Tariffication in the dairy industry a spatial equilibrium approach to analyze geographic price relationships between Canada and United States

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Short title:

THE IMPACTS OF TARIFFICATION IN THE DAIRY INDUSTRY.

ABSTRACT

The impacts of tariffication on Canadian milk producers were estimated via supply price and trade flow parameters using a spatial price equilibrium model applied to milk production regions of Canada and the United States

Two price scenarios were put forward because of supply management in Canada The first incorporated producer prices while the second used shadow prices for Canadian producers defined as the producer price less a reduction in price which accounts for the value of production quota The hypothesis that tariffication reduces milk production in Canada to the extent that U S producers increase their exports to Canada was partly supported in scenario one but not in scenario two Specific tariffs of $11 00/hl prevented U S imports to reach Quebec and Ontario However the rest of Canada increased its inports from Great Lakes to the detriment of Quebec and Ontario Consequently production decreased slightly in Quebec and increased in Ontario whereas prices decreased significantly in both provinces Scenario two showed ability of Quebec and Ontario to withstand American competition Prices and production level remained unchanged while export flows to the rest of Canada increased to the detriment of the Great Lakes

The present study investigated only a specific aspect of the tariffication proposal in the GATT and does not intend not to reflect the very complex aspects of GATT negotiations The findings of this analysis must be interpreted with this caveat Further studies considering other plausible tariffication scenarios or effective tariffs on an individual dairy product basis would broaden our understanding of the potential implications of tariffication

RÉSUMÉ

Les impacts de la tarification sur l'industrie laitiere sont analysés selon les quantités produites, les prix et les echanges commerciaux entre les regions laitieres dominantes du Canada et des Etats-Unis L'étude fut realisee suivant un modèle spatial d'équilibre de prix intitule Generalized Transportation Problem

Deux scenarios de tarification, basés sur un tarif spécifique de 11 00$/hl, furent proposés pour remplaçer les quotas d'importations actuels L'un impliquedes prix aux producteurs et l'autre les prix virtuels comme etant le prix du producteur moins la valeur du quota accumulee dans le prix du lait Les résultats du premier scenario demontrent que les importations américaines au Quebec et en Ontario ne changent pas Cependant, les Americains augmentent leurs exportations dans le reste du Canada La production tend légerement a la baisse au Quebec et à la hausse en Ontario, quant aux prix, la baisse est significative dans les deux provinces Le deuxieme scenario démontre la compétitivité du Québec et de l'Ontario suite aux maintiens des prix et des quantites produites et a l'augmentation de leurs part de marche dans le reste du Canada au détriment des Grands Lacs

De tels resultats demontrent certains ajustements nécessaires de la production laitière face à une competition accrue des États-Unis dans le cadre d'une liberalisation des échanges L'utilisation du prix virtuels démontre le potentiel d'expansion de la production, des prix et des échanges commerciaux au Québec et en Ontario

La presente étude traite d'un aspect particulier de la tarification et ne prétend pas reproduire fidèlement les méandres de la proposition Dunkel Ainsi, les implications d'une telle analyse se doivent de considérer certaines limites

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1.1: PROBLEM STATEMENT

The proposed changes under the General Agreement on Tariffs and Trade (GATT) aim to reduce international trade barriers The tariffication plan put forward to the GATT panel in November 1989 suggests, the replacement of import quotas with equivalent tariffs (Moschini, 1991)

The GATT was initiated in 1947 as a temporary measure before the acceptance of the International Trade Organization, which never came into existence following its rejection by the U S Congress Since its beginnings GATT has completed seven rounds of negotiations, the current Uruguay round was launched in 1986 and comprises the complex and protected agricultural sector

GATT provisions with respect to import access are included within Article XI, which states general prohibition concerning quantitative restrictions. However, Article XI contains one exception very important for Canada, which says that quantitative restrictions on imports are permitted in the specific case where it is coupled with domestic supply restrictions

The original intent of Article XI included in the Charter of the GATT was to satisfy the Americans about the protection of their farm programs under the U S Agricultural Adjustment Act (Section 22) In 1955 however, the Americans gained a GATT waiver concerning their obligations vis-a vis trade distorting measures This exception allows United States to impose import quotas for important agricultural commodities like dairy products, sugar cotton, and peanuts. Therefore, the original article XI was no longer necessary (Rude *et al*, 1992) Canada, which initially disapproved the incorporation of article XI by United States fearing trade distorting impacts, later invoked it, in the 1970's, to implement its supply management programs (Rude *et al*, 1992)

As a result, both Canada and United States have used import quotas for dairy products and for other major commodities These quantitative restrictions have been based on historical trade profiles that tend to be static from one year to the next and as a whole have represented around 3 percent of domestic production The rationale behind this trade philosophy has been to protect domestic dairy producers from the negative effects of the international market That is, the dairy industry has been **oriented toward domestic demand** rather than **export-oriented**

Marketing boards are prevalent in several sectors of Canadian agriculture Powers and activities of marketing boards throughout Canada vary widely from a promotional or product marketing role, to the more powerful supply management role with production or marketing quotas The latter type of marketing board is restricted to milk, poultry, eggs and tobacco, which account for roughly half the boards and 25% of farm cash receipts in Canada (Forbes *et al*, 1982) These sectors use import quotas coupled with domestic production quotas in order to enforce their objectives related to supply control, and improved producer welfare

Bilateral trade under GATT in dairy products between Canada and the United States requires the elimination of import quotas on dairy products in favor of tariff schemes The emerging hypothesis says that the application of tariffication would decrease milk production in eastern Canada to the extent that American producers, through exports to Canada, will replace reduced Canadian milk production

The hypothesis is tested using a quadratic spatial price equilibrium model that is solved for equilibrium prices, and production, as well as export and import quantity flows given domestic supply and demand functions, and existing trade constraints The model is recursively solved for three specific periods of analysis (1) the initial period with tariff implementation (2) the period comprising a tariff reduction of 18% and, (3) the final tableau with 36% reduction completing the proposed phase-out period of six years

Supply and demand functions for the relevant regions of United States and Canada are obtained from the literature, since it is not the objective of this study to estimate such economic relationships The objective is to measure the impacts of policy changes, given supply and demand relationships

1.2. ORGANIZATION OF THE THESIS:

The investigation of the impacts of tariffication on the Canadian dairy industry will be presented in the following steps Chapter two presents a review of literature pertinent to the analysis First, the review surveys the issue of tariffication and the political and economic climate with respect to agricultural trade Second, characteristics of the Canadian and the American dairy industry are outlined A discussion on agricultural trade models considers the role and the capabilitiesof spatial models, including three different empirical models the American Dairy Sector Simulator (USDSS), the Canadian Regional Agricultural Model (CRAM), and the Generalized Transportation Problem (GTP) Chapter three discusses the methodology used to measure the impacts of tariffication on dairy trade GTP isa competitive and a surplus maximization problem used in international trade In this study, it is applied to potential dairy trade between United States and Canada The methodological approach which is described in this chapter includes data requirements, solution procedures and validation techniques involved Chapter four shows the validation outcome and the results of tariff implementation replacing import quotas with respect to two distinct tariffication scenarios Results areshown for the three periods of analysis in terms of quantity produced, milk prices, and trade flow patterns for each of the regions considered in Canada and United States The results are discussed with respect to two hypothetical tariff scenarios reflecting the tariffication proposal of the GATT and their implications on dairy producers Finally, the conclusion recapitulates the discussion, relates the limitations of Generalized Transportation Model (GTP) and makes recommendations on further research on the topic

2.0 REVIEW OF LITERATURE

2.1 THE TARIFFICATION ISSUE

The philosophy of the General Agreement on Tariffs and Trade (GATT) is that market forces should drive international economic adjustments There are two main parts to the GATT which aim to remove impediments to international trade the first one relies on two basic principles where (1) all signatories will not discriminate against the products of any other member and (2) they will not raise import tariffs above the agreed levels The second part is more explicit in the sense that it consists of articles covering a whole array of trade restriction policies (Rude *et al*, 1992) The article important for this study, is Article XI that provides insulation from international markets for supply managed industries This article prohibits the use of import quotas, unless they are coupled with export restrictions Therefore, it can be interpreted that only industries with a negative trade balance usually invoke this article (Rude *et al*, 1992)

Another important article frequently mentioned in the literature is Article XVI which prohibits export subsidies except for agricultural products Besides exceptions provided by those articles XI and XVI there are other agricultural exemptions provided by the GATT treaty The waiver provided to United States as a condition to join the member countries in 1955, allows the Americans to be released from their obligations by imposing import quotas to protect their farm programs for **dairy products**, sugar, cotton and peanuts under the Section 22 of the U S Agricultural Adjustment Act Another exemption was provided to the European Community under the form of variable import levies that are not specifically prohibited by the GATT (Rude *et al* 1992) Finally, the GATT does not define any limits concerning domestic assistance to agriculture All industrialized countries are highly involved in agricultural support programs Thus, huge surplus from excess production, depressed international prices, many trade disputes and distortion of production and trade patterns have resulted (Rude *et al*, 1992)

The current round of negotiations, with the 108 signatories, calls for important changes in policies regulating international trade concerning agriculture, one of the last bastions in GATT not yet settled by an agreement This round of negotiations, called the "Uruguay Round", was initiated in 1986 and it incorporates new areas of negotiations that were not included in the previous rounds such as service, intellectual property, textiles as well as **agriculture** At the present time, agriculture is still not ratified by an agreement and negotiations have still made little tangible progress (DFC, 1991)

An agreement among the 108 countries involved has not yet come to fruition because of important policy divergences between two major players United States and European Community (Lemay, 1990) Nevertheless, progress has been made and Canada must be prepared for the implications of such a deal According to the GATT proposal, Canadian agriculture will face crucial changes with regard to trade liberalization For instance, the dairy industry ranking second nationwide behind the beef sector in terms of total farm cash receipts, will face increasing pressurefor greater trade flexibility at the border Figure 1 shows that in western Canada,beef and cereals (mainly wheat) are the dominant productions, animal production such as dairy, swine and poultry production lead in Eastern Canada Swine producers trade heavily with the United States, while dairy and poultry productions are not export-oriented and rely on a supply management structure characterized by import and domestic supply restrictions (Schmitz, 1983) Nationwide, dairy and poultry represent roughly 23% of agricultural cash receipts (Lebeau *et al*, 1990), justifying the increasing concern towards the recent GATT proposal that suggests the abolition of the import quota system

FARM CASH RECEIPTS, 1990
EASTERN AND WESTERN CANADA

Western Canada	**Eastern Canada**
total: 10 994.3 (Million $)	***total: 10 315.7 (Million $)***

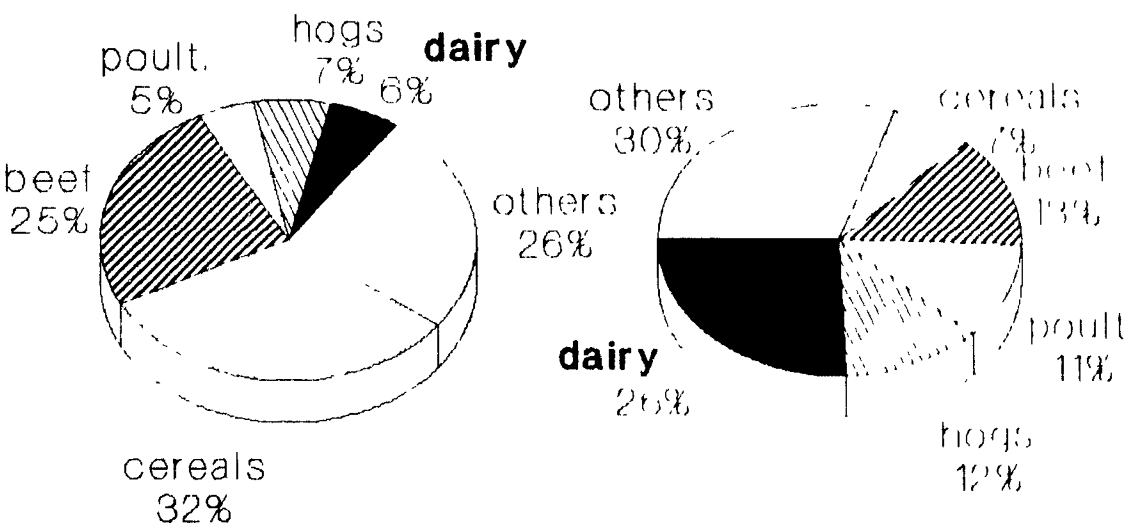


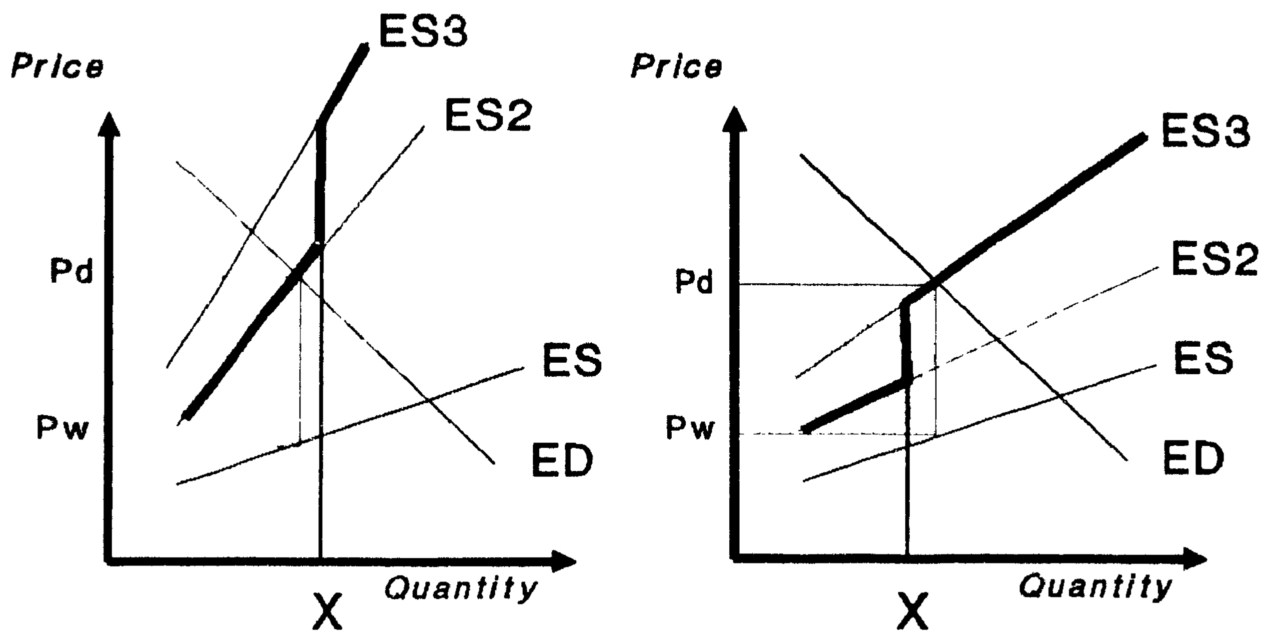
FIGURE 1: FARM CASH RECEIPTS, 1990
SOURCE: Canadian Grain Council

In the early 1970's, the national supply management program for milk was established to incorporate earlier marketing programs for fluid and industrial milk segments. Provincial boards have administered fluid milk programs while the industrial milk pricing has been managed by the Canadian Dairy Commission since 1966. Dairy producers' associations lobbied for regulatory interventions mainlyin terms of interprovincial trade barriers and national import quotas (Veeman, 1988). To enforce import quotas, a special provision named Article XI 2(c)(i) in GATT allows one country to insulate its domestic market by imposing an import quota on the commodities in question as long as it is coupled with domestic supply restrictions. Quotas on both domestic milk production and dairy product imports were introduced with the following multiple objectives in mind: (1) higher and more stable revenues to producers against the argument of weak producer's bargaining position in face of oligopsony at the wholesale level, (2) minimal government costs since surplus milk are greatly reduced, (3) stable milk supply, (4) maintenanceof the milk industry size, (5) maintenance of family-sized farms by slowing down adjustments towards larger farms, and (6) distributional equity to some extent across individuals and regions (Barichello, 1981).

