluid milk plants and from Quebec to Vermont specialty cheese plants. Although a limited amount of raw milk moves 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. Ultimately, equilibrium tendencies would pull prices down toward the levels suggested by the model.

Quebec increases 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 increases its net imports of raw milk for fluid milk processing by 8 points. Similarly, Ontario increases its net raw milk imports for fluid milk, ice cream and cheddar cheese by 34, 7, and 3 points, respectively. New York shifts 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 results from the combined effect of eliminating raw milk imports from New York and diverting local supply to a dry and condensed milk plant.

Interregional flows under Free Trade are summarized in Map 2.

*CAED=Canadian Aggregated Excess Demand*

*USAES=U.S. Aggregated Excess Supply*

*NNE=Northern New England*

*SNE=Southern New England*

*MAT=Middle Atlantic*

**Map 2. Net Interregional Trade Flows: Free Trade Scenario--All Dairy Products, in Million Kilograms of Products (milk equivalent).**

Under free trade conditions, Quebec relinquishes market share for all dairy products except cheddar cheese and ice cream. Quebec significantly increases net exports of cheddar and shifts from being a net importer of ice cream to a net exporter. 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 USAES result in a 33 percentage 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 NFDC milk to Maine did not compensate for the loss of the CAED and Ontario NFDC markets to USAES. Moreover, Ontario, and to a lesser extent USAES, penetrates part of Quebec's domestic market for NFDC milk. As a result, Quebec is expected to lose 4 NFDC milk plants and shifts from being a net exporter to a net importer of NFDC milk. Quebec also switches from being a net exporter to a net importer of yogurt.

Quebec significantly increases exports of cheddar cheese under the Free Trade scenario trade conditions. Traditional East to West movements of cheese in Canada are replaced by North to South movements. Quebec loses its CAED and Ontario cheese market to USAES and New York, but exports to New England more than compensate for the lost market. However, Quebec's farm and plant values for milk components decline greatly in the Free Trade scenario.

Ontario improves its trade position in the Free Trade scenario for all dairy products except yogurt and specialty cheese. Net imports of specialty cheese slightly increase, and Ontario shifts from being a net exporter of yogurt to a net importer and from a net importer of cheddar cheese to a net exporter.

The Free Trade scenario has little effect on Ontario ice cream trade, but there is a negative impact on yogurt trade. Ontario's loss of the CAED cheddar cheese market to USAES is more than compensated by cheddar cheese exports to New York. Ontario also reduces net imports of butter and NFDC milk by 17 percentage points and 117 percentage points, respectively. The reduction in NFDC milk net imports is explained by new exports to Quebec, New York and SNE. As a result, the Western Ontario NFDC plant is replaced by a larger plant in Eastern Ontario. Significant decreases in the value of Ontario farm and plant

milk components are predicted under free trade conditions.

For New York, imports of yogurt and NFDC milk decrease by 50 and 343 percentage points, respectively. Cheddar cheese exports decrease by 2 percentage points, and specialty cheese exports are reduced by 8 percentage points. However, the values of plant milk components and the farm milk value are greatly improved relative to the base.

By decreasing net imports of butter and increasing net exports of specialty cheese and NFDC milk, NNE gains trade in hard products. However, NNE significantly increases its net imports of yogurt and shifts from being a net exporter of ice cream and cheddar cheese to a net importer of these two products. Although, NNE farm milk value and plant components values do not increase as much as for other Northeast states, they nonetheless increase significantly.

All Northeast U.S. region supply and processing shadow prices increase in the Free Trade scenario. Significant decreases occur in the value of central Canadian farm milk and plant milk components. Table 1 illustrates the implications for calculated milk values.

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

	SNE			NNE			NY			ON		
	Supply	Fat	SNF	Supply	Fat	SNF	Supply	Fat	SNF	Supply	Fat	SNF
Fluid	26%	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%
Speciality 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%

	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%
Speciality cheese	46%	20%	-3%	-77%	-52%	-32%	0%	0%	0%
Dry & Condensed	56%	41%	-7%	-75%	-51%	-28%	0%	0%	0%

## Sensitivity Analysis

Twelve simulations are run to determine the sensitivity of the analysis to small changes in the cost functions. The model does not appear to be sensitive to interplant transfer cost and

to processing cost, but it is sensitive to distribution and assembly costs. If one believes that distribution and/or assembly costs differ notably from those used in this study, either regionally or between one another, then it would be wise to run the analysis with new data. The magnitude of trade flows will be affected before their basic character is changed.

