# ANALYZING THE POTENTIAL FOR INCREASED TRADE IN DAIRY PRODUCTS: A CANADIAN PERSPECTIVE

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## INTRODUCTION

The U.S. and Canadian dairy industries have been protected from foreign competition for decades. The Uruguay Round of multilateral trade liberalization forced Canada and the United States to replace their very restrictive import quotas with tariffs. However, the tariffs on dairy products are high enough to leave each countries complex milk marketing system largely intact (Meilke and van Duren 1995, IATRC). The recent challenge to Canada's tariffs, by the United States, on dairy and poultry products has the potential to upset the current trading arrangement. The outcome of the challenge will not be known for several months (Meilke; Martin).

Nonetheless, the warm winds of trade liberalization are gathering speed and the dairy industries in Canada and the United States will not be able to lean against this wind indefinitely. A first step towards increased market integration might be liberalized trade in milk and/or dairy products within the current, or an expanded NAFTA agreement (Meilke and van Duren 1996). Partial trade liberalization has several disadvantages from the perspective of Canada. Dairy product prices in Canada and the United States are well above world market levels and Canada's are significantly above those in the United States. Continental free trade would reduce Canada's prices to U.S. levels. Canadian prices would decrease because of the large size of the U.S. dairy industry compared to the North American market. Moreover, North American trade liberalization would not provide the general equilibrium price increases that would follow from multilateral trade liberalization (Graham, *et al.*; Meilke and Larue; Roningen; Roningen and Dixit). As a result, adjustment costs in Canada from free trade with the United States may be large. In fact, adjustment costs in Canada may be larger than they would be from free trade with all industrial market economies.

The purpose of this paper is to highlight the factors that determine the direction and the size of trade flows in milk and dairy products between Canada and the United States, with North American trade liberalization. By identifying the key economic factors, the importance of various assumptions necessary in modelling the Canadian milk market are exposed. Free trade is analyzed with a static, nonspatial, partial equilibrium model. The model employs parameter estimates derived from a literature survey. The literature survey is helpful in identifying several estimation problems and in providing a range of estimates for essential parameters. The results from the economic model and the literature survey provide a guide for future research.

## BUILDING BLOCKS

Seven key building blocks are necessary for the construction of any economic model of the Canadian dairy sector (Agriculture Canada 1980; Stonehouse and Kizito; Cozzarin). These building blocks include: 1) the marginal cost of producing milk; 2) the supply elasticity of milk; 3) the shut-down price for milk production; 4) the demand elasticity for fluid milk; 5) the demand elasticity for industrial milk; 6) the difference between Canadian and U.S. processing margins; and 7) the landed price of U.S. milk and dairy products in Canada.

### Marginal Cost of Producing Milk

Supply management involves setting a producer price, based on a cost of production formula, and restricting the level of production to the quantity that is demanded at this price. Since the 1970s a number of key agricultural sectors (dairy, poultry, eggs) have been regulated under Canada's supply management policies. The economic implications of supply management are well known (Barichello, 1981); Stonehouse; Barichello and Cunningham-Dunlop; Forbes, Hughes and Warley; and Schmitz and Schmitz). Supply control policies ensure a sizeable income transfer from consumers to producers of these commodities. The welfare gains to producers, however, are outweighed by the welfare losses to consumers.

Figure 1 illustrates the net welfare loss due to Canadian dairy policy[1]. Without supply control, the equilibrium price is $P_e$ and the quantity demanded and supplied at this price is $Q_e$. However, supply control restricts output to Q, resulting in a demand price of $P_d$ and a supply price (marginal cost) of $P_s$. The difference between the two prices ($P_d$ - $P_s$) is the annual rental rate for quota. The welfare loss is area ABC.

The departure from marginal cost pricing is a distinguishing feature of supply management. The size of the departure from marginal cost pricing is a key element in 1) determining the size of the efficiency losses, and 2) determining the size of the impact of trade liberalization. During the past 15 years many attempts have been made to measure the

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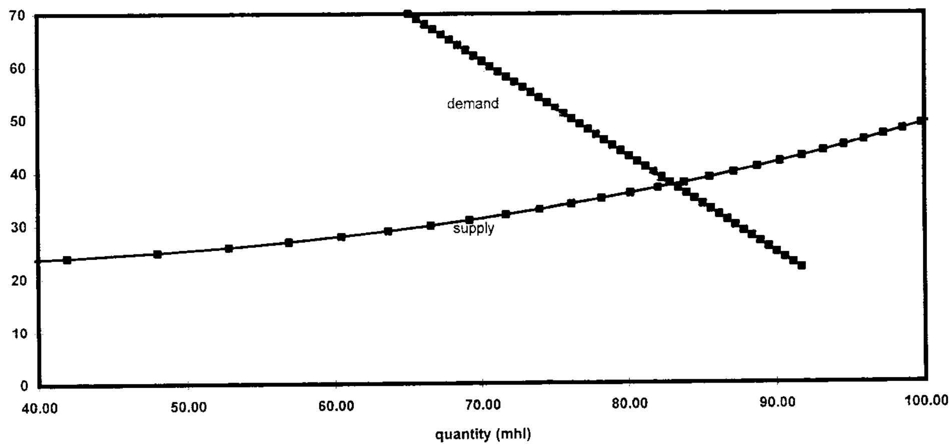
[1] Figure 1 has been simplified by assuming there is only one type of milk that fetches only one price.

departure from marginal cost pricing in the Canadian dairy industry. Some of these efforts involve accounting procedures. Others involve the statistical estimation of cost relationships. Each approach has strengths and weaknesses.

**Figure 1. Price Determination with Supply Control**




The most direct approach, to obtain a value for marginal cost, is to use cost of production survey data. Cost of production data is used to compute the average cost of milk production. It is then assumed that an estimate of average variable cost provides a crude approximation to marginal cost (Barichello 1981; Barichello and Stennes). Although the cost of production approach is simple, it has several drawbacks. First, unit costs of production vary considerably between farms due to variations in size, technology, and location. Second, because average costs vary substantially by output level, it is important that sample farms be representative and that the sample includes the largest firms in the industry. Third, the opportunity costs of farm supplied inputs (family labour and returns to management and equity capital) are unknown and difficult to proxy. Fourth, if farm production is characterized by joint production of multiple outputs, using shared inputs, cost allocation becomes arbitrary. Finally, under supply management, there is an incentive for farmers to inflate input usage and reported costs, since these are used in determining their administered price.

If there was a rental market for production quota then milk production would move from inefficient producers to efficient producers, over time. The rental rate of quota also would be directly observable. If the rental rate is known, a well behaved supply function can be derived from the profit function (or restricted profit function in the short-run). Once the supply function is estimated the departure from marginal cost at any output level can be determined[2]. However, there is no rental market for Canadian milk quota and the rental rate is not observed. Instead, dairy quotas are exchanged as capital assets and confer the right to produce and market milk indefinitely. In this situation, two alternative strategies can be pursued to overcome the problem of estimating the milk supply function.

Another strategy to follow in determining marginal cost is to exploit the duality between profit and cost functions. By using farm-level data it is possible to estimate econometrically a joint cost function. The marginal and average cost of milk production can be derived from the cost function and then used to determine the departure from marginal cost pricing. This approach does not require any information on quota rental rates.

Moschini (1988a) used the joint cost function approach to analyze aggregate supply response with supply management. He also estimated a joint cost function for the Ontario dairy sector using farm-level cost data from 1980 to 1986 (Moschini 1988b). The departure from marginal cost was estimated as the difference between the farm level milk price and marginal cost (and average cost) at the optimum long-run scale of production. At the optimal output level (which was about 5,000 hl of milk per year), the minimum value of average cost was estimated to be \$26.10/hl. The average price of industrial and fluid milk during the study period were \$30.70/hl and \$36.90/hl, respectively. Thus, for industrial milk, the departure from marginal cost pricing was 15 percent. For fluid milk, the extent of departure was over 29 percent (Moschini and Meilke).

Milk quota confers the permanent right to produce milk and to sell it at privileged prices. The production rights provide a stream of annual returns to the producer. According to the capital asset pricing model, the capitalized quota value is equal to the sum of the discounted future returns. That is,

(1) $V_o = R / i$

where ($V_0$) is the current capital value of the asset, (R) is the average annual return on the investment and (i) is the average discount rate.[3] The return, R, can be interpreted as the difference between price and marginal cost.

If two of the three variables in equation (1) are known, the value of the third variable can be derived from the formula. Since the capitalized quota values ($V_0$'s) are observable, it is possible to recover from equation (1) the departure from marginal cost pricing (R) if the discount rate is known. But what is the appropriate discount rate? In theory, the discount rate reflects the riskiness of the asset. In this case the major risk is that the right to produce milk at privileged prices might be lost (Lermer and Stanbury). Expected capital gains, expected nominal interest rates and the planning horizon will also affect the risk assessment. These factors are difficult to quantify and incorporate into the choice of a discount rate.

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[2] Babcock and Foster used this approach to determine the marginal cost of flu-cured tobacco production in North Carolina.

[3] Note that this simple capitalization formula assumes an infinite planning horizon, no growth in asset value and zero covariance between the value of the asset and aggregate consumption (Varian:368-386).