As a result of the costly price and subsidy wars between United States and European Economic Community (E.E.C) agricultural exports (Lemay, 1990), the GATT has come up with a tarification proposal touching four interrelated areas: (1) import access, (2) export subsidies, (3) internal support, and (4) sanitaryand phytosanitary measures. The proposal is an attempt to alleviate trade barriers among trading countries by replacing all non-tariff barriers, i.e. import quotas, for the dairy industry with tariffs calculated as the difference between the domestic and the world price during the base period of 1986-1988 after all transaction costshave been considered. Such tariffs will be gradually reduced given a phase reduction scheme. The tariff reduction proposed under the GATT calls for average tariff reductions across all agricultural products of 36 percent over a six-year period (1993-1999), i.e. 6% per year. The minimum tariff for an individual product is 15 percent Since the 36 percent is a simple average across all agricultural commodities, Canada may decide to apply the minimum reduction tariff of 15% for highly protected goods like dairy, provided there is an offsetting percentage for the other goods involved In addition, all clauses restricting agricultural importsas well as Article XI, the cornerstone of supply management in Canada, will be eliminated As an adjustment period during the phased reduction schedule the United States have envisaged tariff-rate quotas (Moschini, 1991), after this period, the residual method of protection would be a bound tariff

An important problem concerning tariffication arises as non-equivalence between tariffs and non-tariff barriers because of imperfect competition in importing countries, price instability in both importing and exporting countries, and inefficient allocation of quantitative restrictions (Moschini, 1991) Thus, appropriate equivalent tariffs cannot be solely computed on the basis of price differences between countries Tariff-rate quotas are meant to be a transitional tools for tariff implementation, however, they are not widely adopted as a commercial policy because of greater administrative burden to enforce both tariff payments and quota limits (Moschini, 1991) Figure 2 displays the tariff schedule as a step function The tariff rate system reflects the American position involving **one** quota level and **two** tariff levels in-quota and over-quota tariffs

Tariff-rate quotas



a) in-quota tariff is binding

b) over-quota tariff is binding

LEGEND:

Pd: domestic price
Pw: world price
ED: excess demand
ES: no-tariff excess supply
ES2: in-quota excess supply
ES3: over-quota excess supply
X: import quota

FIGURE 2: TARIFF-RATE QUOTAS
SOURCE Moschini, 1991

This is illustrated in a partial equilibrium framework with three different excess supply curves one for the in quota case(ES2), one for the over-quota case(ES3) and the original no-tariff excess supply(ES) facing the importing country In this scenario over quota tariffs act as a safeguard when the quantity imported exceed the specified import quotas Therefore over quota tariffs are greater than in-quota tariffs Given the two tariffs (both are ad valorem tariffs) and the import quota the effective excess supply is given by the **bold** portion linking the two excess supply curves The implications of tariff rate quotas depend on where the effective excess supply(ES) and the excess demand(ED) of the importing country intersect It is worth notice, here, that such a tariff rate system does not put an absolute ceiling on import volumes Figure 2(a) and (b) reflect binding in quota and over-quota tariffs, respectively The implications about the conversion of import dairy quotas into tariff-rate quotas vary according to the method employed In a situation where the quota will be fixed at the observed level of imports and the computation of the over-quota tariff is based on the observed price gap for a recent period, the in-quota tariff will be binding if the observed price gap between trading countries overstates protection offered by import quotas Conversely, over quota tariffs are binding when the price gap understates the protection provided by those import quotas

After the conversion process, the next step involves a gradual decrease in the over-quota tariff and an increase of the quota level over the given tariff implementation period This will lead to a unique reduced in-quota tariff, as the remaining quota is eliminated (Moschini 1991)

Moschini and Meilke (1990) have studied the impacts of tariffication with supply management in Canada on the specific case of U S Canada chicken trade The authors investigated the impacts of (1)large and (2)small tariffs on the chicken industry in replacement of Canadian import quotas The results focus on two categories of equivalent tariffs exhibiting dissimilar consequences **Price-**

preserving tariffs (1) reflecting the actual price difference between the U S and Canada, keep the domestic prices unchanged from the actual quota system, but drive the imports down to zero On the other hand, **import-preserving tariffs (2)** preserve the current levels of imports but substantially decrease Canadian chicken prices Regarding the tariff magnitude, results showed price-preserving tariffsto be roughly three times the import-preserving tariffs, i e 40 % and 15 % (based on U S price), respectively These findings for the chicken industry provide a useful benchmark for other major supply managed industries in Canada, like the dairy industry

Canada, as a major agricultural exporting nation, is in a difficult position On one hand the country is in favour of a proposal calling for trade liberalization that will eliminate the world **price war** for agricultural commodities, costing billions of dollars to Canadians Exports of primary resource commodities are important to Canada because of its historical positive balance of trade regarding agricultural commodities such as cereals and oilseeds, beef, and pork Therefore, these sectors suffer from such trade distortions On the other hand, other predominant sectors of the Canadian agriculture like eggs, poultry, and dairy productions have based their structure on a supply management where import access is very limited Tariff conversion applied to these insulated sectors of the economy would initiate fundamental changes in the structure of Canadian agriculture

2.2 INDUSTRIAL STRUCTURES

2.2.1 CANADIAN DAIRY INDUSTRY:

The Canadian community decided, through its political decision process, in the early 1970's to put in place a centralized decision system, [The National Marketing Board System], which has regulated the dairy industry since. Initially, the central system was responsible for allocating provincial share of theindustrial milk production, where in turn, each province was allowed to choose its own system of reallocation to its producers. Some provinces chose a centralized or administrative system for quota allocation. However, Quebec and Ontario have chosen aquota market for allocating its provincial quota share to producers. The National Marketing Board System has had jurisdiction on milk production for**industrial** use only, whereas milk production for **fluid** milk purposes was established under provincial jurisdiction. Interprovincial fluid milk trade is prevented, because the quota system was established as an incentive to provincial self sufficiency.

The initial allocation of industrial milk quota to provinces was based on the highest of the following two amounts: milk deliveries during the fiscal year 1969-70 or the subsidy eligibility quota. For subsequent increases or decreases in the national quota, each province's quota allocation was modified according to its share of quota in effect at time of changes. [However, some of the lowest-share provinces have received some special allocations or benefits to lessen the disadvantage of being small]. These allocation adjustments have been based on population variation, regional per capita consumption, regional market needs, prior quota utilization, and comparative advantage. However, in practice, provinces have not been able to mutually agree on the weighted value attributed to each of the above factors. Consequently, allocation was decided by ad hoc decisions made through subsequent negotiations involving parties of the ten provinces in orderto allocate milk production licenses (Proulx and Gouin, 1989).

In Canada, Milk production is concentrated in Québec and Ontario Concentration patterns in favor of Québec and Ontario were observed before quota implementation in the 70's This dynamic pattern has been slowed down because of the distributional equity effect of quotas, but they are still the leading provinces in terms of milk production

TABLE 1 DISTRIBUTION OF MILK PRODUCTION BY PROVINCE

Canada: Distribution of Farms Reporting 18 or More Dairy Cows and Milk Production, 1986 or 1988

Province		1988 Fluid[1] (hl)	1988 Industrial[1] (hl)	1988 Total[1] (hl)	% of Production	1986 Number of Farms	% of Farms
Central --							
Ontario	ON	10,245	15,168	25,413	33%	11,787	31%
Quebec	QU	7,038	22,801	29,838	39%	16,252	43%
Central Total		17,283	37,969	55,251	72%	28,039	74%
Maritime --							
Newfoundland	NF	180	0	180	0%		0%
Nova Scotia	NS	1,157	645	1,802	2%	734	2%
New Brunswick	NB	695	684	1,380	2%	628	2%
Prince Edward Island	PE	143	863	1,006	1%	752	2%
Maritime Total		2,176	2,193	4,368	6%	2,114	6%
West --							
Manitoba	MA	1,173	1,938	3,111	4%	2,432	6%
Saskatchewan	SA	983	1,360	2,343	3%	1,825	5%
Alberta	AB	2,602	3,332	5,934	8%	2,489	7%
British Columbia	BC	3,172	1,833	5,005	7%	1,050	3%
West Total		7,930	8,463	16,393	22%	7,796	21%
Canada	CA	27,388	48,624	76,012	100%	37,949	100%

[1] Standardized to 3 6 kg butter fat per hl

Source 1986 Census of Agriculture, Statistics Canada

SOURCE Price Waterhouse, 1991.

For the period 1983-87, Québec and Ontario possessed, respectively, 47% and 31% of Canadian industrial milk quotas (Proulx and Gouin, 1989) Québec has shown the greatest milk surplus in absolute quantities Since the implementation of supply management, Québec, along with the Maritimes, has had a tendency to increase its national quota share, while the Prairies and Ontario have shown a decline (Appendix 1)

In Canada, the Canadian Dairy Commission (CDC) sets a target price and a support price to regulate the price for industrial milk in Canada The targetprice is established based on a cost of production formula that includes returns for labour and return on equity It is based on butter and skimmed milk powder target prices (Appendix 2) Those two products are linked at the processing level because one is the co-product of the other Historically, they have been the two principal dairy products for milk-fat and solid non-fat components of raw milk The target price includes a direct subsidy payment (support price) which becomes the basis for pricing milk in each province Producers' prices across the provinces may vary because they are linked to provincial programs and policies

Fluid milk pricing, under provincial jurisdiction, follows a similar pattern but with the difference of costs of production being specific to each province As a result, both industrial and fluid milk prices are heterogeneous across provinces These two categories of milk refer as Pool 1[1] and Pool 2[2], respectively and have two different price schemes Fluid milk price is higher than industrial price because of historical differences in phytosanitary and daily production requirements throughout the year However, production delivery standards are already the same for both fluid and industrial milk, whereas differences in milk quality standards will be eliminated following an agreement for identical production and pricing conditions for both pool 1 and 2 by 1996 This agreement takes its source from asymmetry in the ownership of quota rights for pool 1 and pool 2 among individual

[1]Pool 1 includes fluid milk and fresh cream

[2]Pool 2 includes butter, cheese, ice cream, yogurt, skimmed milk powder

producers Increasing friction due to numerous factors such as historical higher investment made by fluid milk producers, the skimming process of fluid milk affecting industrial milk quota, and the persistant higher fluid milk price over industrial milk confronted with industrial milk standards resembling fluid milk standards Consequently the Fedération des Producteurs de Lait du Québec (FPLQ) voted in Fall 1991 for a progressive merging of the two pools to reacha unique quota and a unique blend price, according to milk final uses by 1996 For the present study this argument is taken into consideration where fluid and industrial milk producers will be merged to account for one all-milk supply response Distributional asymmetry regarding fluid and industrial milk quotas, even if decreasing, is still prominent This may imply different elasticities reflected in distinct output responses at the production level Within each province, fluid milk supply almost perfectly matches the provincial demand through the fluid milk quota that always contains unused quota in order to match short run demand changes with production adjustments without modifying the provincial production quota allowance Industrial milk however does not maintain such a rigid tie because transformed products can be stored and transported farther distances relative to fluid milk and, contrarily to fluid milk surpluses are exported [1] As a result, the province of Quebec shows the greatest industrial milk surplus and dairy product exports to other provinces that are deficit regions (Appendix 3)

[1] The Canadian Dairy Commission has allowed a chronic surplus to exist so as to insure fulfillments of domestic requirements which indirectly provide a window for Canadian dairy exports

2.2.2 THE AMERICAN DAIRY INDUSTRY

The U S Dairy sector is regulated by two price programs The **Dairy Price Support Program** and the **Federal Milk Marketing Order Program** The former established in 1941 supports milk price to 75-90% of parity[1] The **Commodity Credit Corporation** (CCC) has maintained the support price by purchasing excess butter, cheese and nonfat dry milk from dairy processing plants at prices calculated to permit the processors to pay the support price Program costs fluctuated quite a bit in the 50's and 60's, but reached very high levels in the 70's and 80's In the late 70's, milk production started to increase without a corresponding increase in demand A tentative answer may be the rise in the **milk-feed price ratio** for the period 1974-83, caused by an abrupt drop in grain prices Government costs rose from 0 25$ billion in 1979 to 2$ billion in 1982 83, where the CCC purchases represented 12% of U S milk production in 1982 83 (GAO, 1988)

Dairy program cnanges were made, in the early 80's, to reduce government costs, milk production, and government purchases The rigid tie between milk price support and parity guidelines was eliminated so that prices no longer increase parallel to parity (Hammond and Brooks 1985) For instance, producers were charged an extra fee per hundred-weight (cwt)in 1983 to offset some government programs, an incentive milk diversion program was introduced in 1984 Despite these adjustment programs government costs and involvement in the industry are still very high, and the dairy industry faces additional necessary needed changes

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[1]Parity reflects the current price level at which a unit of milk would have the same purchasing power it held between 1910–14, when prices received and paid by farmers were considered to be in good balance

The Federal Milk Marketing Orders (FMMO), the other major dairy price program which regulates an increasing proportion of all milk sold (70% in 1983) specifies minimum milk prices (class A) paid to producers in the 45 geographical marketing orders of United States The basic objective of this program is to fulfil regional fluid milk demand with corresponding regional milk supply points

This program introduces the concept of classified pricing enforced both by government and producer cooperatives, where the price for fluid milk (class A) depends on its end use processors pay a Class 1 price for fluid milk and decreasing prices for industrial milk Class 2 and 3 (Table 2) Only Marketing Orders can deal with fluid milk for producers wanting to sell through a FMMO, they must satisfy minimum conditions with regard to phytosanitary measures and with minimum production flow delivered to the plant Within each marketing order, there are four prices of increasing magnitude Minnesota-Wisconsin price, class III, II, and I prices A pooled price is also computed and is paid to class-A approved producers (either pooled or non-pooled), this price is higher than the Wisconsin-Minnesota U S base price (grade B) for processed dairy products Fluid milk prices differ in each FMMO, while manufacturing milk prices, based on the Upper MidWest Grade B milk price are more uniform nationwide[6] As opposed to the Canadian system, fluid milk purchase is allowed between marketing orders but, as long as costs of purchases and transportation from alternative sources are **lower** than within the milk purchasers' home order

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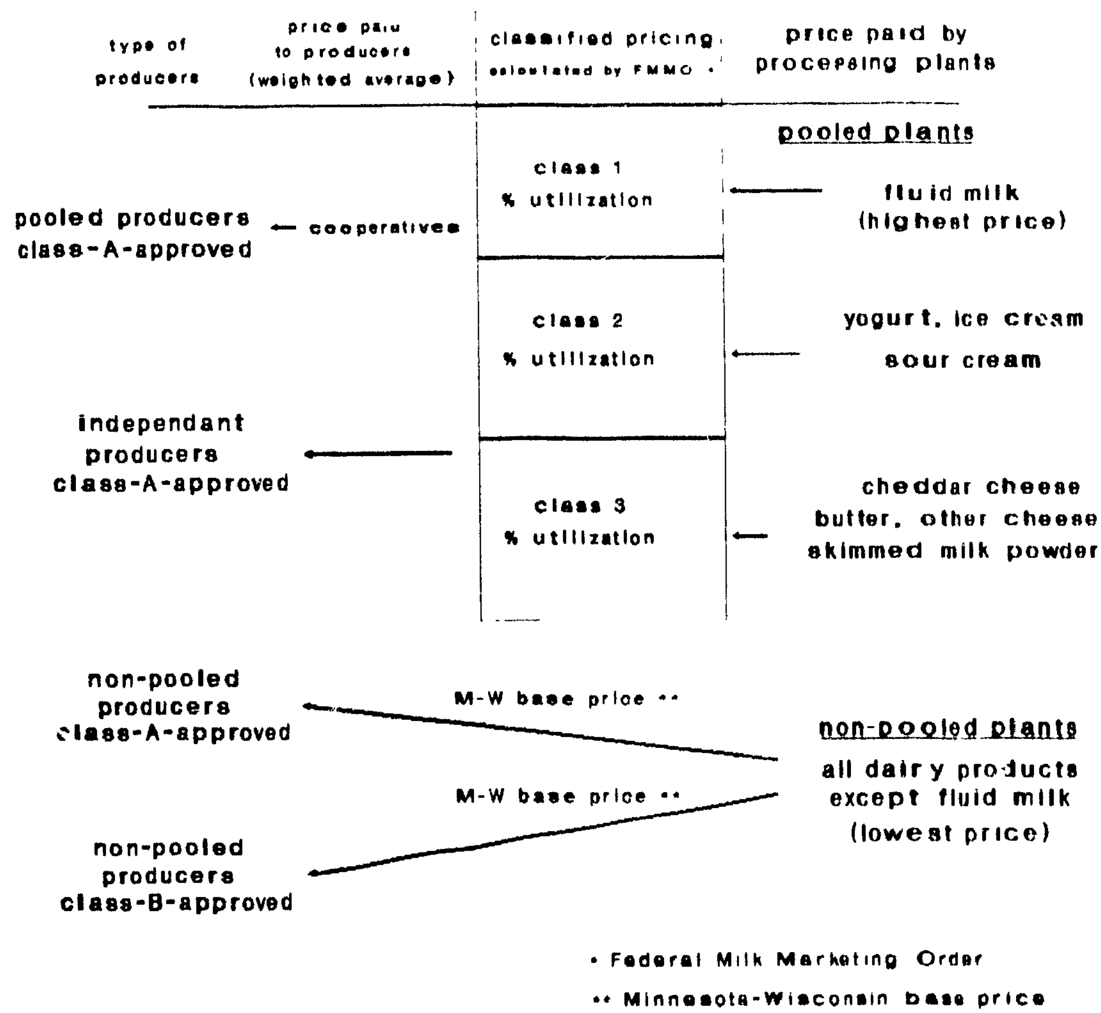
[6] The above pricing system does not apply for Pacific states Western milk pricing is different from milk pricing on the east side of the Rocky mountains California, the biggest supplier on the west coast, is not covered by a FMMO but it rather has its own milk pricing system Fringe milk producing states geographically close to California are thus influenced by its price structure