## Summary

The results indicate that geographic proximity is an important factor in determining trade impact on regions. Physical trade in New York and NNE are impacted somewhat by free trade, primarily due to imports from Quebec. The trade levels of the other Northeast US regions are not notably affected. The USES gains the majority of new exports to Canada in the Free Trade scenario. Most of the USES exports are, however, directed to the CAED point. **Thus, free trade tends to alter somewhat the predominant flow of dairy products from east to west in Canada and west to east in the U.S by creating North-South trade.** All regions in the Northeast US, especially New York and Pennsylvania, register a significant increase in shadow prices under the Free Trade scenario.

Fluid milk processing and distribution is minimally affected by either trade scenario. It appears that marketing costs alone are enough to essentially insulate fluid milk from free trade. This is particularly interesting because purchases of US packaged milk by Canadian shoppers at nearby shopping areas, many of which have been set up specifically for cross border shoppers, has been a sore spot with Canada. The Dairy Farmers of Canada have estimated that approximately 3% of the Canadian fluid milk consumption in 1991 could be attributed to US cross-border shipments. This obviously 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% to 5% 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 might 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 fare well with regards to cheese when trade is allowed between U.S. and Canada. Quebec cheese processors have a competitive advantage and can ship cheddar and specialty cheese to New England. Ontario cheese processors also have a competitive advantage relative to western and mid-western US sources and can ship cheese to New York. These competitive advantages are robust and resistant to changes in marketing costs. On the other hand, the USAES has a clear competitive advantage for cheese in Western Canada. Despite the loss of the domestic market, Quebec and Ontario more than compensate with cheese exports to the Northeast U.S.

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% is not necessary to protect the Canadian cheese industry. Papillon (1995) found that a tariff level of 30% to 40% would be as effective as a 300% tariff level. Thus, it would be to Canada's advantage to lower Canadian tariffs on

cheese in exchange for greater access to US markets.

Through shadow prices, the model confirms that any degree of trade liberalization will change the intrinsic value of raw milk, especially in Canada. Although the price effect on raw milk has not been directly estimated, changes in the supply shadow prices still allow for conclusions. Using the average net milk price at the farm for Quebec and New York in May 1995 and the predicted changes in supply shadow price from the Base scenario to the Free Trade scenario, a price effect can be estimated. In Quebec, dairy farmers received an average of \$51.00 per hectoliter in May 1995. Milk price would have been reduced to \$39.00 per hectoliter (-24%) with the implementation of Free Trade. New York dairy farmers received an average of \$40.50 (Canadian) per hectoliter in May 1995. Under Free Trade conditions, average price in New York for raw milk at the farm would rise to \$46.00 per hectoliter (+14%). These price effects should be viewed as the first step in a price adjustment process following a shock to the market structure. The final equilibrium would most likely imply a smaller price decrease for Quebec, and a small price increase for New York.

The model also suggests that consumers will be affected by trade liberalization in the dairy sector through consumer price changes. A look at the processing shadow price provides some insight as to how consumer prices of dairy products might be affected. Thus, Canadian consumers should realize significant price decreases with trade liberalization. In contrast, Northeast U.S. consumers could see price increases in the Free Trade scenario. Obviously, these results do not take into account any price pressures from world trade at large. Thus, the entire price structure could shift up or down with world wide conditions, but the relative impacts reported here should hold consistently regardless.

For many it may be tempting to assume that partial free trade is less disruptive and an easier intermediate step toward total free trade. However, when trade restrictions are lifted on the basis of product sector, new distortions are created which may be worse in the final analysis. Although not reported in detail here, the results of the partial trade liberalization scenario mentioned earlier show substantially greater trade in yogurt and ice cream than the Free Trade scenario suggests is optimal.

## **Conclusions**

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.

Drawing on several pieces of research done at Cornell, the following general conclusions seem to emerge.

In the SR, 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 US and Canada
- but trade with Mexico is likely to be larger in total and more dominated by specific products

Free Trade between US and Canada tends to:

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

US 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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