Consequently, discount rates as diverse as 0.14 (Veeman) and 0.32 (Barichello 1984) have been considered appropriate to estimate the departure from marginal cost pricing. Even for assets as closely related as fluid milk quota and industrial milk quota, estimated rates of return vary considerably over time (Moschini and Meilke; Barichello 1995). A shortcoming of the capital asset pricing model is that of the three variables contained in formula (1), only one is known with certainty. The other two variables are equally difficult to estimate with precision.

Barichello (1984) has proposed another method to determine marginal cost using the capital asset pricing model. In Ontario, there are markets for two types of industrial milk quota, used and unused. Exactly the same set of policies regulate both markets, but the per unit values of the quotas are different. Note, that used quota bought in year (t) can be used to ship milk beginning in year,(t+1). However, milk can be shipped under unused quota immediately. The difference in value between used and unused quota can be considered a return on investment in current milk production. Note that unlike imputed returns on investment, the return on an investment in current quota (milk production) is market determined. The rate of return reflects the riskiness of the asset, nominal interest rates and the time horizon. The approach is analytically simple and empirically appealing. Obviously, the nominal discount rate retrieved in this way will vary over time. However, it is one of the few ways to avoid the arbitrary choice of a discount factor.

Hickling used the Barichello approach to retrieve the annual rental rate of milk quota and the marginal cost of milk production. He estimated the departure from marginal cost to be 43 percent. Some experts have argued that a departure of 43 percent is too high (Halpern *et al.*). Consequently, while this is an intuitively appealing approach to obtain the departure from marginal cost pricing, it seems to generate unrealistically high values for the discount rate. High discount rates produce implausibly low marginal cost estimates.

Chen and Meilke have proposed a dynamic variation on Barichello's approach. The authors estimate the marginal cost of Ontario milk production from 1980 to 1991. The estimated marginal costs are consistently higher than those obtained using Barichello's method (in 1985-86 marginal cost were $22/hl vs. $12/hl)[4]. Consequently, the estimated departures from marginal cost pricing are consistently lower in Chen and Meilke's study than similar estimates obtained using Barichello's approach.

The choice of any single marginal cost estimate is fraught with difficulties and is bound to be controversial. However, for empirical analysis a point estimate is needed and $33/hl is assumed to be the margin cost of producing the current quantity of milk. The estimate of $33/hl is consistent with cost of production surveys. Furthermore, a $33/hl marginal cost implies a discount rate of 20 percent, based on 1993 Ontario used industrial milk quota values. A 20 percent discount rate is in the mid-range of discount rates estimated by other economists.

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[4] Unless otherwise noted all dollar values are in Canadian currency.

## Supply Elasticities

Information on the departure from marginal cost pricing provides one point on the underlying supply function. It does not describe the shape of the supply function nor the responsiveness of milk supply to free market price changes. Most Canadian studies involving supply managed commodities borrow supply elasticity estimates from analysis conducted using U.S. data. Regulatory differences have introduced dissimilarities in the average size and capital structure of dairy farms in Canada and the United States (Agriculture Canada 1995a, USDA). Identical supply responses cannot be expected in the United States and Canada. Nonetheless, there are similarities in production practices and input prices in the two countries. As a result, supply elasticities estimated using U.S. data are indicative of the responsiveness of the underlying Canadian supply function.

Estimated long-run supply elasticities for milk derived from several U.S. studies are presented in Table 1. The estimated supply elasticities vary considerably across studies depending on the structural characteristics of the models, the data sets, the time period of analysis, and the expectations mechanism used. All of the estimated long-run supply elasticities are greater than 0.5, except for the estimate obtained by Howard and Shumway. In four of the studies the estimated long-run supply elasticity is greater than one. The American Agricultural Economics Associations Task Force on Dairy Marketing Orders in summarizing their survey of milk supply elasticities came to the conclusion that... "quite high long-run supply elasticity, say more than two, makes a good deal of economic sense given modern dairy production methods (p. 51)" which provides an argument against using a small supply elasticity in the Canadian context.

**Table 1. Estimated Long-Run Supply Elasticities for Milk in the United States**

| Source | Study Period | Supply Elasticity[a] |
|---|---|---|
| Elterich and Masud | 1966-78 | 2.8 |
| Dahlgran | 1953-83 | 1.0(6)-2.0(16) |
| Thraem and Hammond | 1949-78 | 1.15 |
| Chavas and Klemme | 1960-82 | 0.89(5)-2.46(10) |
| LaFrance and de Gorter | 1950-80 | 4.8-8.0 |
| Kaiser et al. | 1949-85 | 0.80 (5) |
| Howard and Shumway | 1951-82 | 0.23 |
| Helmberger and Chen | 1966-90 | 0.58 |

[a] The numbers in the parentheses are the number of years allowed for the indicated supply response.

**Shut-Down Price**

Most economists pay little attention to the price at which the production of a commodity falls to zero[5]. Policy changes typically involve small price changes which seldom push prices near the shut-down point. However, MacGregor, *et al.* did consider the issue, in a mathematical programming context, when they analyzed changes to Canada's subsidized rail freight rates. Fox, Roberts and Brinkman discuss a non-linear functional form, for a supply curve, that allows for an explicit shut-down price without imposing an inelastic supply response. In some situations the shut-down price can be important, especially if price declines are expected to be large. Supply response must become very price elastic as prices fall close to the shut-down price.

The only source of information about possible shut-down prices for milk production, are the various cost-of-production surveys. Survey data suggest that for the more "efficient" farms to produce a hectolitre of milk in 1993-1994, the variable cost was around $23-24/hl (ODFAP; OMMB). The variable cost estimate included the variable cost of milk and crop production plus the cost of hired labour. Therefore, a value of $22/hl was selected in this study as the price at which Canadian milk production would go to zero, since some farms have lower costs than the "average" figure.

**Demand Elasticities for Fluid and Industrial Milk**

Milk is consumed either in fluid form or as processed products made from industrial milk (butter, cheese, yogurt, ice cream, and skim milk powder). The demand elasticity for each product is different. By using observed retail prices, the demand elasticities for Canadian dairy products can be estimated using standard econometric techniques.

Table 2 contains some direct price elasticities for fluid milk estimated for the most part with Canadian data. The estimates for the United States are included for the purpose of comparison. Table 2 shows that most of the elasticity estimates for Canada vary between -0.20 and -0.40.

About 70 percent of the raw milk produced in Canada is used in processed dairy products. Despite its large share of the raw milk market, few studies have estimated the price elasticity of demand for Canadian industrial milk products. Goddard and Amuah found the own-price elasticity of demand for butter during the 1973-86 period to be -0.78. Veeman and Peng estimated the following direct price elasticities for various processed dairy products: butter (-1.11), ice cream (-0.62), yogurt (-0.81), cottage cheese (-0.21), cheddar cheese (-0.66) and other cheese (-1.22). Moschini and Moro report a matrix of own-price and cross-price elasticities of demand for fluid milk, butter, cheese and other dairy products. The elasticities estimated by Moschini and Moro are listed in Table 3.

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[5] Studies using linear supply curves with an inelastic supply response imply there is positive output at a zero price.

**Table 2. Estimates of the Own-Price Elasticity of Demand for Fluid Milk**

| Source | Study Area & Period | Price Elasticity |
|---|---|---|
| Kinnucan and Forker | U.S. | -0.04 |
| Kinnucan | Buffalo, U.S. | -0.73 |
| Thompson and Eiler | U.S. | -0.20 |
| Goddard and Tielu | Ontario: 1971-84 | -0.25 |
| Venkateswaren and Kinnucan | Ontario: 1973-84 | -0.19 |
| Stonehouse and Kizito | Canada: 1971-88 | -0.01 (Stnd.)<br>-0.31 (L-Fat) |
| Curtin et al. | Canada: 1961-84 | -0.24 |
| Agriculture Canada 1980 | Canada: 1970-80 | -0.02 (Stnd.)<br>-2.79 (L-Fat) |
| Goddard and McCutcheon | Ontario: 1981-89<br>Quebec: 1981-89 | -0.24<br>-0.23 |
| Goddard and Tielu | Canada: 1977-94 | -0.38 |
| Moschini and Moro | Canada: 1962-88 | -0.34 |
| Fang | Ontario | -0.11 |
| Helmberger and Chen | U.S.: 1966-90 | -0.08 (Fluid) |
| Veeman and Peng | Canada | -0.59 (Stnd.)<br>-0.11 (L-Fat) |

**Table 3. Price Elasticity of Demand for Milk and Milk Products in Canada.**

| | Milk | Butter | Cheese | Other Dairy |
|---|---|---|---|---|
| **Milk** | -0.34 | 0.12 | -0.14 | 0.10 |
| **Butter** | 0.35 | -0.92 | -0.19 | 0.46 |
| **Cheese** | -0.24 | -0.11 | -0.40 | 0.39 |
| **Other Dairy** | 0.15 | 0.24 | 0.35 | -1.02 |

Source: Moschini and Moro (1993, p. 89).

Trade liberalization will affect the prices of all dairy products through a change in raw milk price. The price of all dairy products will fall compared to prices of other goods. The relative prices of dairy products will change slightly or not at all. Therefore, total elasticities are required. An estimate of the "correct" elasticity can be obtained from Moschini and Moro's results by adding the elasticities across the rows in Table 3. Doing this, the total elasticity for fluid milk is -0.26 and for butter, cheese and other dairy products -0.30, -0.36 and -0.28 respectively.