TABLE 2: Mode of payment - processing plants to producers



SOURCE: GREPA, 1987

U S producers do not receive the price processors pay but a blend pricewhichis the average of fluid (class 1) and manufacturing milk prices (class 2 & 3) weighted by the proportion going for each purpose within a given marketing order Price supports and marketing orders through classified pricing[6] are two different regulatory structures dealing with the same industry Even though they were not designed to work together they affect each other It has been said that marketing orders have promoted self sufficiency in milk production at the expense of discouraging comparative advantage Therefore price support program become very important from the viewpoint of low cost areas Without marketing orders, low cost regions would send more fluid milk to high cost areas, resulting in higher blend price for low cost producers since a greater proportion would be sold as fluid grade milk Therefore, one method to compensate these low cost producers has been to maintain a relatively high support price in these areas by purchasing, through the Commodity Credit Corporation large quantities of dairy products at that price (Hammond and Brooks, 1985) Conversely, the argument for low cost producers apply equally well for high cost producers, where Federal Milk Marketing Order program is a key aspect in providing price protection against product movement originating from low cost regions

Similarly to the Canadian structure, dairy production is very asymmetrically distributed across United States According to Table 3, milk surplus is concentrated in the northeastern part of the country New England, an historical leading dairy region and the Great Lakes region, currently the leading dairy region, are both closely located to the Canadian most important dairy region being the province of Quebec and Ontario

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[6]A pricing system under which the price of milk depends on the use made of the milk Higher prices are charged for milk used for fluid purposes

TABLE 3 DISTRIBUTION OF MILK PRODUCTION BY STATE

United States: Distribution of Farms Reporting 20 or More Dairy Cows and Milk Production, 1987 or 1988

State		1988 Production[1] (hl)	% of Production	1987 Number of Farms	% of Farms
Lake States --					
Michigan	MI	23,030	4%	4,905	4%
Wisconsin	WI	110,128	17%	32,870	24%
Minnesota	MN	45,871	7%	14,629	11%
Lake States Total		179,029	28%	52,404	38%
Corn Belt --					
Iowa	IA	17,797	3%	5,720	4%
Missouri	MO	13,215	2%	3,961	3%
Illinois	IL	12,356	2%	3,094	2%
Indiana	IN	9,841	2%	2,649	2%
Ohio	OH	21,079	3%	5,656	4%
Corn Belt Total		74,288	12%	21,080	15%
Northeast --					
Pennsylvania	PA	44,950	7%	11,872	9%
New York	NY	50,412	8%	11,722	9%
Connecticut	CT	2,383	0%	437	0%
Rhode Island	RI	172	0%	47	0%
Massachusetts	MA	2,031	0%	509	0%
Vermont	VT	10,524	2%	2,489	2%
New Hampshire	NH	1,339	0%	323	0%
Maine	ME	2,837	0%	779	1%
Delaware	DE	595	0%	93	0%
Maryland	MD	6,357	1%	1,318	1%
New Jersey	NJ	1,744	0%	412	0%
Northeast Total		123,344	19%	30,001	22%
Total Three Regions		376,661	59%	103,485	76%
Pacific --					
Washington	WA	17,471	3%	1,369	1%
California	CA	81,966	13%	2,519	2%
Idaho	ID	11,577	2%	1,544	1%
Pacific Total		111,014	17%	5,432	4%
United States	US	639,413	100%	136,300	100%

[1] Standardized to 3 5% butter fat per hl

Source 1987 Census of Agriculture, USDA

SOURCE Price Waterhouse, 1991

However, it is important to differentiate between production and net surplus. California is a big milk producing state, but less important in terms of net surplus. For the sake of this study which investigates potential trading patterns among regions, the focus is on net surplus regions and their relative proximity to Québec and Ontario (Appendix 4). The Northeast, the Great Lakes, Québec and Ontario are both important milk producing and milk surplus regions. Milk deficit regions like Southeast U.S. and the rest of Canada will also be incorporated in this study since they play an important role in the consumption of those milk surpluses.

2.3 TRANSPORTATION

Net surplus and deficit regions bring the transportation issue in the foreground Transportation of dairy products allows milk surpluses to be matched with deficit regions The magnitudes of transfer costs set the geographic location of market boundaries between regions however the ranges of transfer costs are characteristic of dairy products Metzger (1982) investigated the cost of transporting dairy products, namely fluid milk, butter and ice cream for various distances, loads, and truck uses for Northeastern and Mid Atlantic states The regression of costs per hundredweight (cwt) of dairy product indicated that distance and truck use, and not truck load accounted for most variations in hauling costs In terms of fixed costs, base rental was the principal item, the balance being insurance premiums, while fuel accounted for most of the variable costs Projections for 1985 and 1990 were made based upon rental insurance rate and gasoline prices to increase by 10% annually, and all other costs to increase by5%, all at simple annual rate

Metzger(1982) has investigated the most frequently use mode of transportation for dairy products, trucking, but does not mention deregulation and its impacts on dairy transport costs Sweeney(1986) has made a thorough description of deregulation in the transportation industry According to the authors, it is inaccurate to say that the motor carrier industry was regulated by the Motor Carrier Act of 1935 and deregulated by its 1980 version Over half the interstate trucking industry in 1980, was not regulated by the Federal government anyway Indeed, hauling of agricultural commodities was not regulated except safety The Motor Carrier Act(MCA) of 1980 has eliminated or changed a substantial degree of Interstate Commerce Commission(ICC) regulations however some aspect of motor carrier operations were added to its jurisdiction Concerning agriculture the MCA in 1980, set rules that still maintains significant freight services to be

exempted from the jurisdiction of the Interstate Commerce Commission Articles of potential influence for dairy product transportation are as follows
1) vehicles controlled by a farmers and transporting agricultural commodities, and
2) transportation of agricultural commodities (other than manufactured products thereof)

Hence, transport at the production level is still not regulated by the I C C but it is so at the processing level Contrarily to the trucking industry, the railroads exemptions cover a much wider field in agricultural commodities transport For instance transport of butter, condensed and evaporated dried milk cheese and specialty dairy products and processed whole milk as well as all farm products except few items are specifically exempted from regulation So the deregulation issue in 1980 was not critical *per se* Some fields were effectively deregulated, some were regulated and others like agricultural commodities basically remained almost unregulated As a result, Metzger's research on dairy transport costs with projections for 1985 and 1990 can be used, although with caution, for moving milk and dairy products across the regions considered in this study

Regarding eastern Canadian regions, Québec dairy products(fluid milk) are transferred from the processing (pasteurizing) plants to retail markets following three broad types of transportation First, transporters fully integrated by dairies, second independent workers paid by commission from dairies(trucks still belong to the dairy), and third independent drivers representing 10% of the market In the province of Quebec, the cooperative movement is well established and specialized Following horizontal concentration, dairy cooperatives are also concentrated and vertically integrated into dairy products transportation Interprovincial movement of dairy products allows some degree of competition with Ontario transporters such that per unit costs of transportation between Québec and Ontario are very similar under equivalent conditions

2.4 NETWORK MODELS

2.4.1 GENERAL:

The trend toward globalization of trade in agriculture is already initiated and the dairy industry cannot avoid this trend The purpose of this section is to review developments in modelling and forecasting North American agricultural trade, and to apply these findings to dairy trade The present section aims at surveying trade models and displaying the perspective between them and with the model and the solution algorithm to be in this study

The essential objectives achievable with trade modelling are as follows, first, to clarify trade linkages between Canada and U S A in an increasingly complex and interrelated world agricultural economy For this purpose, network models can contribute to filling the large knowledge gap in the nature of global interdependence and to identify current and emerging problems in world commodity markets The second objective is to test the theory suggesting which variables should be included in a model These quantitative techniques are used to compare the theoretical framework against real world data The third objective is to provide useful forecasts policy and program analyses as well as projections for policy and decisionmakers (Thompson, 1985)

Thompson's survey of agricultural trade models provides a solid comparative appraisal of spatial models as well as a descriptive analysis of two alternative trade models non-spatial and trade flow models Anderson *et al* (1985) provide a complementary approach by categorizing linear spatial models as transportation, transshipment, and assignment problems Thompson (1985) discussed two widespread algorithm structures used by transportation models linear and quadratic programming Figure 3 denotes the different agricultural trade models currently use and how they relate to each other In section 2 4, the survey made by Thompson (1985) will discuss NON-SPATIAL, SPATIAL, and TRADE FLOW models LINEAR vs QUADRATIC programming in spatial models will also be discussed in view of the classification made by Anderson (1985) In section 2.5, empirical work will be surveyed for (1) linear and (2) quadratic transportation models, and for (3) linear transshipment formulations It will be achieved with the United States Dairy Sector Simulator (USDSS), the Canadian Regional Agricultural Model (CRAM) and the Generalized Transportation Problem (GTP), respectively

Agricultural trade models

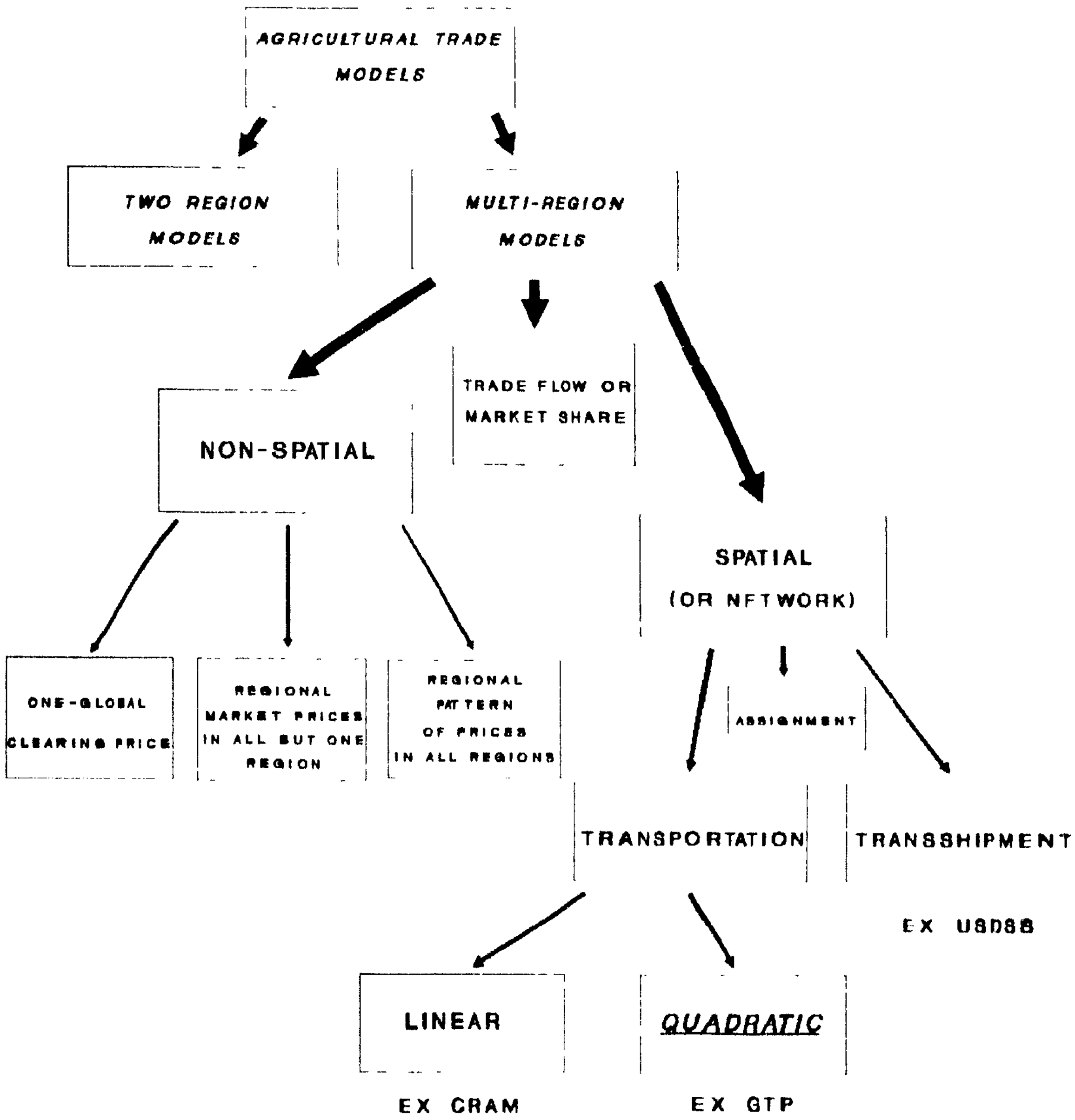


FIGURE 3 AGRICULTURAL TRADE MODELS
SOURCE Thompson, 1985

2.4.2 TRADE MODELS

The present section accomplishes two interrelated objectives First, to make a review of Thompson's comments on trade model, considering their temporal order of development and their applications to agricultural trade, and second, to provide common ground for comparing the quadratic spatial model to be used in this study with other models applied in agricultural commodity trade Comparisons with other classes of models provide a better background the selection of GTP for measuring he impacts of tariffication on milk production Characteristics leading to their advantages and shortcomings will be concisely addressed For spatial models, distinctions between LINEAR and QUADRATIC algorithms will be appraised The discussion evaluates the appropriateness of spatial theory in view of alternative models' theory The next section will review empirical work performed in the field of dairy trade which provides a solid benchmark and situates the present study concerning its implications and capabilities in analyzing trade potential for dairy products across the U S A and Canada, markets presently highly regulated by trade barriers

A relevant technique to analyze the tariffication problem is provided by the **network or spatial** modelling structure The solution technique used by USDSS(transshipment), CRAM(transportation) and GTP(transportation) models allow regional price characteristics and their interrelations to be captured bythe model The categories of agricultural trade models to be discussed are TWO-REGION models and MULTI-REGION models further subdivided into **non-spatial**, **spatial**, and **trade flow or market share** models

2.4.2.1 TWO-REGION MODELS

The structure of these models is divided in two parts the region of interest (usually a country), and a second, often called a residual region Basically, the approach is a **domestic** market open to international trade Even though they are the simplest form of network models, they do contain export demand and import supply functions and they allow for linkages between domestic and world price to determine domestic supply demand and prices in relation with the rest of the world Two region agricultural trade models have limited possibilities because they can be used only to analyze domestic policy issues since they cannot account for change in supply or demand relations of one particular country aggregated into the "rest of the world" region Such arguments apply equally well for the analysis to be between Canada and U S A since consideration of more than two regions is necessary to capture regional disparities Based on the type of analysis they perform, two-region models are not real trade models in the strictest sense because they do not account for delimited import and export flows, they explain only <u>net</u> trade flows

Agricultural dairy trade between Canada and U S A has to be analyzed at a **subnational** level to capture the differences among important milk producing regions Thus, it becomes necessary to specify a model that considers intraregional disparities within each country For that purpose, two regions models have achieved very limited success in contributing to the objectives of agricultural trade modelling Further, they especially fail to reach a consensus on the magnitude of export demand price elasticity for the regions considered (Thompson, 1982)

2.4.2.2 MULTI-REGION MODELS

Multi-region models emphasize regional disparities which are captured using separate homogeneous entities to represent the according trading regions Each region is represented by an excess supply or demand schedule for each commodity (if dealing with multi-commodity models), or by its internal supply and demand structure accounting for the region's export and import behaviour

In the literature reviewed, three basic classes of trade models consider multiple regions These are **non-spatial** models, **spatial** models, and **trade flow and market share** models Although some models treat more than one commodity simultaneously, most of them deal with one commodity at any given time Multiple region models, take the aggregate "rest of the world" region and divide it intotwo or more regions

The above three models require empirical estimates very similar to two-region models nevertheless, multi-region problems differ in the nature of the price linkages between trading regions and in the mathematical procedure to solve the problem The solution procedure fo. each of the three multi-region algorithms imposes a different set of restrictions on the behaviour of the variables endogenized in the model Thus, these differences affect the abilities among the three classes to answer one or more of the above cited objectives of agricultural trade modelling

2.4.2.2.1 NON-SPATIAL PRICE EQUILIBRIUM MODELS

This type of model, the simplest of multi-region models, is a partial equilibrium model To treat trade relationships between regions, they assume a global market to clear through a world price level determined simultaneously by supply and demand balance among all regions Nonspatial models provide world market-clearing price and net trade flow for each trading region but nothing on source-destination trade flow Models of this sort are further categorized as three subclasses A **first** subclass assumes one global market-clearing price at which all international trade occurs where it completely abstracts differential prices associated with freight rate In the **second** subclass commodity prices in all but one region (base region) in the model are linked through transportation costs to the remaining regions The **third** subclass links prices through transport costs among trading partners Although this subclass considers spatial patterns of prices it does have one substantial difference with spatial models it only generates **net** trade flow for each trading region as opposed to **source-destination** trade flow endogenized in spatial models Although tariffs schedules can be easily incorporated nonspatial price equilibrium models tend to have an exaggerated free trade bias (Thompson, 1982) Some important contributions of these models have been made to reflect the policy environment, however nontariff barriers that predominate in agricultural trade, are more difficult to endogenize in nonspatial models as opposed to tariff policies Thompson (1982) in his survey states that non-spatial price equilibrium models focus on model specification and solution technique rather than on the empirical content Non spatial price equilibrium models carry an excessive free trade view In reality all countries intervene in their domestic agriculture, whether as import or export subsidies specific or variable tariffs, or as import quotas(the most widely used restriction method) to provide some form of protection Such policy interventions which still permit trade tooccur but in a distorted manner must be incorporated into trade models

One of the most important contributions of non-spatial price equilibrium models has been the analysis in which world market price shocks are transmitted to the domestic market through a policy reaction function or price transmission equations This is an important feature in which nonspatial multiple region models are an improvement over two-region models

2.4.2.2.2 SPATIAL PRICE EQUILIBRIUM MODELS

This is the most common class of agricultural trade models, especially for comparative static analysis to measure the effects of changes in a particular policy Their distinguishing feature comprises trade flows and market shares as endogenous variables Prices, according to spatial equilibrium theory, are linked only to those pairs of countries actually trading with each other

Similar to nonspatial models, the data requirements are internal supply and demand schedules or export supply or import demand schedules for each trading region, information on all policy variables, transportation costs, and exchange rates The basic difference lies in the solution technique Most common spatial price equilibrium models are formulated with **linear** export supply and import demand schedules and they are solved by quadratic programming

Historically, the special structural problem that was first analyzed was the linear transportation problem, a particular category of network models Such models exhibit a special structure that can be used in the construction of efficient algorithms for their solution (Bradley *et al*, 1977) The search for an efficient solution procedure for this problem resulted in the first widespread application of linear programming to problems of industrial logistics The important feature that allows such efficiency is the simplex algorithm allows subtraction without the need for maintaining and updating the usual tableau at each iteration

The spatial formulation first introduced by Samuelson(1952) was later converted into a quadratic programming problem by proving appropriate linear dependencies between regional supply, demand, and price by Takayama and Judge (1972) and has shown wide possibilities of applications in agricultural trade Recent developments in non-linear solvers have overcome the limitations of linear programs, even though trade flow patterns may not be replicated through a quadratic structure because countries may differentiate commodities traded by country of origin, they may limit trade with quantitative restrictions or they may purchase from many suppliers to spread risk In the literature spatial models most frequently use linear export supply and import demand functions and solve by the quadratic formulation put forward by Takayama and Judge (1972) Samuelson (1952) stated that the maximization of the area under all the excess demand functions less the area under the excess supply schedules minus total transport costs permits a competitive, spatial, equilibrium solution to be attained The contribution of Takayama and Judge was to show the maximization of a quadratic objective function subject to linear constraints was inherent in Samuelson's argument More recently, Holland (1985) developed an iterative, nonlinear spatial equilibrium solution algorithm that has been applied for world wheat trade This is the Generalized Transportation Problem that will be further discussed in the following section

Anderson *et al* (1985) took a different approach and distinguish between transportation models and transshipment models In their explanation, the authors looked at linear algorithms to make their comparisons, and did not raise the issue with quadratic programming With this argument in mind the structures of transportation and transshipment models are very similar They arise in planning the distribution of goods or services from several supply points to several demand locations, where supply quantities at each location are fixed or restricted, and where quantity demanded is predetermined The major difference lies in the addition of intermediate nodes for the transshipment structure Figure 4 denotes the linkages between intermediate nodes with supply and demand nodes They usually represent either temporary storage capacity or processing market level for the commodity(ies) traded, the Dairy Sector Simulator model developed at Cornell University is the most appropriate example where dairy processing plants have been regarded as intermediate nodes

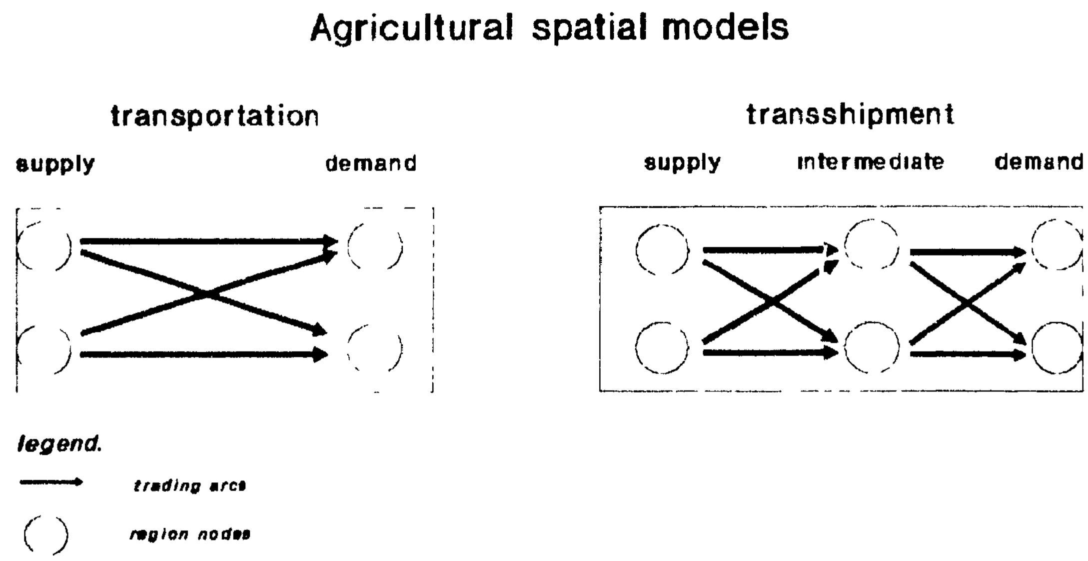


FIGURE 4 TRANSPORTATION AND TRANSSHIPMENT STRUCTURES
SOURCE Anderson *et al* (1985)

Spatial price relationships are mainly determined by transfer costs between regions providing competitive conditions prevail Price differentials across regions have potential impacts at the production level, which directly reflect farmers' behaviour through supply responses At the supply level, product prices differ from one region to the next depending on its proximity to principal market areas Under competitive conditions, spatial price differentials across the regions are solely due to transfer costs For many agricultural commodities this is not realistic, differences may exceed transfer costs because of incomplete or inaccurate information, preferences of buyers for a particular product source, but the dominant reason lies in powerful institutional or legal barriers (Tomek and Robinson, 1972) In dairy trade, present regulation across Canada causes transfer costs not to be linked to distance separating production from consumption points Trade between United States and Canada exhibits very restrictive barriers to trade causing the assumption of competitive conditions to be unrealistic The Canadian dairy industry, similarly to its American counterpart, is highly regulated, especially concerning import access

Even with the proposed scenario of tariffs in replacement of import quotas, it is not realistic to use a spatial model based on a free trade assumption, rather, an algorithm taking into account remaining restrictions measures would be more appropriate As mentioned previously, agricultural trade models which take cares of such situations are not widespread, however, the "Generalized Transportation Problem" developed by Holland (1985) is one of them

The present type of policy analysis will assume tariff schemes to be carried out over a six-year period, leading to freer trade profile at the end of the phase in period To analyze this scenario, it may become necessary to gather information on the time path of adjustment of supply, on disappearance, and on price, but dynamic models developed for this purpose are expensive and hard to manage Instead, static spatial models can be expressed as dynamic by linking current supply as a function of lagged prices and to solve the model recursively through time (Thompson, 1982)

Spatial models are most useful in analyzing interregional price relationships and trading patterns where they are numerous producing and consuming points The most important variable determining spatial price relationships is **transfer costs** It is important, to collect data on transfer costs that are specific to each region to the extent that they are available The spatial equilibrium formulation has been one of the most popular approaches for policy analysis because of the advantages with trade flows generated and with non-tariff barriers easily introduced in the model

An important argument in favor of spatial models over nonspatial models is the generation of trade flows and market shares, two important variables of interest. However, there have been some questions raised because empirical findings demonstrate correlations between trade flows generated in the solution and observed data not to be very high. In the real world, there exist many quantitative restrictions related to trade policies that bring additional tradeflows to the basic solution as those restrictions are added to the model. Spatial models require a large number of such restrictions to perform relatively well in measuring trade flows. Thompson (1982) mentioned that these models are efficient in measuring the effects of changes in transport costs on net trade position. However, these effects have to be interpreted with caution since trade flows solutions are very sensitive to any small changes in transport costs. Further, many doubts have been raised about their efficiency in policy analysis, mainly because of the assumptions of spatial equilibrium theory may not explain reality in agricultural trade.

According to Thompson (1982), the greatest deficiencies of spatial models found in the literature arise from empirical applications: data deficiencies, specification error, simultaneous equation bias, and validation. Data requirements are very similar to non spatial models so that deficiencies in data apply equally well to both models with exception of transportation costs. Freight rates are key inputs for spatial models, however unreliability and lack of data often impair the results. The second shortcoming is specification error when dealing with a partial equilibrium framework. Models surveyed often contain linear functions for export supply and import demand for each trading region, very few consider domestic supply and demand curves apart from residual derived exports or imports. The common procedure is to specify and estimate the export supply and import demand quantity as a function of its own price alone (Thompson, 1982), other parameters being omitted. Third, most supply and demand functions in spatial equilibrium models are estimated with ordinary least squares regression where quantity is a function of its own price alone This is very likely to result in biased estimates of the price coefficient due to the combination effect of specification error and simultaneous equation bias with OLS If price coefficients are biased, the usefulness of spatial models for policy analysis is doubtful because price coefficients are the key parameters in determining adjustments in response to policy shocks

The literature is not rich with spatial models subjected to validation techniques It seems to be a neglected aspect Validation criteria must be set as to compare predicted and observed trade flows Thompson(1985) stated that the choice of validation criteria must not be affected whether we choose an econometric model of a world commodity market or a spatial equilibrium of the same market, the only difference lies in the solution procedure

2.4 2.2.3 TRADE FLOW AND MARKET SHARE MODELS

The motivation behind the development of these models was the lack of capabilities of spatial price equilibrium models to efficiently estimate trade flows and the lack of empirical evidence for the "one price" rule in international agricultural markets This implies that agricultural products are not perfectly homogeneous concerning physical characteristics An important advantage of trade flow (or market share) models consider commodities not to be perfectly homogeneous, because importers may want to differentiate among suppliers because of historical or political reasons or simply because of world market uncertainty The rationale behind trade flow models is the argument that trade flow patterns are not necessarily related to prices Their approach begins with a mechanical procedure that transforms trade flow patterns from one year to the next without considering prices Second econometric techniques explain one or more elements of the trade flow matrix Third, the models incorporate a modification of spatial models where the elasticity of substitution among supply sources is less than infinite for each importing region

Development and applications of these models are to the most recent work done in agricultural trade modelling (Thompson, 1982) Many of these approaches seem to better represent observed trade flows than do spatial models Nevertheless the theoretical background for trade flow and market share models is either nonexistent or of doubtful validity (Thompson 1982) Very few works in these models have considered the incorporation of policy content, they have hardly contributed to explain the observed behaviour not explained by spatial models Their mechanical techniques offer little usefulness for policy formulation although they may be useful in forecasting Therefore their contribution has not been as great as their potential Their main contribution to this field has been in testing theory and to better understand how world commodity trade works, although not as much as if their conceptors would have taken more care of the empirical content of their work Trade flow/market share models are based on a structure which support the hypothesis that goods are differentiated by source of supply However, there have been few attempts to incorporate these findings into empirical work (Thompson, 1982)

2.5 THREE APPROACHES WITH NETWORK MODELS

2.5.1 UNITED STATES DAIRY SECTOR SIMULATOR (USDSS)

The survey of agricultural trade models provides insights about theory and how it relates to the real world It is now necessary to consider empirical work in dairy trade The impacts of Federal Milk Marketing Orders (FMMO) on regional milk prices are at the centre of many policy debates in United States Pratt *et al* (1989) have analyzed the problem in their paper on "Geographic Price Relationships in the U S Fluid Milk industry A Mathematical Programming Analysis" The transshipment model of the American dairy sector combines both network flow and optimal plant location procedures, and calculate values of milk supplies at Class 1 processing locations, called **shadow prices** The authors argue that geographic shadow price relationships conform to the traditional regulatory logic provided by Marketing Orders However, differences exist between relative spatial values of milk provided by the model from those FMMO price differentials implemented under federal policy (Pratt *et al* 1989)

The Dairy Sector Simulator (USDSS) model incorporates three functional market levels **farm supply**, **dairy product processing**, and **dairy product consumption** The supply side is aggregated into multi-county supply areas that were selected according to the distribution of milking cows and where a single point, normally a city, is chosen to represent the entire geographic area Similarly, but independent of the supply side, aggregation is implemented to obtain multi-county consumption areas The dairy product processing and consumption market level considers five dairy product groups fluid milk, soft manufactures (yogurt & ice cream), cheeses, butter, and nonfat dry milk products including other evaporated and condensed products USDSS assigns all processing facilities to representative consumption or supply cities Within each "multi county consumption area", every **fluid milk** plant is designated to the city representing the area of consumption Alternately, all other processing facilities of the **four(4) milk products** (soft manufactures, cheese butter, and NFDM) are attributed to the city representing the area of supply The rationale behind this assumption is that milk production is usually closely located to fluid milk consumption area because of the perishable nature of fluid milk For industrial milk, the same reasoning cannot be invoked because dairy products can be transported farther away The alternative is to link processing plants to areas of supply

2.5.1.1: TRANSSHIPMENT FORMULATION

USDSS can simultaneously solve for the optimal, least cost, processing locations and corresponding milk and dairy products flows, given any constraints on processing locations and/or capacities (Pratt *et al*, 1989) USDSS combines network flow and facilities' location methods in a single-time period and single commodity transshipment model The formulation of this type of problem is characterized by three distinct groups of nodes (Appendix 5) The first level of nodes are the supply points, the second level represents intermediate or transshipment nodes (NODE LEVEL 2) which consider locations such as warehouses where products from origin (NODE LEVEL 1) can be stored temporarily before being shipped to NODE LEVEL 3, dairy product consumption The intermediate node level is the characteristic of transshipment models that provide the opportunity to study and emphasize the processing levels without neglecting production and consumption levels USDSS provides detailed information on processing market level since its major objective is to optimize spatial plant allocation with respect to least-cost transfer routes through the transshipment formulation However, USDSS does not incorporate supply and demand functions but rather specifies them as fixed, *a priori*

2.5.2 CANADIAN REGIONAL AGRICULTURAL MODEL

Agriculture Canada has completed a study on "The Effects of Trade Liberalization on the Canadian Dairy and Poultry Sectors" (Graham *et al*, 1990) to analyze what production patterns, supply responses, trade flows and provincial and national sector earnings that may be expected from major commodities in Canada and in other countries if all support programs are dismantled multilaterally Such a scenario is an extreme one, based on the general trend in GATT, it is unlikely that multilateral negotiations would end with a completely free trade scenario The authors argue that the model estimates how Canadian supply-managed industries like poultry and dairy would respond to this scenario According to Graham*et al* (1990), the free trade scenario provides a useful benchmark against which to compare partial trade liberalization For instance, the authors incorporate findings by Roningen and Dixit (1988) about the impacts of government intervention in agriculture, which reported that complete elimination of subsidies would decrease world production and consequently, world prices will increase by 19% on average The market prices for different agricultural commodities were incorporated into CRAM The dairy sector would gain with this scenario, and dairy farmers' net earnings would be increased by 34%

2.5.2.1: STRUCTURE OF CRAM

The Canadian Regional Agricultural Model (CRAM), focuses on international trade for agricultural commodities The program structure is based on static, spatial, partial equilibrium linear programming model which includes seven agricultural commodity groups The dairy section consists of seven dairy products and the dairy processing sector in each province Twenty nine crop regions (22 in the Prairies and 1 for each of the remaining provinces) and five geographical regions representing Canadian agriculture Additional characteristics include endogenous production input functions, and exogenous unit costs and commodity inventories Supply and demand functions are specified for each commodity, with excess demand/supply met by imports/exports

This multi-commodity and multi-region model is interesting because it has empnasized the dairy trade sector as a separate entity with seven types of dairy products specified The dairy sector of CRAM differs from its earlier version with respect to the manufacturing sector of all the provinces, which is more detailed Additionally, farm gate milk supplies are allowed to vary to capture the effects of policy changes The assumption of quota controls and fixed supplies is relaxed, since supply functions are incorporated