**Processing Margins**

According to Industry Science and Technology Canada, Canadian processing costs are similar to those in the United States when the higher cost of raw milk is excluded. However, the guaranteed margin to dairy processors, in Canada, is considerably larger than the one used in the United States to set support prices for butter and skim milk powder( de Gorter). Therefore, with free trade, processor margins might get squeezed due to increased competition. Reduced processor margins would be shared between consumers and producers. Elasticities of supply and demand and arbitrage conditions would determine the extent of the margin squeeze and the shares allocated to consumers and processors. Little is known about the competitive conditions in the Canadian milk processing industry. Moreover, there is limited information on the supply and demand conditions for processed dairy products that would be traded under free market conditions (Rude). A careful analysis of dairy product trade is well beyond the scope of this paper. However, the effect of lowering the Canadian processing margin on dairy products is simulated.

**U.S. Milk Prices**

Table 4 shows that the nominal price of U.S. industrial milk has ranged between US$11.03/cwt and US$12.57/cwt. Transfer costs between the United States and Canada are assumed to equal US$1.00/cwt which is roughly consistent with the findings of de Gorter and Agriculture Canada (1995b). Table 4 reveals that most of the variation in the landed value of U.S. milk ($31.73/hl to $41.02/hl) has resulted from currency fluctuations. With the U.S. dollar trading at $1.35-$1.40 the landed price of industrial milk from the United States is about $40/hl.[6] The price gap between Canadian producer returns and U.S. industrial milk prices is $8-$10/hl, of which $5.43 is the direct federal subsidy. Consequently, Canada's market prices for industrial milk are not much different from the current landed price of U.S. milk. The price gap shown in Table 4 assumes that Canada would be in a net import

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[6] The price relationships in Table 4 and Table 5 should only be considered as indicative of trading prices. Actual trade would take place between Canada and low cost producing points in the Northern United States. Especially for fluid milk, prices in the Northern United States are below those in the Southern Milk Marketing Orders.

position. If Canada is exporting milk and dairy products to the United States, industrial milk prices would have to fall to about $34/hl, ie. the U.S. price less transfer costs.

**Table 4. A Comparison of Canadian and United States Prices for Industrial Milk, 1980-1994.**

| Year | US-Man. | Transfer | Exchange | US-Man | Can-Target | In-Quota | Ontario | Producer Net | Prodcer | Direct | Plant Gate | Plant Gate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Price | Costs | Rate | Price | Return | Levy | Mkt. Fees | Return | Price Gap | Subsidy | Price Gap | Price Gap |
| | | | | | | | | | | | excl. subsidy | incl. subsidy |
| | us$/cwt | us$/cwt | c$/us$ | c$/hl | c$/hl | c$/hl | c$/hl | c$/hl | c$/hl | c$/hl | | |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] |
| 1980 | $11.88 | $1.00 | 1.19 | $34.79 | $35.55 | $2.96 | $0.48 | $32.11 | ($2.68) | $6.03 | $0.76 | ($5.27) |
| 1981 | $12.57 | $1.00 | 1.22 | $37.58 | $38.92 | $3.27 | $0.64 | $35.01 | ($2.57) | $6.03 | | ($4.69) |
| 1982 | $12.49 | $1.00 | 1.23 | $37.67 | $41.33 | $4.68 | $0.69 | $35.96 | ($1.70) | $6.03 | $3.66 | ($2.37) |
| 1983 | $12.49 | $1.00 | 1.26 | $38.58 | $43.24 | $5.14 | $0.73 | $37.37 | ($1.21) | $6.03 | $4.66 | ($1.37) |
| 1984 | $12.29 | $1.00 | 1.34 | $40.43 | $44.65 | $6.17 | $0.77 | $37.71 | ($2.71) | $6.03 | $4.22 | ($1.81) |
| 1985 | $11.48 | $1.00 | 1.38 | $39.09 | $45.64 | $6.07 | $0.84 | $38.73 | ($0.36) | $6.03 | $6.55 | $0.52 |
| 1986 | $11.30 | $1.00 | 1.36 | $37.97 | $46.48 | $5.35 | $0.92 | $40.21 | $2.24 | $6.03 | $8.51 | $2.48 |
| 1987 | $11.23 | $1.00 | 1.27 | $35.26 | $46.77 | $4.11 | $0.99 | $41.68 | $6.42 | $6.03 | $11.51 | $5.48 |
| 1988 | $11.03 | $1.00 | 1.20 | $32.77 | $47.06 | $3.08 | $1.06 | $42.93 | $10.16 | $6.03 | $14.29 | $8.26 |
| 1989 | $12.37 | $1.00 | 1.17 | $35.51 | $47.45 | $2.91 | $1.06 | $43.49 | $7.98 | $6.03 | $11.94 | $5.91 |
| 1990 | $12.21 | $1.00 | 1.15 | $34.48 | $48.69 | $3.40 | $1.10 | $44.19 | $9.71 | $6.03 | $14.21 | $8.18 |
| 1991 | $11.05 | $1.00 | 1.16 | $31.73 | $49.92 | $3.38 | $1.23 | $45.32 | $13.58 | $6.03 | $18.19 | $12.16 |
| 1992 | $11.88 | $1.00 | 1.26 | $36.84 | $50.11 | $2.10 | $1.38 | $46.64 | $9.80 | $6.03 | $13.27 | $7.24 |
| 1993 | $11.80 | $1.00 | 1.35 | $39.23 | $50.84 | $1.90 | $1.45 | $47.49 | $8.26 | $5.43 | $11.61 | $6.18 |
| 1994 | $12.00 | $1.00 | 1.39 | $41.02 | $52.28 | $2.18 | $1.45 | $48.65 | $7.63 | $5.43 | $11.26 | $5.83 |

[1] M-W Manufacturing grade milk, 3.5% fat, calendar year. Dairy Outlook. USDA.

[2] Assumed average transfer costs.

[3] Canadian dollars per United States dollar, calendar year. Medium Term Outlook. Agriculture Canada.

[4] United States price of manufactured milk landed in Canada, Canadian dollars per hectoliter, calendar year. Calculated as (1 + 2)*(3)*2.27.

[5] Canada target return for industrial milk, dairy year. Medium Term Outlook. Agriculture Canada.

[6] In-Quota levy on all milk, dairy year. Medium Term Outlook. Agriculture Canada.

[7] Ontario Milk Marketing Board marketing levy, dairy year. Dairy Statistical Handbook. OMMB.

[8] Canada net producer return for milk, dairy year, including direct federal subsidy. Calculated as (5-6-7).

[9] Gap between Canadian industrial milk producer returns, including the direct federal subsidy, and the M-W average manufactured milk price.

Calculated as (8-4).

[10] Canada industrial milk direct federal subsidy, dairy year. Medium Term Outlook. Agriculture Canada.

[11] Gap between Canadian industrial milk price, plant gate, excluding the federal subsidy, and the M-W average manufactured milk price. Calculated as (5-4).

[12] Gap between Can. industrial milk price, plant gate, including the federal subsidy, and the M-W average manufactured milk price. Calculated as (5-10-4).

Table 5 lists the nominal prices of fluid milk in the United States. In this case, the producer price gap is much larger, ranging from $12-$17/hl, in recent years. A reasonable fluid milk import price is about $43/hl.

**Table 5. A Comparison of Canadian and United States Prices for Fluid Milk, 1980-1994**

| Year | US-Fluid Price us$/cwt [1] | Transfer Costs us$/cwt [2] | Exchange Rate c$/us$ [3] | US-Fluid Price c$/hl [4] | Ontario Fluid Price c$/hl [5] | In-Quota Levy c$/hl [6] | Ontario Mkt. Fees c$/hl [7] | Ontario Fluid Producer Return c$/hl [8] | Producer Price Gap c$/hl [9] | Plant Gate Price Gap c$/hl [10] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | $13.23 | $1.00 | 1.19 | $38.44 | $40.11 | | $0.48 | $39.63 | $1.19 | $1.67 |
| 1981 | $13.95 | $1.00 | 1.22 | $41.40 | $43.36 | | $0.64 | $42.72 | $1.32 | $1.96 |
| 1982 | $13.80 | $1.00 | 1.23 | $41.32 | $46.04 | | $0.69 | $45.35 | $4.03 | $4.72 |
| 1983 | $13.75 | $1.00 | 1.26 | $42.19 | $48.23 | | $0.73 | $47.50 | $5.32 | $6.04 |
| 1984 | $13.61 | $1.00 | 1.34 | $44.44 | $51.49 | | $0.77 | $50.72 | $6.28 | $7.05 |
| 1985 | $12.90 | $1.00 | 1.38 | $43.54 | $52.51 | | $0.84 | $51.67 | $8.13 | $8.97 |
| 1986 | $12.62 | $1.00 | 1.36 | $42.05 | $52.51 | | $0.92 | $51.59 | $9.54 | $10.46 |
| 1987 | $12.66 | $1.00 | 1.27 | $39.38 | $52.51 | | $0.99 | $51.53 | $12.14 | $13.13 |
| 1988 | $12.36 | $1.00 | 1.20 | $36.39 | $54.51 | | $1.06 | $53.46 | $17.06 | $18.12 |
| 1989 | $13.66 | $1.00 | 1.17 | $38.94 | $54.45 | | $1.06 | $53.40 | $14.46 | $15.51 |
| 1990 | $13.89 | $1.00 | 1.15 | $38.87 | $56.95 | | $1.10 | $55.85 | $16.98 | $18.08 |
| 1991 | $12.30 | $1.00 | 1.16 | $35.02 | $56.95 | | $1.23 | $55.73 | $20.70 | $21.93 |
| 1992 | $13.16 | $1.00 | 1.26 | $40.50 | $58.94 | | $1.38 | $57.57 | $17.06 | $18.44 |
| 1993 | $12.86 | $1.00 | 1.35 | $42.47 | $59.08 | $1.90 | $1.45 | $55.73 | $13.26 | $16.61 |
| 1994 | $13.03 | $1.00 | 1.39 | $44.27 | $59.83 | $2.18 | $1.45 | $56.20 | $11.93 | $15.56 |

[1] Price of milk eligible for fluid market, calendar year, Dairy Outlook. USDA.