In order to measure the impacts of complete trade liberalization, it is necessary to determine the supply responses The authors present the analytical difficulty of analysis with the supply management structure that prevents producers from responding to prices as they would under an uncontrolled environment Thus, the normal relationships used in economic analysis to predict producer response to various market situations are not reproducible Graham*et al* (1990) argue that it is possible to estimate a supply function provided the existence of a random sample of observations on output levels, input costs, output prices, and **a rental market for quota**:the key parameter to estimate producers responsiveness in a supply managed production

Traditionally, two strategies have been available to empirically estimate supply functions for supply managed industries The first concerns the computation of shadow (or supply) prices as the difference between the administered price and the quota rental price The second estimates an aggregated restricted profit function defined from a multicommodity approach The latter requires output prices and input prices for more than one commodity, but no quota rental rates are needed However, econometric problems are increased because of the large number of parameters about the size of the time series available Because of difficulties associated with both approaches, Graham *et al* (1990) developed a hybrid approach to estimate provincial supply curves for supply managed industries This can be achieved provided the availability of a random sample of observations exists for output levels, input costs, output prices and a rental market for quota exists (Moschini, 1988) But quota rental is prohibited by law, therefore the best alternative is to use information on the capital values of quota to determine supply (or shadow) prices In this case, quotas are viewed as assets where their values equal the discounted value of present and future returns Quota values capture the difference between output prices and marginal costs of production The authors point out the difficulty of defining an appropriate discount rate that would allow for expected gains or loss with quotas expected real interest rate, risk associated with holding this asset, etc These quota values may be interpreted as a measure of the capitalized value of economic rent created by restricting the supply This procedure assumes that the slope evaluations of these supply functions are feasible Once the position of producers on their supply functions is established it becomes possible to estimate their response to profit level or product price changes because of the removal of the production controls under a free trade regime (Graham *et al*, 1990)

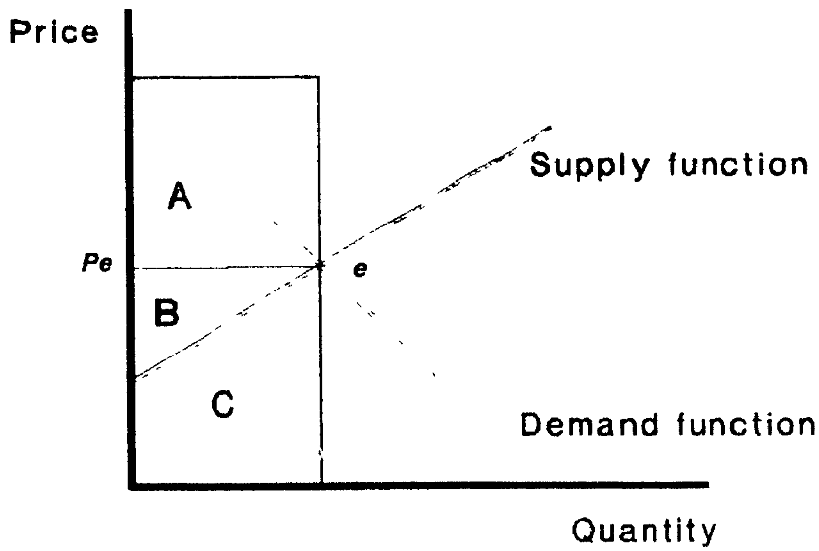
Supply response estimation is a difficult task with supply management In United States, milk supply functions can be formulated as functions of milk prices, input costs, profits of alternative productions, and general economic conditions (Buxton, 1985) In Canada, Moschini (1988) has described two broad approaches to assess supply response with supply-managed industries One requires **farm-level** data while the other requires **aggregate data** There are two methods available to estimate location and elasticity of supply for the above two approaches in supply function estimation either directly evaluated (through a cost function at the farm-level or through a restricted profit function at the aggregate level), or indirectly, through a prior measure of the departure from marginal cost pricing to estimate supply elasticity (using a profit function) Graham *et al* (1990) have decided to employ a hybrid of the approach using farm- level data with a measure of marginal cost pricing, the rental value of quota

2.5.3 GENERALIZED TRANSPORTATION PROBLEM

The Generlized Transportation Problem software package (Holland, 1985) provides up to ten (10) exporting regions and 25 importing regions Lower and upper bound constraints can be incorporated on export and import quantities as quotas an additional characteristic is that individual trade flow limitations between exporting and importing regions as specific or ad valorem tariffs and as exchange rates Transportation costs between exporting and importing regions are specified as fixed unit costs For excess demand and supply schedules the Generalized Transportation Problem (GTP) is a static model that enforces a fixed functional form allowing scalar, linear constant elasticity and mixed-type schedules forthe excess demand and supply functions

A linear transportation model (CRAM) has been used for dairy trade and for other major agricultural commodities to measure the impacts of free trade on Canadian dairy producers linear transshipment model (USDSS) has been used to estimate optimal processing plant allocations in United States and consequently how milk production would be influenced The GTP spatial model algorithm is a surplus maximization problem using a quadratic formulation (Figure 5) which can be utilized, in the present study, to estimate the impacts on **prices** and **quantities produced and traded** following the application of tariffication Hazel and Norton (1970) defined the objective function that leads to an equilibrium solution as being derived via the geometry of producer and consumer surplus The objective function being defined as the maximization of the sum of producer and consumer surplus (A+B+C) Thus GTP can be expressed as a surplus maximization problem to which a third element transportation costs has been added

Producer and consumer surplus



A: consumer surplus
B: producer surplus
C: total costs of production
B+C: gross margins

FIGURE 5. PRODUCER AND CONSUMER SURPLUS
SOURCE Hazel & Norton 1986
Takayama and Judge, 1972

2.5.3.1 SOLUTION PROCEDURE

The solution algorithm used in GTP minimizes transfer costs by choosing the cheapest-cost supplier for each importing region, if a trade flow constraint is binding, the model will search for the second lowest alternative, and so forth, if the second best alternative is also constrained GTP links exporters and importers through a price linkage function that is similar to the first order conditions for the surplus maximization formulation

$$L_i(P_i) = ((P_i * (V_i + 1) + U_i) * E_i + T_{ij}) * ((V_j + 1) / E_j) + U_j$$

where V_i ad valorem tariff imposed by ${}_i$th exporter

U_i specific tariff imposed by ${}_i$th exporter

E_i exchange rate for the ${}_i$th exporter

T_{ij} transport costs from ${}_i$th exporter to ${}_j$th exporter

V_j ad valorem tariff imposed by ${}_j$th importer

U_j specific tariff imposed by ${}_j$th importer

E_j exchange rate for the ${}_j$th importer

The quadratic algorithm utilized by GTP is called the Vector Sandwich Method(VSM) This type of algorithm is a fixed point or path-following equilibrium which means that given an initial point, it will follow a path leading to an equilibrium point The algorithm used by GTP moves from simplex to simplex following a set of rules, where a linear approximation is created on each of the simplex where the algorithm moves To move from an initial point to an equilibrium point, GTP needs only price vectors and the quantity vectors linked to the price vectors There is no need for an objective function nor for derivatives (or system of path-following differential equations) to be evaluated As a result, it makes the algorithm relatively easy to use and more flexibility exists in excess equation formulation On the other hand, the algorithm converges more slowly compared to those algorithms using derivative information (Holland, 1985)

The assumptions of this model are (1) markets behave competitively, (2) each region represents a distinct market, (3) the commodity traded is homogeneous, (4) quantities supplied and demanded are well-behaved functions of prices, (5) transportation costs are constant per unit costs, and (6) the exporting and importing regions may be specified *a priori*

The theory underlying GTP is graphically presented in Figure 6 with a two-region example where geographic price relationships are illustrated

<u>**Trade between two regions**</u>

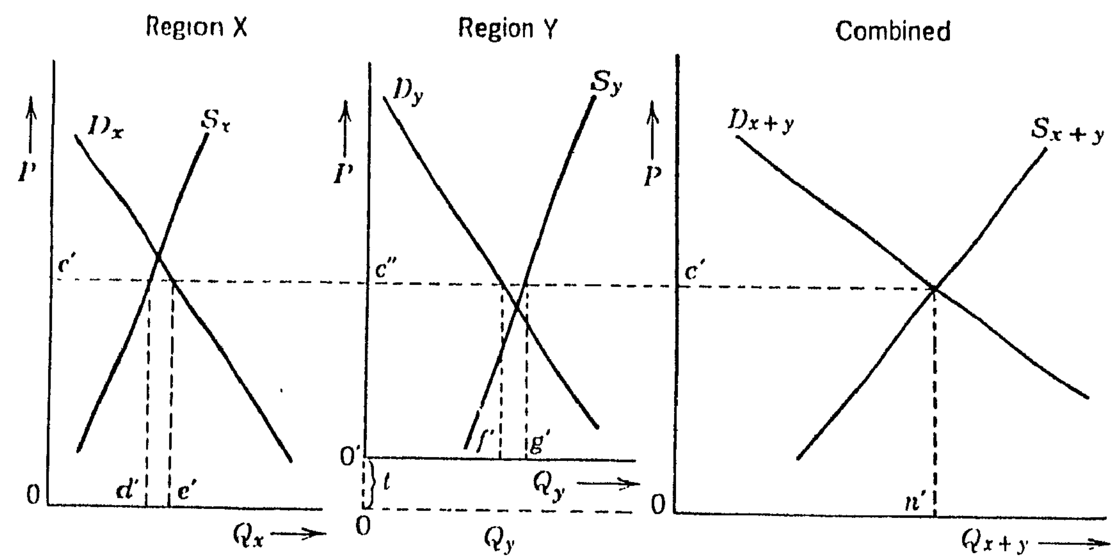


FIGURE 6. TRADE BETWEEN TWO REGIONS
SOURCE Bressler and King, 1970

Supply and demand curves are displayed for a high price region(X) and a low price region(Y) When transportation costs are incorporated the equilibrium price is lower in the exporting region than in the importing region Thus, supply and demand can no longer be aggregated directly but a displacement equivalent to transfer costs must be added The exporting region(Y) shows an upward shift of supply and demand by an amount "t" representing unit costs of moving the product from region Y to X After that curves can be aggregated to find the equilibrium trading price (c') The final diagram ("combined") is expressed in terms of prices prevailing in region X(importer)

The same analogy applies to multi-region cases In short, a spatial algorithm will follow these steps to solve for maximum surplus net of transportation costs

1) Data on supply and demand for each region involved will be summarized into excess supply and excess demand for all the regions
2) The model will solve for an equilibrium price at which all aggregated supply and demands are equated
3) From the equilibrium price, the algorithm solves for each region given the binding constraints relevant to regions
4) From regional prices, the algorithm determines consumption and production levels for each region
5) The iterative procedure solves for the least-cost route, given the constraints

CHAPTER THREE: METHODOLOGY

3.1 THE HYPOTHESIS TO BE TESTED

The hypothesis that *tariffication would decrease milk production in eastern Canada to the extent that U.S. producers will increase their exports to Canada* is tested using a spatial price equilibrium model. The solution algorithm of GTP (Generalized Transportation Problem) is used to find a competitive, spatial price equilibrium given an array of potential constraints that can be introduced.

The research objectives of this study are: first, to calculate the impacts of tariff implementation on milk supply and demand, second, to analyze the effects on producer milk prices, and third, to measure the impacts on interregional import and export trade flows. In order to capture the most important regional effectson milk production, the GTP model is applied to five (5) delimited surplus regions. These consist of two Canadian regions: provinces of Québec and Ontario and three U.S. regions (Northeast, Mideast, and Great Lakes) (Figure 7). In addition, one residual region for Canada and one for United States are incorporated to serve as demand sinks for milk surplus from the other regions since these two residuals are significant deficit regions. Supply and demand equations will be specified,*a priori*. The five surplus regions are specified as both exporters and importers whereas, the two residuals are restrained as being importers only. All regions are specified to conform to existing national, provincial, and state borders.

The present chapter describes the methodology employed to test the hypothesis that the conversion of import quotas to tariffs will decrease Canadian milk production to the extent that U.S. producers will export dairy products into Canada to replace reduced Canadian milk production. Thus, Section 3.2 describes the core of the methodology as the linear supply and demand equations for each of the regions considered, and how they are specified in the spatial model. Section 3.3 explains the calculation of excess supply and demand functions, the form required by the solution algorithm Section 3 4 reviews tariff schedules while section 3 5 provide precision and justification of transportation costs The recursive procedure described in section 3 6 incorporates all of the above data in the solution algorithm and display the annual recursive loop as a means to embody tariff schedules Finally, section 3 7 discusses model validation

Geographic delimitations of regions

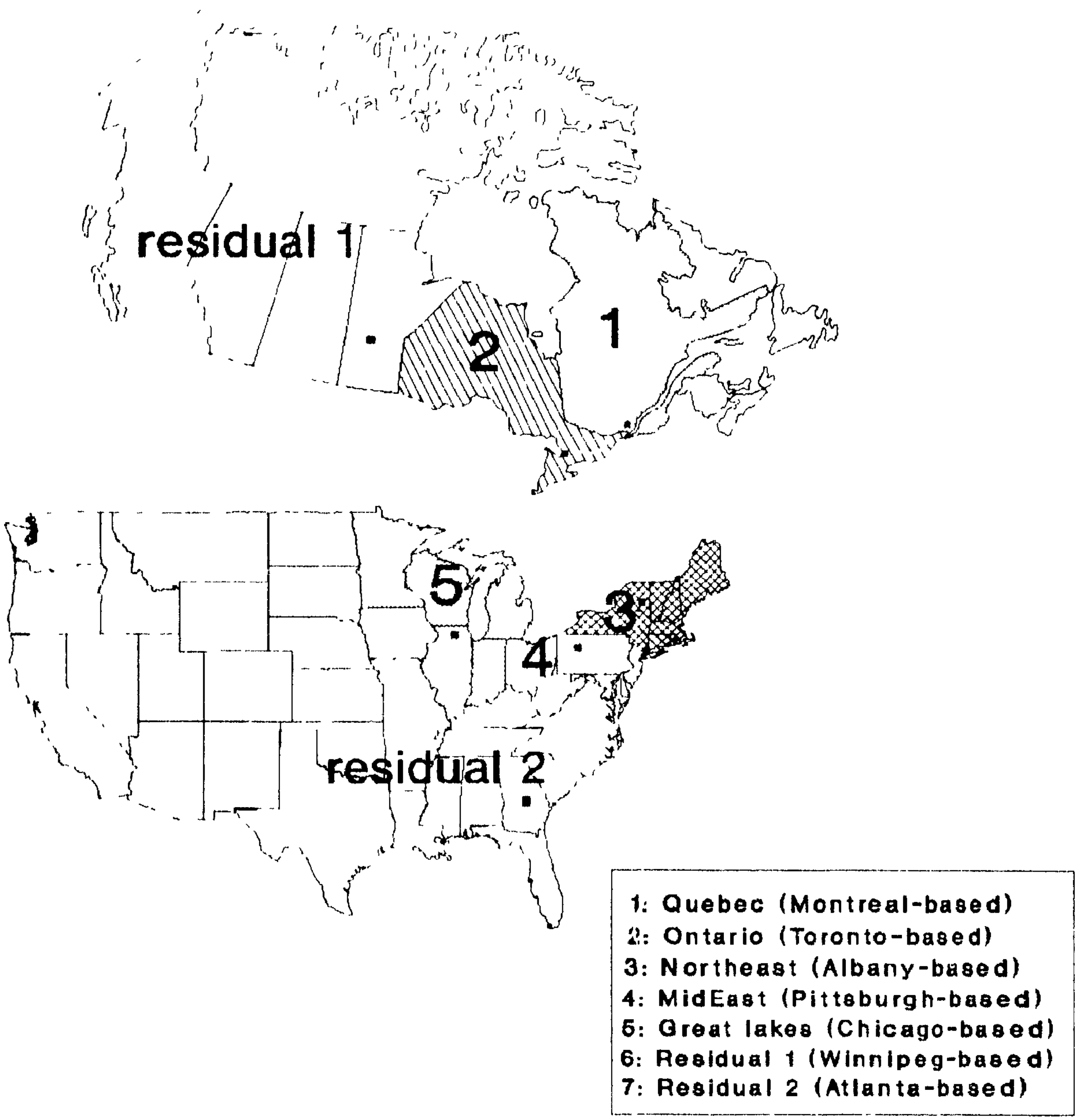


FIGURE 7 GEOGRAPHIC DELIMITATIONS OF REGIONS

3.2 LINEAR SUPPLY AND DEMAND EQUATIONS

The formulation of supply and demand at the production level is better-suited than at the wholesale level to answer the hypothesis regarding the impacts of tariffication on dairy producers For each of the five exporting regions, one supply and two demand curves, obtained from literature searches, will be incorporated in GTP The use of only one milk supply accounting for all milk is justified by the absence of a clear-cut definition between fluid milk and industrial milk producers Milk prices and quantity supplied available on an individual state basis necessitate aggregation for the states forming a region These milk supply responses as well as price-elasticities found in the literature are formulated at the production level Demand functions for dairy products are estimated from price elasticities on fluid milk and manufactured dairy products, from data on quantities consumed (built from population figures in each distinct region and per capita consumption of milk and dairy products), and from prices at the production level for both fluid milk and industrial milk (accounting for all transformed products) Processors and retailers margins are assumed constant for the sake of simplicity This argument follows the theory of derived supply and demand equations presented in Figure 8 that allows both sides of the market (supply and demand) to be on the same basis for analysis

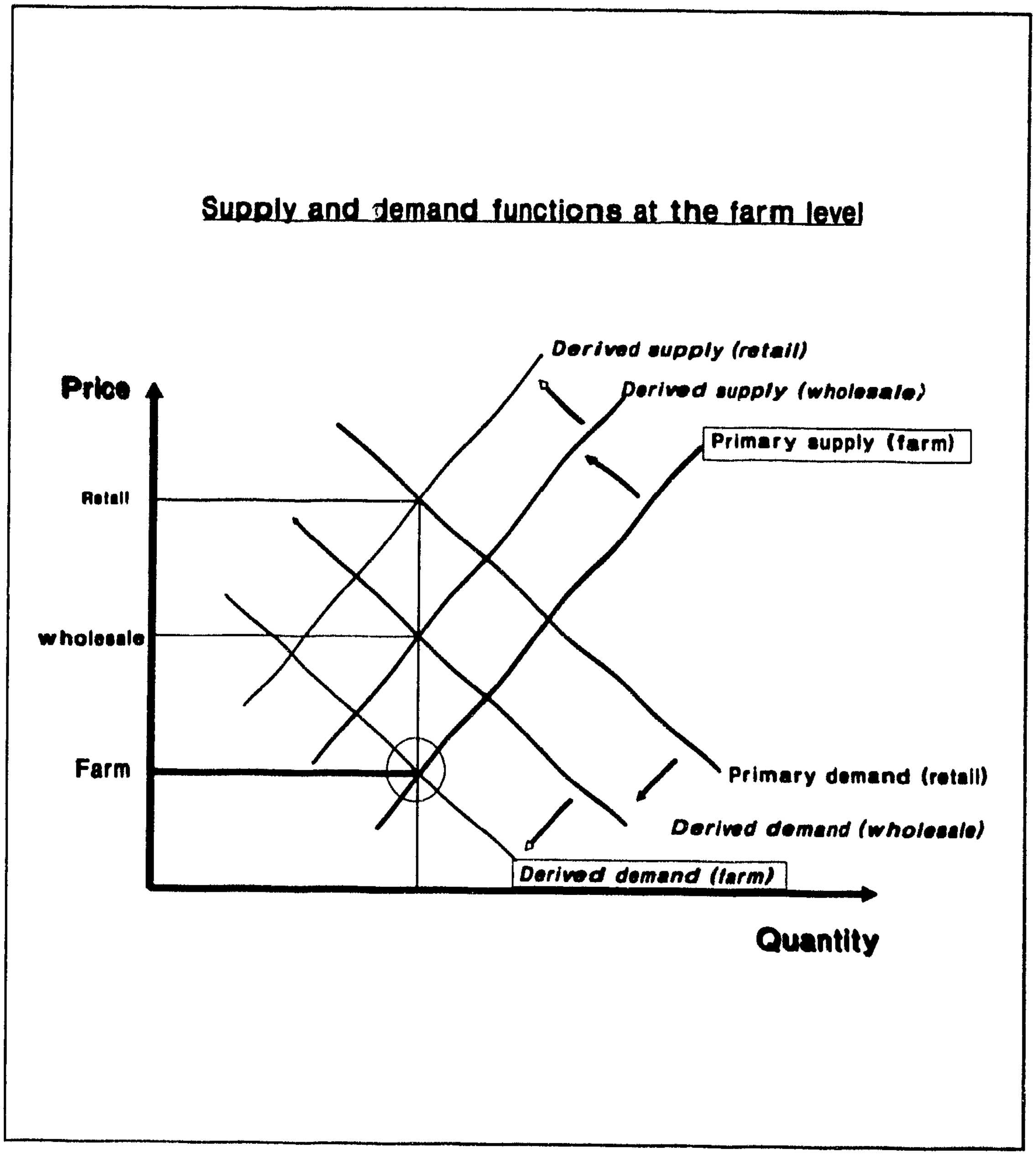


FIGURE 8 DERIVED DEMAND AND SUPPLY CURVES
SOURCE Tomek, 1980

The estimation of demand equations bears some similarities with its supply counterpart but with the important distinction that separate equations for fluid milk and dairy products were made possible In each individual region, one supply function is specified but two demand functions are specified Since GTP is a one-commodity model, we have to specify the algorithm that two demand functions exist for the same supply function To do so, an additional importing region is matched with each of the five exporting regions In each pair, one sub-region is attributed a fluid milk demand function coupled with the all milk supply while the other one is added the industrial milk demand As a result, each paired region has the standard supply and demand pattern while the other has only a demand function, inducing the model to search for the supply of its "twin " Constraints have been specified to induce the model to look at this supply source in its own region first The duplication of regions and their specification as two distinct formspermits appropriate specifications in the solution algorithm On one hand, one sub region accommodating all milk supply with fluid milk demand is, by definition, a surplus region specified as an exporting region in GTP On the other hand, its duplicated counterpart contains only industrial demand but no supply, which implies it is an importing region

The relevant market is expressed as five exporting regions **Québec, Ontario, Northeast, Mideast,** and **Great Lakes.** Similarly, their duplicated counterparts create five importing regions and two additional ones as**Residual 1 and Residual 2**, which are additional demand sinks for Canada and United States, respectively A summary of all regions and their status as exporter or importers are explicitly shown in Figure 9 According to these specifications, fluid milk demand of one given region is fulfilled by the all-milk supply of the same region No interregional trade flows in fluid milk are expected since all-milk supply is always greater than fluid milk demand Therefore expected interregional trade flows will consist of industrial milk only A summary illustrating regions' specifications is presented in Figure 9

Trading regions in the solution algorithm

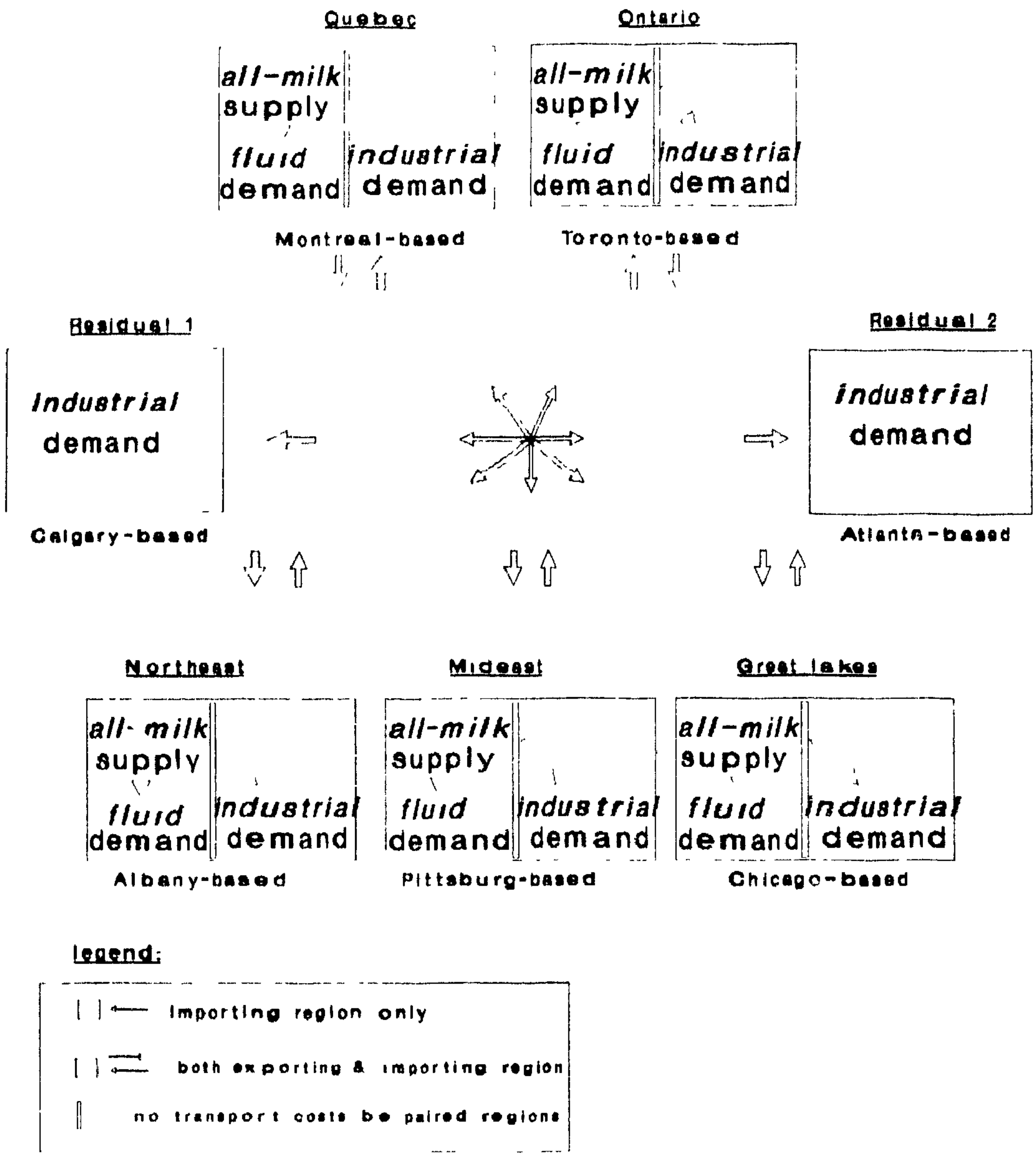


FIGURE 9 TRADING REGIONS IN THE SOLUTION ALGORITHM.

3.3 EXCESS SUPPLY AND DEMAND CURVES

The solution algorithm of GTP requires the formulation of each region's linear supply and demand equations into **excess** supply and demand form GTP is able to find a solution to price equilibrium problems with very complicated excess supply and demand schedules However supply and demand schedules are restricted to particular functional forms that are used in the program to simplify its use. The excess schedules are of the form

$$\text{Quantity} = \alpha + \beta * (\text{Price})^{\gamma}$$

The Generalized Transportation Problem allows

scalar $\alpha = 0$ and/or $\gamma = 0$

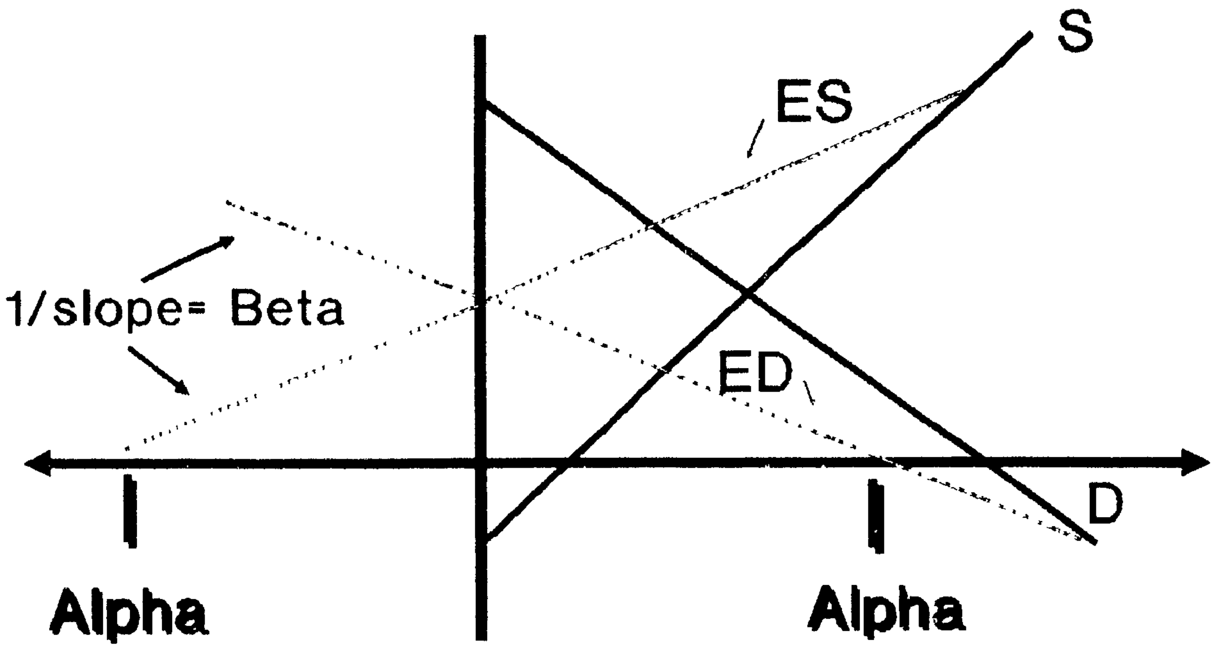
linear $\alpha = 0$, $\gamma = 1$

constant elasticity $\alpha = 0, \ \beta > 0, \ \gamma \neq 0$

mixed schedules $\alpha \neq 0, \ \beta \neq 0, \ \gamma \neq 0$

The conversion of supply and demand curves into excess supply or demand is calculated as the difference between the quantity supplied and demanded for each price locus The linearity in supply and demand estimations, assumed for simplicity, compel excess functions to be linear as well Positive numbers obtained from the subtraction, represent points of the excess supply linear curve negative ones make the excess demand function By mathematical definition, the X intercept (coefficient Alpha) and the slopes (1/coefficient Beta) for the both excess supply and demand curves have the same value but of opposite signs Also it can be noted that the slope values for excess curves are smaller than those their corresponding supply and demand original equations Figure 10 summarizes the above arguments relating basic supply and demand curves with excess supply and demand ones

Excess supply and demand curves



legend:

S: supply curve
D demand curve
ES. excess supply curve
ED. excess demand curve
Alpha: X-intercept coefficient
Beta: slope inverse coefficient

FIGURE 10 EXCESS SUPPLY AND DEMAND CURVES

SOURCE Bressler and King, 1970

The formulation of excess supply and demand equations, developed above, possesses the following structure

1) $Q = \alpha + \beta * P^{\gamma}$ 331

This mathematical form requires three parameters as α the X-intercept, β the slope-inverse, and $\gamma = 1$ the linearity coefficient The computation of linear supply and demand is performed with data on price elasticity, quantity, and price, which are incorporated in two straightforward formulas in order to estimate coefficients (α) and (β), whereas (γ) is valued at 1 because of the linearity assumption

price-elasticity $(\eta) = (\Delta Q/\Delta P) * (P/Q)$

$$(\eta * Q)/P = (\Delta Q/\Delta P)$$
$$(\eta * Q)/P = (1/\text{slope})$$
$$(\eta * Q)/P = \text{coefficient } \beta$$

2) $\beta = (\eta * Q)/P$ 332

Rewriting equation 1 in the following mathematical terms, with gamma(γ) set at value 1, permits the evaluation of coefficient alpha (α)

3) $Q - \beta * P = \alpha$ 333

Equation 2 and equation 3 generates coefficient (β) and (α), respectively, which are then incorporated in the solution algorithm of GTP to provide excess supply and demand functions for each region The same procedure has been followed to generate the original supply and demand equations where no complete functions were available

3.4: TARIFFS

Although Canada has not submitted an official estimate of tariff equivalents to the GATT panel, it has been reported that tariff equivalents, based on international price for the period 1986-88 for dairy products would be as follows

fluid milk 27%

cheese(cheddar) 178%

butter 209%

skimmed milk powder 93%

These are *ad valorem* tariffs based on current international prices submitted by Canadian officials to the GATT panel (DFC, 1991) Such tariffs appear to be protectionist because current international prices for dairy products are depressed due to trade distorting policies practised by dairy exporting countries The above *ad valorem* tariffs need to be transformed from their international price-based into American price based to be useful for this study Also, these tariff estimations (fluid milk excepted) apply on an individual dairy product basis that would necessitate further calculations to carry out the analysis at the production level, i e , at the industrial milk level Such estimations are beyond the scope of this study Consequently, the *ad valorem* fluid milk tariff of 27% converted to a specific tariff of $11 00 per hectoliter of milk has been used for regional ALL-MILK supply curves in this study It is assumed that the protection level for fluid milk is equally applicable to industrial milk since most dairy producers produce both fluid and industrial milk Which makes the argument of distinct tariffs not easily applicable at the producer level