[2] Assumed average transfer costs.

[3] Canadian dollars per United States dollar, calendar year. Medium Term Outlook. Agriculture Canada.

[4} United States price of fluid milk landed in Canada, Canadian dollars per hectoliter, calendar year. Calculated as (1 + 2)*(3)*2.27.

[5] Ontario Class I price for milk, dairy year. Medium Term Outlook. Agriculture Canada.

[6] In-Quota levy on all milk, dairy year. Medium Term Outlook. Agriculture Canada.

[7] Ontario Milk Marketing Board marketing levy, dairy year. Dairy Statistical Handbook. OMMB.

[8] Return received by Ontario fluid milk producers, dairy year. Calculated as (5-6-7)

[9] Gap between average Ontario fluid milk producer returns and US average fluid milk prices. Calculated as (8-4).

[10] Gap between average Ontario fluid milk prices, plant gate, and US average fluid milk prices. Calculated as (5-4).

## THE MODEL

To illustrate the importance of the economic variables mentioned above a simple two-good, synthetic economic model is constructed. The model depicts trade between Canada and the United States in milk and dairy products. It is assumed that Canada is a small-country price-taker.

The model consists of two consumption goods: industrial milk products and fluid milk, produced from a single raw milk input. While fluid milk would trade in its raw (fluid) form, industrial milk is more likely to be traded as processed dairy products (butter, skim milk powder, cheese, ice cream, etc.). The model is calibrated in terms of the milk equivalent of processed product consumption, and constructed to reproduce the 1993/94 Canadian dairy year.

Prices, quantities, and the assumed base values of parameters used for simulation, are listed in Table 6 and Table 7. All Canadian prices and quantities are based on data, for the dairy year, except for exports of Canadian dairy products (milk equivalents) where data for calender year 1993 is used. Similarly, the U.S. prices shown in Table 6 and Table 7 are for a calendar rather than a dairy year. The choice of the base parameter estimates has been guided primarily by the literature review. A reader may disagree with the choice of the base parameters. Therefore, a range of values are used in the sensitivity analysis to illustrate the importance of various parameter choices (Table 7).

### Model Specification

The simulation model consists of two linear demand functions and a non-linear supply function calibrated to representative prices and quantities. The demand elasticities for fluid and industrial milk demand are set at -0.10 and -0.50. The industrial milk demand elasticity is slightly higher than the total elasticities estimated by Moschini and Moro but considerably lower than most Marshallian demand elasticities for individual processed dairy products. The elasticities should be calculated at the processing plant gate (wholesale) and not at retail, as are nearly all of the estimates in the literature. Under most conditions, demand elasticities will be lower at the wholesale rather than at the retail level. To capture all "reasonable" demand elasticities sensitivity analysis is conducted over the range -0.05 to -0.40 for fluid milk and from -0.20 to -0.90 for industrial milk (Table 7). These elasticities are imposed on a linear demand curve at the 1993/94 price-quantity point.

The farm level supply elasticity for milk has been set at 1.0. Selecting a supply elasticity also requires selecting a length of run to which it applies. A base period value of 1.0, should be appropriate for the medium run. A range of values from 0.5 to 2.0 should capture all expected supply responses beyond the very short run to the long run.

## Table 6. 1993/1994 Dairy Year - Base Data

| | | | |
|---|---|---|---|
| [1] | Industrial target return ($/hl) | | $50.84 |
| [2] | | minus within quota levy ($/hl) | $1.90 |
| [3] | | minus marketing board fees | $1.45 |
| [4] | | minus domestic butter program costs | $0.08 |
| | **Producer Net Return for Industrial Milk ($/hl)** | | **$47.41** |
| [5] | | minus direct subsidy | $5.43 |
| | **Producer Net Market Return for Industrial Milk ($/hl)** | | **$41.98** |
| | Industrial target return ($/hl) | | $50.84 |
| | | minus direct subsidy ($/hl) | $5.43 |
| | **Price Paid by Processors for Industrial Milk ($/hl)** | | **$45.41** |
| [6] | | plus processor margin | $7.60 |
| | **Price Guarantee to Processors** | | **$53.01** |
| [7] | Ontario Fluid Milk Price ($/hl) | | $59.08 |
| | | less over quota levy | $1.90 |
| | | less marketing board fees | $1.45 |
| | **Producer Net Return for Fluid Milk** | | **$55.73** |
| | Ontario Fluid Milk Price ($/hl) | | $59.08 |
| [8] | | plus weighted average processing margin | $0.63 |
| | **Price Received by Fluid Processors** | | **$59.71** |
| [9] | **Fluid Milk Deliveries (mhl)** | | **30.73** |
| [10] | | less skim off | 8.16 |
| [11] | **Fluid Milk Consumption** | | **22.57** |
| [12] | Industrial Milk and Cream Deliveries (mhl) | | 43.27 |
| | | plus skim off cream from fluid sector (mhl) | 8.16 |
| | **Industrial Milk Supply, butterfat basis (mhl)** | | **51.43** |
| [13] | **Exports of Industrial Products, butterfat basis (mhl)** | | **3.00** |
| [14] | **Imports of Industrial Products, butterfat basis (mhl)** | | **2.63** |
| | **Net Exports of Industrial Products (mhl)** | | **0.37** |
| | **Domestic Consumption of Industrial Milk and Cream Products, butterfat basis (mhl)** | | **51.06** |
| | **United States Milk Price + Transfer Costs** | | |
| [15] | | Fluid Milk Price + transfer costs | **$42.47** |
| [16] | | Industrial Milk Price + transfer costs | **$39.23** |
| | **United States Milk Price - Transfer Costs** | | |
| [17] | | Fluid Milk Price - transfer costs | **$36.35** |
| [18] | | Industrial Milk Price - transfer costs | **$33.10** |

[1], [2], [5], [6], [7], [8], [9], [10], [11], [12] Medium Term Outlook. Agriculture Canada.
[3] Dairy Statistical Handbook. OMMB
[4] Dairy Facts and Figures. Dairy Farmer's of Canada.
[13], [14] Figures are for calendar year 1993. Dairy Facts and Figures. Dairy Farmer's of Canada.
[15], [17] See table 5.
[16], [18] See table 4.

**Table 7. Base Parameter Values and Values Used in Sensitivity Analysis**

| PARAMETERS: | Base Value* | Range for Sensitivity Analysis |
|---|---|---|
| Demand Elasticity for Fluid Milk | -0.10 | -0.05 to -0.40 |
| Demand Elasticity for Industrial Milk | -0.50 | -0.20 to -0.90 |
| Supply Elasticity for all Milk | 1.00 | 0.50 to 2.00 |
| Marginal Cost of Production at Current Output | $33.00/hl | $30.00 to $45.00 |
| Shut-Down Price | $22.00/hl | $20.00 to $28.00 |
| US Fluid Milk Price, import basis | $43.00/hl | $33.00 to $48.00 |
| US Industrial Milk Price, import basis | $40.00/hl | $30.00 to $45.00 |
| US Industrial Milk Price, export basis | $34.00/hl | $30.00 to $45.00 |

* All values are expressed in Canadian dollars.

There are two other aspects of the model that need further elaboration: (1) the functional form for the supply curve and (2) the point on the curve to impose the supply elasticity. The functional form selected in this study is:

(2) $S = \alpha ( P - \beta )^{\gamma}$

where S is the quantity supplied, P is price (marginal cost) and $\alpha$, $\beta$ and $\gamma$ are parameters.

A supply curve of this form permits the specification of a shut-down point and the price where milk supply goes to zero. In equation (2), when $P=\beta$ supply goes to zero, the parameter ($\beta$) defines the shut-down price. The parameters $\alpha$ and $\gamma$ determine the shape of the curve.

The supply elasticity is imposed at a marginal cost of $33/hl and a quantity of 74 mhl, conditional on the assumed shut-down price of $22/hl. To test the robustness of the results to these assumptions, a sensitivity analysis is conducted. Shut-down values are varied between $20/hl-$28/hl and marginal cost values are varied between $30/hl and $45/hl.

## Processing Margin

The base model is constructed on the assumption that the processing margin in Canada is a competitive margin. Consequently, if Canadian processing plants pay the same price for raw milk as their U.S. counterparts, Canadian processed dairy products would be priced competitively with the processed product from the United States. To simulate the possibility that Canadian processing margins might be reduced with trade liberalization, the effect of reducing the Canadian processing margin from $7.60/hl to $3.80/hl is examined.

## U.S. Milk Prices

Prices for fluid and industrial milk produced in the United States are needed to simulate the model. With the U.S. dollar trading at $1.35-$1.40, the landed price of milk produced in the United States is about $40/hl, the base value chosen for industrial milk. The value selected for fluid milk is $3/hl higher at $43/hl. A drop in the American milk price to $22.70/hl (US$10/cwt) plus a weaker U.S. dollar of $1.25, could push landed prices down to $30/hl. Hence, a range of landed values for U.S. milk from $30/hl to $45/hl are simulated. Values below $40/hl are the most probable. In all simulations it is assumed that Canada could price fluid milk at the import competitive price of $43/hl, even when it is a net exporter of dairy products.

# THE RESULTS

Table 8 describes the consequences of freer trade under two alternative scenarios, and compares these results to the current policy situation. Base 1 assumes that producers react to the blend price in making their supply decisions. In Base 2, producers are assumed to react to the industrial milk price - which is the marginal output price. Under both assumptions Canadian milk output increases from the base level of 74 mhl. In Base 1 output increases to 81.3 mhl (blend price scenario) and In Base 2 output rises to 79.1 mhl (industrial milk price scenario). Output increases in both cases despite a producer price decline of 25-30 percent following the removal of supply restrictions. As a result of a reduced market price, the demand for fluid milk increases by 2.7 percent and the demand for industrial milk increases by about 10 percent.

In Base 1, Canada is a small net exporter of milk (1.53 mhl) and industrial milk prices are pushed down to the export floor of $34/hl. The blend price in Base 1 is reduced to $36.57/hl, compared to $49.95 under supply control. Under Base 2, Canada is self-sufficient in milk production and net trade in milk products is zero. Autarky industrial and blend prices rise from Base 1 levels to $35.41 and $37.64/hl.

**Table 8. Current and Free Trade Policy Results: Base Period Variable and Parameter Values**

| VARIABLE | UNITS | CURRENT POLICY BASE value | FREE TRADE BASE 1 value | % change | FREE TRADE BASE 2 value | % change |
|---|---|---|---|---|---|---|
| Fluid Milk Demand | mhl | 22.57 | 23.18 | 2.7 | 23.18 | 2.7 |
| Industrial Milk Demand | mhl | 51.06 | 56.56 | 10.8 | 55.88 | 9.4 |
| Total Domestic Milk Demand | mhl | 73.63 | 79.73 | 8.3 | 79.05 | 7.4 |
| Total Milk Supply | mhl | 74.00 | 81.26 | 9.8 | 79.05 | 6.8 |
| Net Exports of Milk Products | mhl | 0.37 | 1.53 | 313.5 | 0 | -100.0 |
| Fluid Milk Producer Price | $/hl | $55.73 | $ 43.00 | -22.8 | $ 43.00 | -22.8 |
| Industrial Milk Producer Price | $/hl | $47.41 | $ 34.00 | -28.3 | $ 35.41 | -25.3 |
| Producer Blend Milk Price | $/hl | $49.95 | $ 36.57 | -26.8 | $ 37.64 | -24.6 |
| Price of Fluid Milk, plant gate | $/hl | $59.08 | $ 43.00 | -27.2 | $ 43.00 | -27.2 |
| Price of Industrial Milk, plant gate | $/hl | $50.84 | $ 34.00 | -33.1 | $ 35.41 | -30.4 |
| Wholesale Price of Fluid Milk, ex plant | $/hl | $59.71 | $ 43.63 | -26.9 | $ 43.63 | -26.9 |
| Wholesale price of Industrial Milk Products, ex plant | $/hl | $53.01 | $ 41.60 | -21.5 | $ 43.01 | -18.9 |
| US Fluid Milk Price, import basis | $/hl | $43.00 | $ 43.00 | | $ 43.00 | |
| US Industrial Milk Price, export basis | $/hl | $34.00 | $ 34.00 | | $ 34.00 | |
| Gross Revenue from Milk Sales | mil. dol. | $3,461.30 | $ 2,971.68 | -14.1 | $ 2,975.44 | -14.0 |
| Rental Value of Production Quota | mil. dol. | $1,248.82 | $ 0.00 | | $ 0.00 | |
| Gross Revenue less Rental Value of Quota | mil. dol. | $2,212.48 | $ 2,971.68 | 34.3 | $ 2,975.44 | 34.5 |

Gross revenue from milk sales, excluding the direct federal subsidy, is $3,461 million under the current policy. Gross revenue is estimated to fall by about 14 percent under free trade to just under $3 billion. However, the annual rental value of production quota, under the base assumptions is $1,249 million. Deducting the $1,249 million from gross revenue leaves about $2.2 billion to cover production costs and to provide a return to non-quota assets. This "net" return is 34 percent less than under the free trade assumptions. The opportunity cost of quota is not an out-of-pocket expense for all producers, but for new entrants the cost of quota is a major expense.

Historically, quota holders have benefitted from the rising value of quota. Over the past 10 years, the value of Ontario's used industrial milk quota has increased at a compound rate of 5.3 percent per year. At 1993 quota values, this represents a capital gain of $370 million, or $5/hl. If capital gains are taken into account, the gross return to non-quota assets rises to $2,582 million - still less than under free trade assumptions.

The results presented in Table 8 are contingent on the assumptions made about the base parameters. In the remainder of this section, the sensitivity of the results to these assumptions are examined. The focus of the sensitivity analysis is on three variables. The first of the three variables is Canada's net exports of dairy products. Net exports captures both supply and demand changes in a single indicator. In both Base scenarios and under the current policy, net exports are close to zero. The other two variables reported are Canada's industrial and blend milk prices. Industrial and blend milk prices show how the base parameter assumptions influence the returns received by Canadian dairy producers. Under the Base assumptions Canada's industrial milk price is either at, or close to, the export floor price of $34/hl. Sensitivity analysis is conducted on six parameters: 1) the marginal cost of production; 2) the shut-down price; 3) the milk supply elasticity; 4) the milk demand elasticities; 5) the industrial milk processing margin; and 6) U.S. milk prices.

## Sensitivity Analysis: Marginal Cost of Production

Figure 2 describes the effect of increasing marginal cost to $45/hl from $30/hl while holding the shut-down price at $22/hl. This corresponds to a situation where "average" production costs change, but the costs of the most efficient producers are held constant at a low level. In all cases, the assumed marginal cost is imposed on the milk supply curve at 74 mhl.

Figure 2 illustrates that at marginal costs below $32/hl, Canada is a small net exporter of dairy products. At marginal costs of production between $33/hl and $38/hl Canada is self sufficient. Marginal costs above $38/hl imply that Canada begins to import dairy products. If Canada's marginal cost, at 74 mhl, is as high as $45/hl then Canada would import 11.56 mhl of dairy products. An import level of 11.56 mhl of dairy products represents 15 percent of domestic consumption. As a consequence of higher marginal costs, milk production in Canada would drop to 65.3 mhl from 74 mhl (-11.8%).

**Figure 2. Net Exports at Various Values for Canada's Marginal Cost: Holding Shut-Down Price at $22/hl**

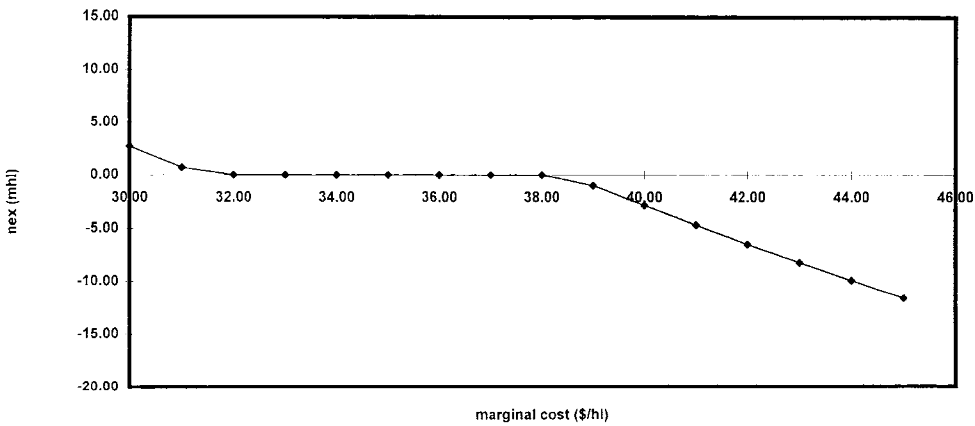
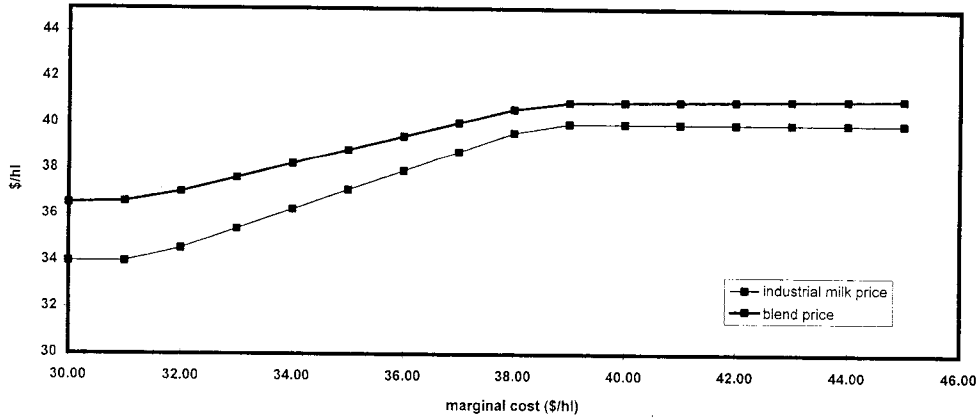


Figure 3 shows the evolution of the industrial milk and blend milk prices as marginal costs increase. The industrial milk price starts at the export floor price ($34/hl) and rises to the import ceiling price($40/hl) by the time marginal costs reach $39/hl. The blend milk price illustrates the effect of assuming that Canada always supplies the fluid milk market at the import ceiling price of $43/hl.