3.5 TRANSPORTATION COSTS

Costs of transport are critical variables in spatial models They must be as accurate as possible GTP allows only a per unit cost for each possible trade flow For instance one assigned city has been determined for each of the seven regions to have a focal point for source and destination of dairy products

Transportation comprises two parts farm-to plant hauling and plant to retail movement Concerning farm-to-plant costs high regulation is present in Canada For instance, in Quebec there is one uniform cost across the province, while in Ontario, the cost structure is broken in four geographic distinct regions In the **U.S.A.** however, fluid milk hauling rates vary according to farm location, milk volume, competitive environment and initial and maintenance costs to the transporter On average intraregional transport costs are assumed not to be significantly different between regions and are thus omitted from the study

Transportation of dairy products between Canadian regions (interregional transport) refer to refrigerated trucks with 42 000 lbs of milk equivalents based on cheese, excise taxes excluded This information was obtained from Groupe Lactel, a Montreal-based processing firm

Fluid milk is not handled by Lactel but it is assumed to possess similar transport conditions, therefore transportation costs for dairy products apply equally for packaged-fluid milk Cost comparisons with Ontario transporters have shown similarities, thus, the same unit costs are used

In United states, Metzger (1982) studied tractor-trailer operating costs for three products fluid milk ice cream and butter that were updated in 1985 and 1990 to be used for fluid soft products, and butter (transport costs for cheese are assumed to be the same as for butter) for the Northeastern United States Projections for 1985 and 1990 are assumed to be representative

Concerning processing costs and intraregional transport costs, no specifications are considered because all regions are assumed to have equal costs , whith implies no effects on optimal movements or plant locations

3.6 ANNUAL RECURSIVE PROCEDURE

Figure 11 provides the overall view of the planned methodology The calculation and conversion of supply and demand equations into their proper form to be incorporated into GTP and their incorporation into the quadratic algorithm, is a recursive two step procedure applied to three distinct periods (i) the initial tariff implementation in 1993 (ii) the mid-course situation with 18% tariff reduction (according to the argument of Annual tariff reduction of 6%), and (iii) the final case, six years later, with 36% tariff reduction

A primary step involves the use of supply and demand curves converted into excess supply or demand forms These curves along with the constraints are incorporated into GTP to solve for an equilibrium solution The output results on producer prices and quantities produced are utilized to readjust supply equations in light of the above changes Such readjusted functions along with the reduction of tariffs are "feedback" into the solution algorithm to generate a second set of results for the second period (1996) and similarly for the third and final period (1999) following the same recursive procedure Demand functions, however, maintain their original form since the focus of this study is on the supply side

RECURSIVE METHODOLOGY

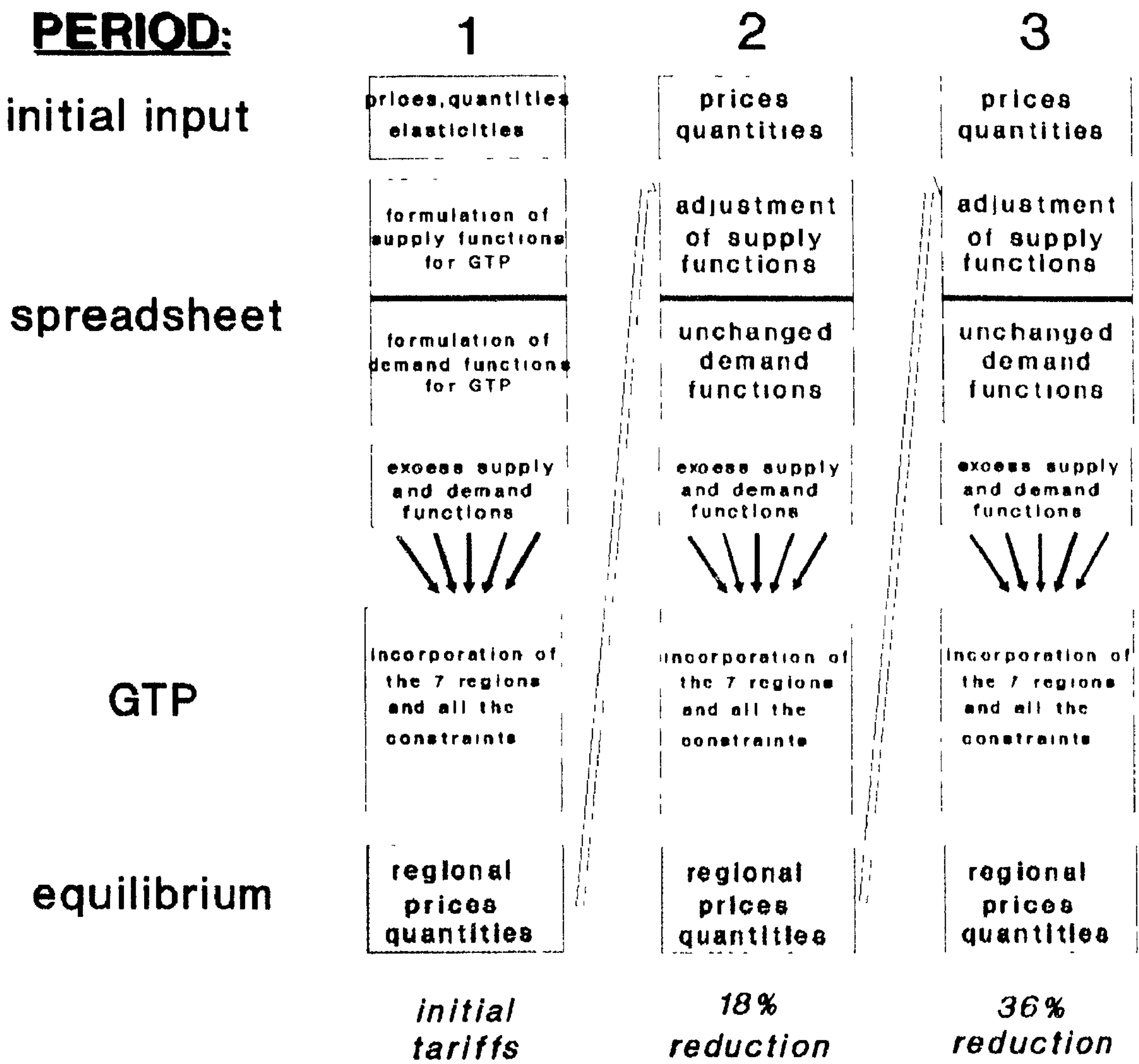


FIGURE 11 RECURSIVE METHODOLOGY

SECTION 3.7: VALIDATION TECHNIQUE

Supply and demand functions as well as all other data requirements have to be validated before the analysis is undertaken Nelson and Winter (1978) pose the argument that simulation is a valid technique to corroborate one model's inferences, and although it does not have the force of a theorem it does raise one's confidence in both conjectures and general understanding of the model's logic However if results are shown to be inconsistent with conjectures, it forces the researcher to review the model and raise attention to previously neglected arguments When the model's parameters are set at realistic values, simulation provides a plausible interval of confidence concerning the significance of the effects being analyzed Validation through simulation techniques propose an avenue to confirm spatial price theory and "expand and strengthen our understanding of a simplified model the better to judge how, and whether, the model relates to more complex reality (Nelson and Winter, 1977)

The procedure uses excess supply and demand curves estimated from supply and demand curves and sets of constraints effective in 1988, to simulate results for 1989 This resulting outcome as supply, prices and trade flows is then compared with 1989 historical data to validate the predictive power of GTP The baseline year considered in this study, 1988, was chosen because numerous articles on the tariffication proposal refer to the period 1986-88 for the calculation of tariff equivalents

CHAPTER FOUR: RESULTS

4.1 ORGANIZATION OF RESULTS

The hypothesis that tariffication would decrease milk production in eastern Canada to the extent that U S producers will increase their exports to Canada was tested using a spatial model solved by GTP algorithm The results were compared with the stated hypothesis Section 4 2 describes two tariff scenarios to be implemented Section 4 3 presents the model specification as supply and demand coefficients to be used by GTP Section 4 4 shows the results of model validation based on 1989 data Section 4 5 shows results obtained for the two tariff scenarios Section 4 6 provides a discussion of results and concluding remarks are made in Section 4 7

4.2 TARIFFICATION SCENARIOS

According to the Dunkel proposal on tariffication, all non-tariff barriers are initially converted to tariff equivalents which are then reduced by 36% over a period of six years Global support measures like the national milk support price program are to be decreased by 20% over the same period A minimum market access of 3% of domestic consumption is to be increased to 5% by the end of the phase out period These measures of trade liberalization are to be implemented to increase trade flows However special safeguards such as incremental tariffs would apply to imported volumes in excess of 125% of the previous three year average, and on prices if the unit value of imported products fall below the 1986 88 reference period

The tariffication scheme described above will form the basis for the analysis The solution algorithm of GTP permits the incorporation of various types of trade barriers However the complexity of the tariffication proposal can not be fully reproduced into the quadratic algorithm without *a priori* simplifications The magnitude of the tariffs to be chosen in this study aim to find a compromise between potential outcome from GATT negotiations likely to bring highly protectionist tariffs with very little trade flows and lower tariff values which would permit significant trade to occur This study appeals to the estimation of trade impacts with compromised tariff values Table 4 presents two plausible tariff scenarios **Case 1** introduces specific tariffs of $11 00/hl of raw milk on Canadian importing regions (i e Quebec, Ontario and Residual 1) and $7 00/hl on American importing regions (i e Northeast Mideast Great lakes and Residual 2) Tariff schemes for Canada have been obtained from Canada's commodity list submitted to the GATT panel with regard to conversion of all non-tariff barriers to tariff equivalents (Dairy Farmers of Canada, 1991) These Canadian tariffs are based on the average of the fluid milk price differential between Canada and United States for the period 1986-88 evaluated at $11 00/hl (Appendix 6) The baseline for tariffs on dairy products is international prices on fluid milk the American fluid milk price is used, since no international market exists for this commodity No official list has been available for American equivalent tariffs but calculations used by the Dairy Farmers of Canada (DFC), comparing tariff equivalents for dairy products, shows U S tariffs as being in the range of 50% to 75% of Canadian estimates (Appendix 6) This argument is based on the assumption that Americans would favor international prices as the baseline for both fluid and dairy products because the international price equivalent for fluid milk provides the greatest protection obtainable for fluid milk This is because international prices are much lower than Canadian prices for milk and dairy products It is thus a reasonable assumption to use U S tariffs presented by the DFC(1991) on dairy products to represent the middle value between 50 and 75% (i e 63%) of Canadian tariffs Scenario 1 incorporates initial fluid milk tariff evaluated at $11 00/hl for U S imports into Canada and $7 00/hl ($11 00 * 63%) for Canadian imports into United States

Even though international prices do not exist for fluid milk, they can be calculated from fluid milk equivalents for skim milk powder and butter

These tariffs are assumed to be the same for both fluid and industrial milk since this study does not distinguish effective equivalent tariffs for each dairy product The objective is rather to approximate two plausible scenarios and to measure the impacts on dairy producers Equivalent tariffs for manufactured products cannotbe used in the framework of this study for two reasons First they are based on international prices and not on American prices It is beyond the scope of this study to investigate the impacts of tarification based upon the full range of international prices, since only the eastern American market is considered Second this study focuses on the farm production level, instead of finished dairy products Consequently, specific tariff equivalents for Canada, estimated at $11 00/hl according to the country list (DFC, 1991), serve as a basis for relating Canadian to American milk prices

Case 2 is very similar to the first scenario except that the analysis is performed with shadow milk prices for Canadian regions The departure from marginal cost pricing due to supply management is not directly observable To date, this spread has been estimated from capital quota values, Moschini (1988) used a capital asset pricing model which assumes production quota rights as being an asset which equals a discounted value for the present and future returns and where the returns are the difference between the producer milk price and the marginal cost of production The departure from marginal cost pricing estimated as the difference between the average net price of milk and the minimum value of average costs was estimated to be 15% of industrial milk price for the period 1980-86 (Moschini, 1988) The present study used such values to obtain shadow prices in Canada In what follows it has been assumed that this price departure has been applied to both fluid and industrial milk Thus the second scenario takes fluid and industrial milk prices of scenario 1 reduce them by 15% and incorporate them in scenario 2 Accordingly, tariff magnitude has been reduced to maintain the same protection level as with scenario 1 The resulting tariffs are presented in Table 4

TABLE 4 TARIFF SCENARIOS

TARIFF SCENARIOS

SCENARIO 1:

SPECIFIC TARIFF:
($/hl)

	1993	1996	1999
	INITIAL	-18%	-36%
U.S.A. to CANADA:	11.00	9.00	7.00
CANADA TO U.S.A.	7.00	5.75	4.50

SCENARIO 2:

SPECIFIC TARIFFS:
($/hl)

	1993	1996	1999
	INITIAL	-18%	-36%
U.S.A. to CANADA:	3.25	2.65	2.05
CANADA TO U.S.A.	2.00	1.64	1.28

4.3. MODEL SPECIFICATIONS.

The *Generalized Transportation Problem* uses a quadratic solution algorithm which maximizes producer and consumer surpluses less transportation costs More specifically, the algorithm solves the problem with **excess** supply and demand curves As defined in the previous chapter, initial linear supply and demand curves are used to calculate excess supply and demand functions

Canadian supply responses are constructed from quantities and prices obtained from the Dairy Market Review (1991), whereas short run own-price elasticities were taken from McCutcheon (1992) and Conboy, Goddard and McCutcheon (1992) Their estimates ranged from 0 68 to 0 765 for fluid milk to 0 31 for industrial milk (Tielu, unpublished) The authors derived farm level supply elasticities of the following form

Quantity of milk = f (milk price, production factors)
where milk price = producer price - static quota value
= marginal cost price
= shadow price

American price and quantity data are taken from the Dairy Situation and Outlook Yearbook (various issues) Own-price elasticities of supply originate from the research work of Buxton (1985) who estimated supply equations for the 48 contiguous states For the demand side, Kilmer's (1987) dairy products price elasticities were used

TABLE 5 CANADIAN SUPPLY AND DEMAND FUNCTIONS - 1988

	SUPPLY				DEMAND		
	ONTARIO	QUEBEC	RESIDUAL		ONTARIO	QUEBEC	RESIDUAL
				FLUID			
				Q	9742 9	6834	9933
ALL MILK				P	53840	52200	54560
				E	0 24	-0 24	-0 24
Q quantity ('00 tons)	2541 3	29840	20766	A	12081	8474 2	1231 7
P producer price ($/00 tons)	50840	4971 0	50740	B	-0 043	-0 031	-0 044
E short run price elasticity	0 65	0 65	0 65	C	1	1	1
Coefficient A Q BP	8894 5	10444	7268				
Coefficient B (E*Q)/P	0 325	0 39	0 266	INDUSTRIAL			
Coefficient C	1	1	1	Q	14582	10202	14841
				P	48820	4871 0	471 28
				E	0 54	0 54	0 54
				A	22456	1571 1	22855
				B	0 161	-0 113	-0 17
				C	1	1	1

EXCESS SUPPLY COEFFICIENTS

		SUPPLY			DEMAND		
		ONTARIO	QUEBEC	RESID	ONTARIO	QUEBEC	RESID
ALL MILK FLUID DEMAND	A	31 87	1969 5	5049	3186 6	1970	5048 6
	B	0 3683	0 421	0 3097	-0 368	-0 421	0 31
	C	1	1	1	1	1	1
		ONTARIO	QUEBEC	RESID	ONTARIO	QUEBEC	RESID
ALL MILK INDUSTRIAL MILK	A	22457	15712	22855	22457	15712	22855
	B	0 161	0 113	0 17	0 161	0 113	0 17
	C	1	1	1	1	1	1

TABLE 6 AMERICAN SUPPLY AND DEMAND EQUATIONS 1988

SUPPLY

ALL MILK	NORTHEAST	MIDEAST	GR LAKES	RESID 2
Q quantity ('00 tons)	74900	69805	207223	101546
P producer price ($/00 tons)	27836	27704	26779	30120
E short run price elasticity	0.242	0.242	0.4	0.09
Coefficient A = Q BP	56774.2	52912	124334	92406.9
Coefficient B = (E*Q)/P	0.651164	0.6098	3.09531	0.30342
Coefficient C	1	1	1	1

DEMAND

	NORTHEAST	MIDEAST	GR LAKES	RESID 2
FLUID				
Q	32701	[illegible]	[illegible]	[illegible]
P	[illegible]	[illegible]	[illegible]	[illegible]
E	0.185	[illegible]	[illegible]	[illegible]
A	38750.69	41640	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]	[illegible]
C	1	1	1	1
INDUSTRIAL				
Q	[illegible]	[illegible]	[illegible]	[illegible]
P	[illegible]	5800	[illegible]	[illegible]
E	0.376	0.476	0.476	[illegible]
A	[illegible]	[illegible]	[illegible]	[illegible]
B	0.77034	0.814	1.08	[illegible]
C	1	1	1	1