**Figure 3. Industrial and Blend Milk Price as Canada's Marginal Cost Varies Between $30/hl and $45/hl**




In the next scenario the $11/hl difference between the shut-down price and the marginal cost is maintained rather than holding the shut-down price at $22/hl, as in the previous scenario. As marginal costs are increased from $30 to $45/hl the shut-down price is increased to $34 from $19/hl. The outcome is illustrated in Figure 4 and Figure 5. In this situation, Canada begins to import dairy products at a marginal cost of $39/hl and by the time marginal costs reach $45/hl net imports equal 13 mhl, about 1.5 mhl more than in the previous scenario, which maintained a lower shut-down price.

**Figure 4. Net Exports at Various Values for Canada's Marginal Cost: Shut-Down Price Eleven Dollars Less than Marginal Cost**

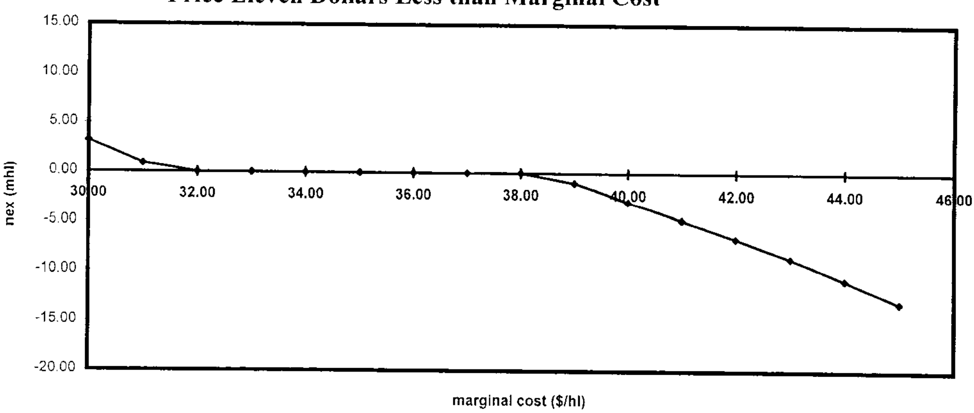
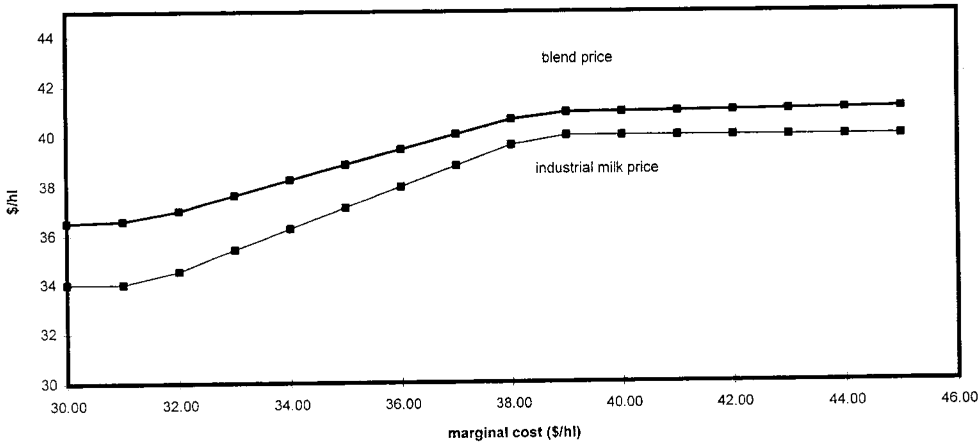


**Figure 5. Industrial Milk and Blend Price as Canada's Marginal Cost Varies Between $30/hl and $45/hl and the Shut-Down Price from $19-$34/hl**




In the final marginal cost scenario it is assumed the shut-down price is only six dollars below the marginal cost instead of eleven dollars. Again, the shut-down price is allowed to increase with the marginal cost, always remaining $6/hl below the illustrated value of marginal cost in Figure 6 and Figure 7. By the time marginal cost reaches $45/hl and the shut-down price $39/hl, Canada becomes a net importer of 18.6 mhl of dairy products. Milk output declines to 58.3 mhl, a decline of 21.2 percent from current levels.

**Figure 6. Net Exports at Various Values of Canada's Marginal Cost: Shut-Down Price Six Dollars Less than Marginal Cost**

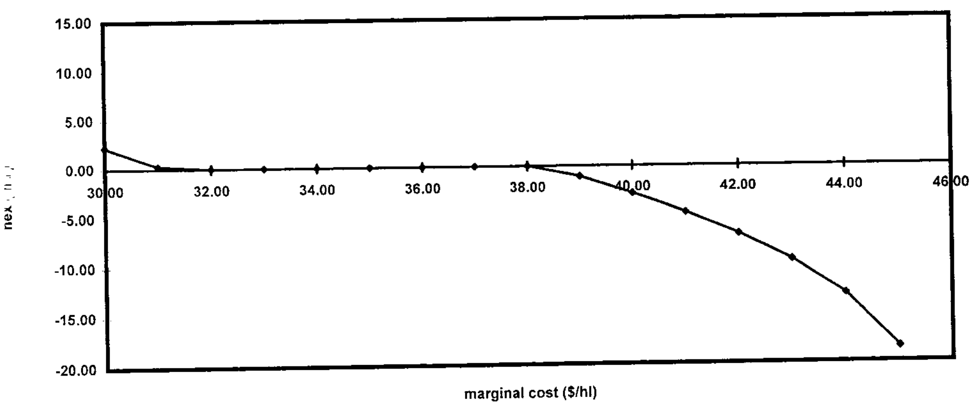
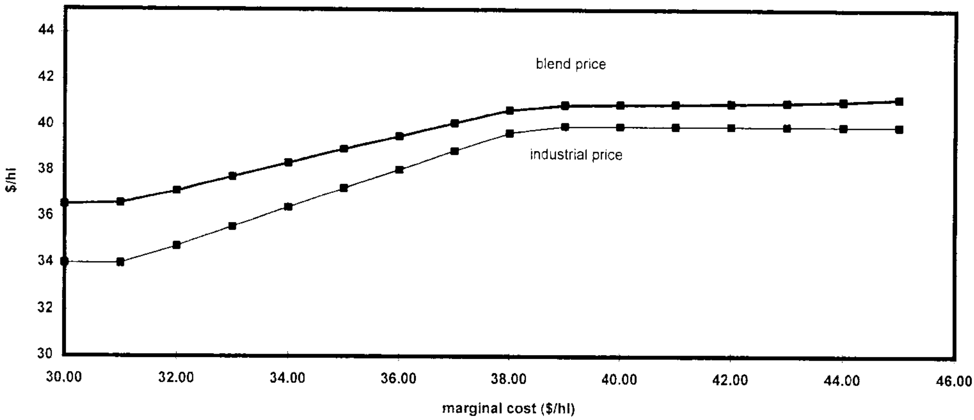


**Figure 7. Industrial Milk and Blend Price as Canada's Marginal Cost Varies Between $30/hl and $45/hl and the Shut-Down Price from $24-$39/hl**




## Sensitivity Analysis: Shut-Down Price

In this scenario, the shut-down price is varied from $20/hl to $28/hl while holding the marginal cost at $33/hl. Variations over this range maintain Canada's no trade position. Moreover, variations in the shut-down price have little effect on the industrial or blend milk price. Total milk output varies from 79.1 mhl with a shut-down price of $20/hl, to 78.9 mhl with a shut-down price of $28/hl. The small response of supply to the shut-down price is not surprising since the supply inducing price is above the assumed marginal cost.

## Sensitivity Analysis: Supply Elasticity

In Figure 8, the supply elasticity is varied from 0.5 to 2.0 holding the marginal cost and shut-down price constant at the base values. The variation in the supply elasticity does not change Canada's no trade position, but it does influence the autarky industrial milk price. As the supply elasticity is increased, output expands. Production is 78.2 mhl when the supply elasticity is 0.5, and increases to 79.6 mhl when the supply elasticity is 2.0. The additional output is enough to lower the equilibrium domestic price for industrial milk from $37.27/hl to $34.27/hl.

## Sensitivity Analysis: Demand Elasticities

Figure 9 shows the effect on the equilibrium prices of industrial and blended milk as the demand elasticities for industrial milk and fluid milk are varied. The demand elasticity for industrial milk is varied from -0.20 to -0.90 (*shown*) while the elasticity of demand for fluid milk is increased simultaneously from -0.05 to -0.40 (*not shown*). Canada remains in a no trade situation as quantity demanded increases from 76.1 mhl at low demand elasticities, to 82.9 mhl with large price elasticities. Over the simulated range of demand elasticities, the equilibrium industrial milk price rises from $34.00/hl to $37.48/hl.

**Figure 8. Industrial and Blend Milk Price at Various Domestic Supply Elasticities**

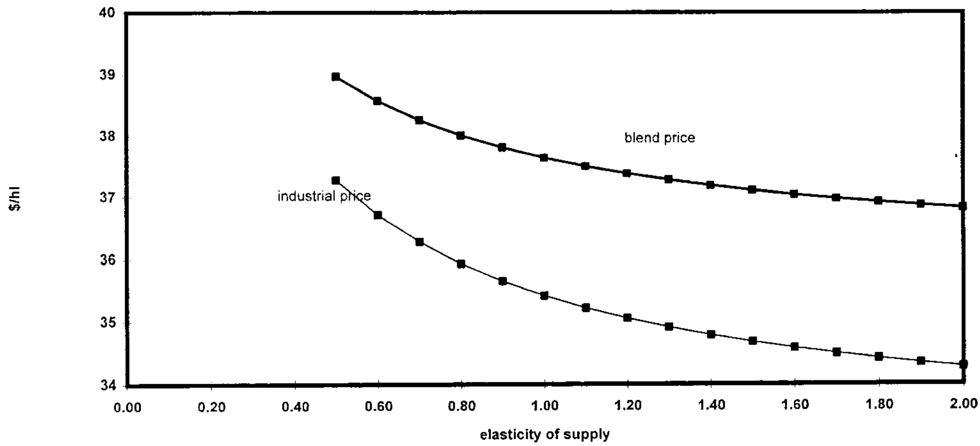
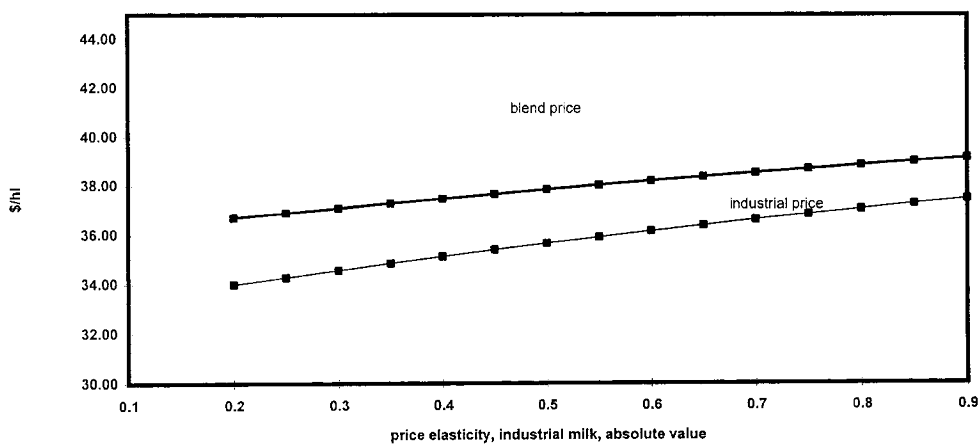



**Figure 9. Industrial and Blend Milk Price with Various Domestic Demand Elasticities**




## Sensitivity Analysis: Processing Margin

The result of lowering Canada's assumed processing margin to $3.80 from $7.60 is shown in Table 9 where they are compared to the current policy base and to Base 2. The lower processing margin increases Canada's demand for processed dairy products. The lower processing margin also raises the industrial milk price received by producers to $36.17, from $35.41 in Base 2. Industrial milk demand and milk production both increase about 1.5 mhl in comparison with Base 2 and Canada remains in a no trade situation.

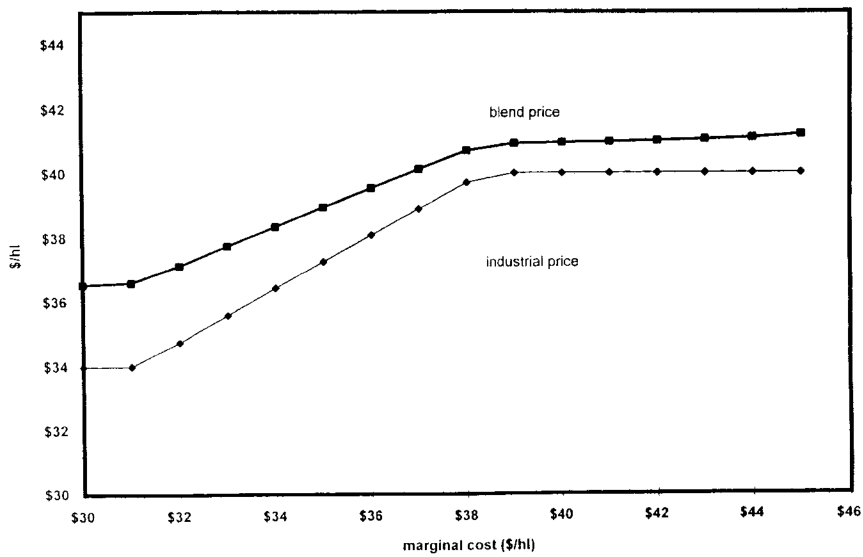
**Table 9. Current, Free Trade Base 2 and Industrial Processing Margin Reduced to 50 Percent of Current Level**

| VARIABLE | UNITS | CURRENT POLICY BASE | FREE TRADE BASE 2 | | FREE TRADE 50 % Lower Processing Margin | |
|---|---|---|---|---|---|---|
| | | value | value | % change | value | % change |
| Fluid Milk Demand | mhl | 22.57 | 23.18 | 2.7 | 23.18 | 2.7 |
| Industrial Milk Demand | mhl | 51.06 | 55.88 | 9.4 | 57.34 | 12.3 |
| Total Domestic Milk Demand | mhl | 73.63 | 79.05 | 7.4 | 80.52 | 9.4 |
| Total Milk Supply | mhl | 74.00 | 79.05 | 6.8 | 80.52 | 8.8 |
| Net Exports of Milk Products | mhl | 0.37 | 0 | -100.0 | 0 | -100.0 |
| Fluid Milk Producer Price | $/hl | $ 55.73 | $ 43.00 | -22.8 | $ 43.00 | -22.8 |
| Industrial Milk Producer Price | $/hl | $ 47.41 | $ 35.41 | -25.3 | $ 36.17 | -23.7 |
| Producer Blend Milk Price | $/hl | $ 49.95 | $ 37.64 | -24.6 | $ 38.14 | -23.6 |
| Price of Fluid Milk, plant gate | $/hl | $ 59.08 | $ 43.00 | -27.2 | $ 43.00 | -27.2 |
| Price of Industrial Milk, plant gate | $/hl | $ 50.84 | $ 35.41 | -30.4 | $ 36.17 | -28.9 |
| Wholesale Price of Fluid Milk, ex plant | $/hl | $ 59.71 | $ 43.63 | -26.9 | $ 43.63 | -26.9 |
| Wholesale price of Industrial Milk Products, ex plant | $/hl | $ 53.01 | $ 43.01 | -18.9 | $ 39.97 | -24.6 |
| US Fluid Milk Price, import basis | $/hl | $ 43.00 | $ 43.00 | 0.0 | $ 43.00 | 0.0 |
| US Industrial Milk Price, export basis | $/hl | $ 34.00 | $ 34.00 | 0.0 | $ 34.00 | 0.0 |
| Gross Revenue from Milk Sales | mil. dol. | $ 3,461.30 | $ 2,975.44 | -14.0 | $ 3,071.03 | -11.3 |
| Rental Value of Production Quota | mil. dol. | $ 1,248.82 | $ 0.00 | -100.0 | $ 0.00 | |
| Gross Revenue less Rental Value of Quota | mil. dol. | $ 2,212.48 | $ 2,975.44 | 34.5 | $ 3,071.03 | 38.8 |

## Sensitivity Analysis: U.S. Milk Prices

Figure 10 illustrates the effect on Canada's net exports of dairy products as the U.S. industrial milk price increases from $30/hl (US$9.50/cwt) to $45/hl (US$14.25/cwt). The fluid milk price remains $3/hl higher. At U.S. prices below $38/hl (US$12.00/cwt) Canada is either self-sufficient or a small net exporter. If the U.S. price increases to $45/hl Canada would export 14.7 mhl of dairy products and produce 90.3 mhl, 22 percent more than current output. Over the range of U.S. industrial milk prices from $33/hl (US$10.45/cwt) to $38.00/hl (US$12.00/cwt) Canada would be self-sufficient in milk production. The effects on prices are shown in Figure 11.

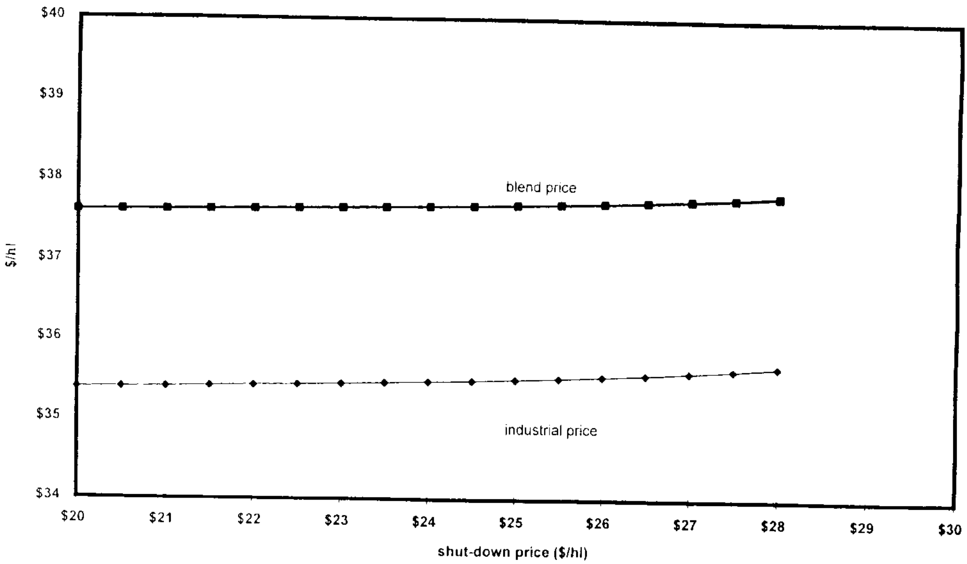
**Figure 10. Industrial Milk and Blend Price as Canada's Marginal Cost Varies Between $30/hl and 45/hl and the Shut-Down Price from $24-$39/hl**




## Summary of Sensitivity Analysis

The most striking feature of the sensitivity analysis is the robustness of a small or no trade solution. Only when Canada's marginal cost of milk production is quite high relative to the U.S. market price, does Canada become a significant net importer of milk and dairy products. Likewise, Canada only becomes a significant exporter when U.S. prices rise sharply relative to Canada's marginal cost of production. The results also indicate the importance of taking into account Canada's output restrictions. Even though Canadian milk prices fall from current levels in nearly all of the simulations, Canada's milk production often expands, or contracts only modestly.

**Figure 11. Industrial and Blend Price as the Shut-Down Price Varies from $20-$28/hl Holding Marginal Cost at $33/hl**




It is impossible to capture all of the subtleties of interregional trade in a non-spatial partial equilibrium model. In the next section three studies of the North American dairy market are reviewed. Two of these models are spatial equilibrium models that provide an indication of the potential sources and destinations of product. In addition, the importance of assumptions in reaching the conclusions taken from the papers are highlighted.

## THE RESULTS FROM OTHER STUDIES OF TRADE LIBERALIZATION

Hallberg and Baker use a spatial equilibrium model of the U.S. and Canadian dairy markets to estimate the impact of freer trade[7]. The static analysis used by the authors is a standard approach to assess trade policy alternatives. Unfortunately, a fundamental error in the specification of the supply side of the Canadian market leads the authors to draw erroneous conclusions from their analysis. The problem lies in the specification of Canada's

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[7] In preparing this review the authors have benefitted from unpublished comments on Hallberg and Baker and Bromfield *et al.* prepared by Don McClatchy, Agriculture Canada.

raw milk supply curve based on observed price and quantity data[8]. Production quotas have the effect of reducing the amount of milk produced at administered prices. The removal of tariff barriers would lower Canada's milk prices but, with the removal of output controls, milk production might increase. The possibility of lower prices and higher output is easily seen in Figure 1.

Hallberg and Baker's results also rely on the assumption that dairy processing must occur in the region where the milk is produced. The assumption that raw milk for manufacturing purposes cannot move between regions maybe be realistic under current U.S. regulations but it is less realistic under free trade assumptions. Processing costs can vary across regions and over time. As a result, it may be advantageous for processing to be located in some regions but not in others.

Bromfield, *et al.* estimate the impact on Canada's supply managed sectors of free trade with the United States[9]. The effects on farmers, input suppliers, processors and further processors are considered. The study predicts the economic impact of the elimination of import tariffs on milk, milk products, poultry and eggs as of January 1, 1996. The impacts are analyzed over the five-year period from 1996 to 2000 to allow for a separation between transitional and longer-run effects.

The authors make several important assumptions. For milk and dairy products, assumed price and production impacts are taken directly from the work of Hallberg and Baker. Based on these results, Bromfield, *et al.* argue that free trade in milk and dairy products would reduce Canada's producer prices by 25 percent, and milk output by at least 15 percent. While the estimated price decline seems reasonable, if the federal direct subsidy is eliminated, it takes very pessimistic assumptions about Canada's marginal cost of producing milk to generate significant output declines. Without significant declines in Canada's milk output there is no way for U.S. dairy imports to fill 20 percent of Canadian domestic consumption as argued by Bromfield, *et al.*

The results of Bromfield, *et al.* reinforce the notion that producers and processors in all provinces would be adversely affected by free trade in milk and dairy products. The annual average loss to the agricultural and food processing sectors, over the five years, was estimated to be $3.2 billion. The annual loss in government revenues over the same period was estimated at $3.6 billion. These loss estimates are based on the assumption that the resources (capital, labour and land) currently used to produce milk and dairy products would remain totally idle under trade liberalization. Roberts has revealed the unrealistic nature of this assumption in anything other than the very short run. In addition, the consumer gains which would offset the losses to producers and processors are not discussed fully. Hallberg and Baker, and Doyon, Pratt and Novakovic argue that with freer trade, milk and dairy

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[8] The high price of milk production quota indicates that the quota is binding and producers are not producing where marginal cost equals the market price of milk.

[9] A NAFTA panel ruling in favour of the United States would require that Canada move more quickly towards freer trade in dairy products but not necessarily to free trade. An adverse panel ruling would be followed by further negotiations (Meilke).

products may move in both directions across the border. However, Bromfield *et al.* assume unilateral trade in dairy products.

Doyon, Pratt, and Novakovic investigate the effects of two dairy trade scenarios between Québec, Ontario, and the Northeast United States. In the first scenario, trade conditions are changed to permit the United States to export yogurt and frozen desserts to Canada. The second scenario allows for an entirely free trade environment. A competitive, static, partial equilibrium, multicommodity, and multi-region linear programming model is used to determine the effects of the two trade liberalization policies. The model includes seven dairy products (fluid milk, frozen desserts, specialty cheese, dry and condensed milk, butter, yogurt, and cheddar cheese), 296 supply points, 184 consumption points, and 307 processing points. The solution to the model depends only on marketing costs (transportation and processing costs). Economic agents are not allowed to react to variations in output or consumption prices.

Two fundamental assumptions drive the results from this model. First, the quantities of raw milk consumed and produced in each region are fixed. Second, the costs associated with assembly, processing, and distribution, although different in each region, are fixed in the assessment of the two alternative trade scenarios.

The results of policy changes on trade patterns are evaluated by comparison to a base simulation. The base scenario reflects trade conditions that existed before the NAFTA and GATT'94 agreements. With only yogurt and frozen desserts exported to Canada in the first simulation, Québec was adversely affected in all categories of dairy products except fluid milk. Ontario's yogurt and ice cream sectors were also negatively affected. However, Ontario became a net exporter of specialty cheese.

The results of the second simulation (free trade) suggest there would be no significant movement of fluid milk across international borders. Québec relinquishes market share for all dairy products except cheddar cheese and ice cream. Ontario improves its trade position for all dairy products except yogurt and specialty cheese. The spatial equilibrium model documents the source-destination trade flows.

The authors conclude that if trade restrictions are lifted on only some dairy products, new distortions are created which may cause more adjustment problems than if all trade restrictions were lifted simultaneously.

These three papers illustrate how the initial assumptions made in analyzing a problem influence the conclusions. In Hallberg and Baker, the assumptions of: 1) a sharp drop in Canadian milk production, and 2) that processing must occur only in the producing region, drive the result that the U.S. exports significant quantities of dairy products to Canada. Bromfield *et al.*, relying largely on the price and output predictions of Hallberg and Baker conclude that free trade would significantly reduce the welfare of Canada's milk producers and processors. Finally, Doyon *et al.* conclusions rest on their two initial assumptions: 1) fixed quantities of raw milk demanded and supplied, and 2) that the costs associated with assembly, processing, and distribution of milk and dairy products are fixed. These assumptions sharply limit the extent of adjustments in milk and dairy product trade, but do illustrate how a fixed quantity of milk would be processed and transferred to minimize these costs.

## CONCLUSIONS

Trade flows in milk and dairy products between Canada and United States, with trade liberalization, are likely to be small. In fact, no trade is a real possibility. For large ranges of the key parameters driving dairy product trade - no trade was the estimated outcome. The no trade finding is largely unaffected by changes in demand and supply elasticities for fluid and industrial milk, changes in milk producers shut-down price and Canadian processing margins for milk products. However, if the marginal cost of milk production in Canada is above the landed price of dairy products from the United States, then Canada could become a significant importer. Therefore, future research should focus on: 1) generating reliable farm-level information on marginal cost by farm size, and 2) the effects of regulation on average farm size and cost structures . It should be emphasized that while no net trade in milk and dairy products between Canada and the United States is a possibility, there could be significant intra-industry trade in differentiated milk and dairy products with trade liberalization.

The base line results indicate that Canada's gross revenues from milk sales, excluding the direct federal subsidy, decrease from $3,461 million to just under $3 billion with free trade. However, the gross revenue under the current policy includes the opportunity cost of milk quotas worth more than $0.8 million, even after allowing for the expected capital gains on quota purchases. Since the existing production quotas would disappear with trade liberalization, a pertinent policy question is: should dairy farmers be compensated for the loss in quota value? Compensation to Canadian dairy farmers is an equity issue which the Canadian government and taxpayers will have to confront.

Finally, several recent studies of trade liberalization in milk and dairy products between Canada and the United States paint a rather gloomy picture for the Canadian dairy industry in a free trade world. The gloom is, to a large extent, driven by unrealistic assumptions about the dairy industry in Canada. Predictions made on the basis of more reasonable assumptions suggest that net trade in dairy products between Canada and the United States is likely to be small following North American trade liberalization.

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