EXCESS SUPPLY COEFFICIENTS

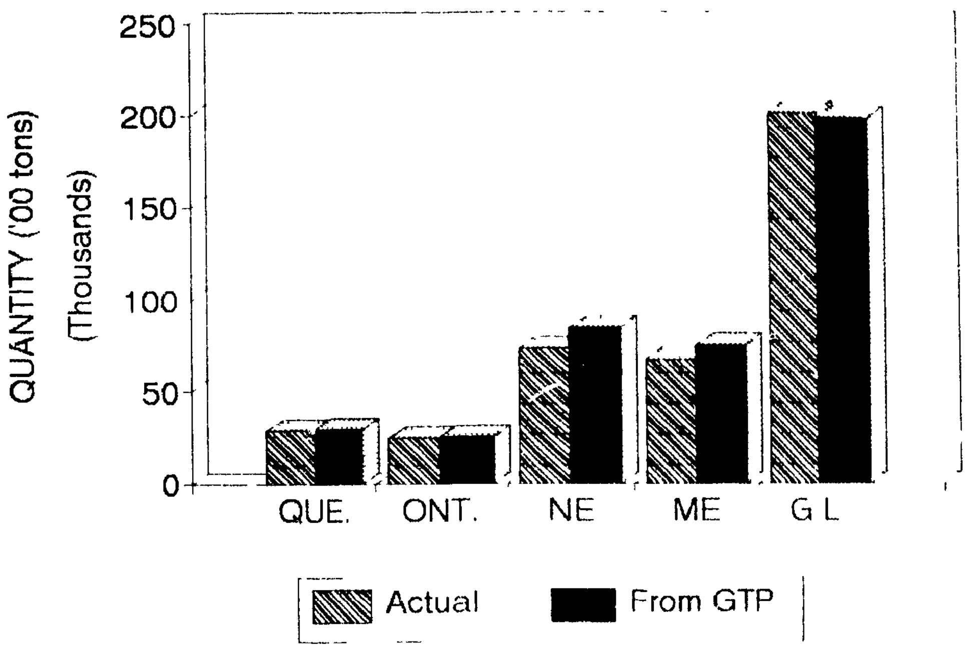
		SUPPLY NORTHEAST	SUPPLY MIDEAST	SUPPLY GR LAKES	SUPPLY RESID 2	DEMAND NORTHEAST	DEMAND MIDEAST	DEMAND GR LAKES	DEMAND RESID 2
ALL MILK-FLUID DEMAND	A	18073.5	11272	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	B	0.861	0.942	[illegible]	1.644	[illegible]	[illegible]	[illegible]	[illegible]
	C	1	1	1	1	1	1	1	1
ALL MILK-INDUSTRIAL MILK	A	-72758.8	65130	82895	222256	72758.8	[illegible]	[illegible]	[illegible]
	B	0.77	0.813	1.08	2.584	0.77	[illegible]	1.08	[illegible]
	C	1	1	1	1	1	1	1	1

4.4. VALIDATION RESULTS

Figures 12 and 13 present regional supplies and prices simulated by GTP against baseline data for the year 1989. These figures generated by GTP represent equilibrium prices and quantities for the five exporting regions. Existing trade barriers were formulated in GTP. The solution algorithm allows trade flow bounds to be incorporated from each exporting (source) to each importing (sink) region. Historical trade flow patterns between Canada and other countries are presented in Table 7 to provide an overall picture of the historical importanceof trade patterns with U.S.A. For the purpose of this study, only trade linkages with United States will be used in the spatial model. These trade patterns have been granted as import quotas and they do not reflect optimal trade movements because of their restrictive nature. To alleviate the impact of non-optimality for the base analysis, the exporting region chosen in GTP has the largest excess supply. Great Lakes and Québec are the greatest surplus regions in U.S.A. and Canada, respectively. Regarding importing regions, Residual 1 (Canadian deficit region)was specified as the importing sink for Great Lakes, whereas Northeast and Mideast were chosen as closely located sinks for Québec exporting region. Values for trade flow upper bounds for U.S.A. and Canada (Table 7) were then introduced to represent these import quotas. It must be noted that the same values were also entered as lower bounds to insure fulfillment of historical (base case) quotas.

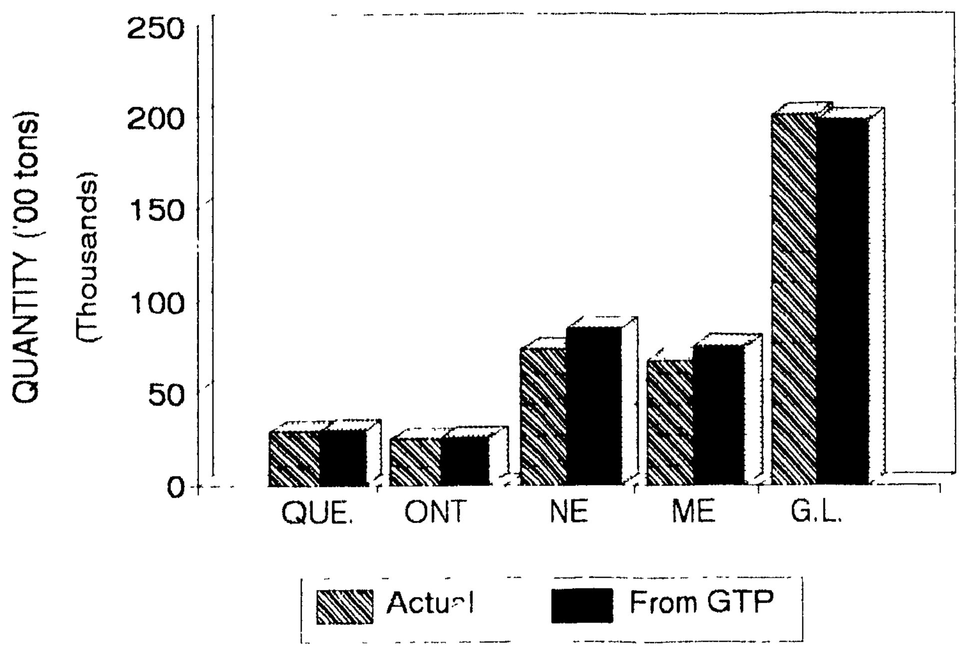
Figure 12 shows the quantity of milk supplied by the five exporting regions defined in the spatial model. The units used are "hundred tons" which permits the solution algorithm to avoid numerical difficulties due to poor scaling. Quantities produced by each exporting region are contrasted, validated with 1989 data. Similarly, prices for the same regions are presented in the same format in Figure 13.

FIGURE 12: SUPPLY VALIDATION
1989



	Actual	From GTP
	...'00 tons...	
QUEBEC	28726	29730
ONTARIO	24538	25484
NORTHEAST	72903	84197
MIDEAST	67590	75127
GREAT LAKES	200690	198232

FIGURE 12: SUPPLY VALIDATION
1989



	Actual	From GTP
	...'00 tons...	
QUEBEC	28726	29730
ONTARIO	24538	25484
NORTHEAST	72903	84197
MIDEAST	67590	75127
GREAT LAKES	200690	198232

TABLE 7: IMPORT/EXPORT PATTERNS - CANADA, 1991

(00 tons of milk equivalents)

	EEC	USA	OTHER	TOTAL	USA/TOTAL %
EXPORTS:	1317	384	3044	4745	8.1
IMPORTS:	1201	299	769	2268	13.2

SOURCE: Dairy Farmers of Canada 1992

TABLE 8: TRADE FLOW PATTERNS - VALIDATION

(00 TONS)

1989: IMPORTERS

EXPORTERS	QUEBEC	ONTARIO	NORTHEAST	MIDEAST	GR LAKES	RESIDUAL 1	RESIDUAL 2	TOTAL EXPORTS
QUEBEC	10115		192	192		12317		22816
ONTARIO		14420				1421		15841
NORTHEAST			46811					46811
MIDEAST				42474				42474
GREAT LAKE					53437	299	117424	171160
TOTAL IMPORTS	10115	14420	47003	42666	53437	14037	117424	299102

Table 8 exhibits the third type of information generated by GTP trade flow patterns between the five exporters and the seven importers for 1989, the validation year Regions on the vertical axis are the exporters and those on the horizontal axis are the importers The diagonal terms, when excluding the last two columns, are the quantities of milk utilized by the region itself to fulfil itsdomestic needs in industrial milk Fluid milk is modeled for regional self-sufficiency Quantity of milk traded as shown by the matrix patterns, represents the movement of milk in excess of intraregional fluid milk demand Thus, all quantity traded in the matrix represent industrial milk movements from sources to the sinks Horizontal summations relate to the total exports by exporting region, while verical summations exhibit total industrial milk demand for each of the seven importing region The total quantity of milk produced for domestic fluid milk purposes can be quickly obtained by subtracting the total exports (Table 8) from the total supply (Figure 12) for a given region Historical import quotas, where the source was allotted to Québec, appeared in the row for Québec as a split figure from the 384 hundred tons of Table 7 into 192 for both Mideast and Northeast Accordingly, Great Lakes possessed the import quota allowance for Residual 1, the Canadian milk deficit region The last two columns, Residual 1 and Residual 2, represent industrial milk deficit regions for Canada and U S A , respectively These two regions are strong deficit regions and, therefore, were not matched with a exporter counterpart

According to Figure 12, regional quantities of milk generated by GTP greatly resemble historical data for 1989 Estimates of production are closer to actual figures for Ontario and Quebec than for the U S regions This may be explained by the accumulation of significant milk surpluses in the U S during this time,which depressed prices and triggered lower supplies

With regards to price validation, Figure 13 shows the pattern of realistic prices for Québec and Ontario, whereas slightly greater price differentials between simulations and actual prices are observed for Northeast, Mideast, and Great Lakes Figure 14 contrasts all milk prices between Canada and U S A over time In United States, milk price jumped from $12 24 in 1988, from which GTP was based for validation, to $13 54/cwt in 1989 This provides an explanation for slight underestimation in the price results obtained for American regions

Historical trade flow patterns provided by the solution algorithm in Table 8 and validated with 1989 base year, shows all trade linkages between exporting and importing regions Residual 1 imported industrial milk mainly from Quebec whereas, smaller proportion came from Ontario Such patterns follow logically, since the province of Québec has been the dominant net surplus region of Canada Accordingly, Residual 2 imported all its industrial milk needs from Great Lakes, a huge milk surplus region Therefore, the solution procedure used by GTP produces consistent results for the base case and can be used for estimating the impacts of two distinct tariff scenarios on dairy production

ALL-MILK PRICE COMPARISONS

CANADA AND U.S.A.

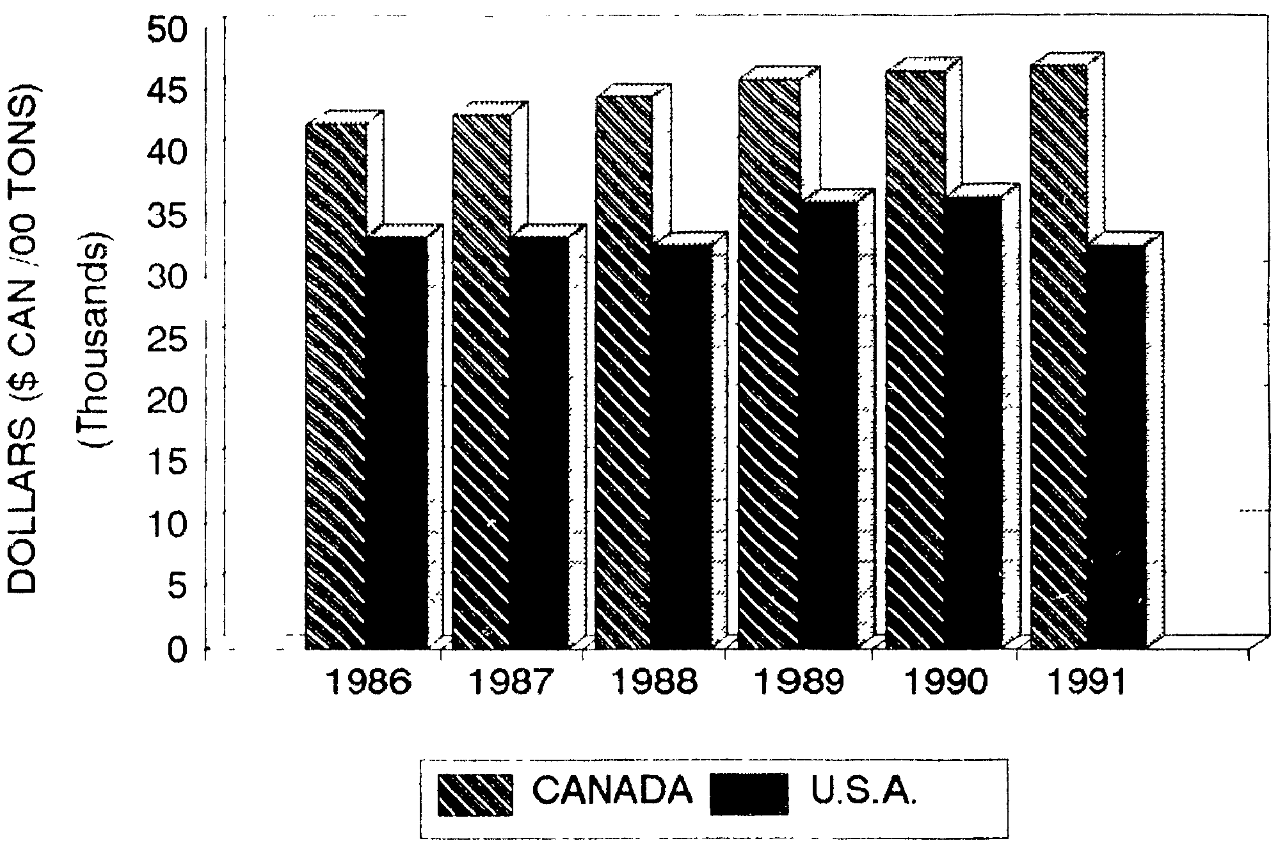


FIGURE 14: ALL MILK PRICES COMPARISONS
SOURCE: Dairy Situation and Outlook Yearbook
Québec Dairy Facts

4.5 RESULTS

4.5.1: SCENARIO ONE

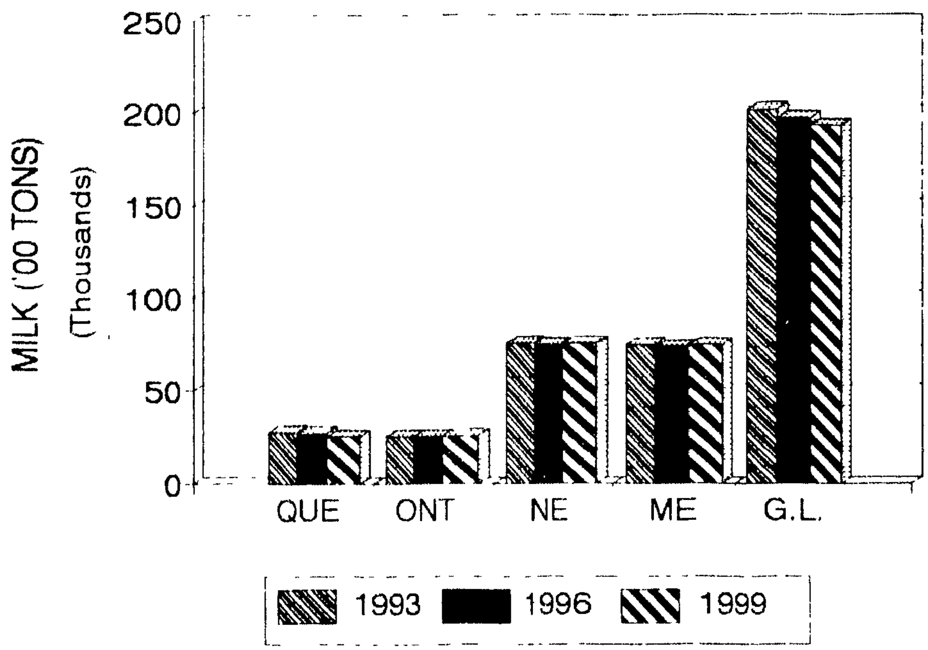
This scenario is based upon specific tariffs of $11 00/hl and $7 00/hl for milk exported from United States to Canada and from Canada to United States, respectively These specific tariffs were based on **producer price** differentials existing between the two countries for the base period 1986 88 Accordingly, supply and demand curves incorporated in GTP for scenario one were built using producer prices for Canadian regions as opposed to shadow prices for scenario two

Figure 15 & 16 present supply and price results for the three periods of analysis (i) initial tariffication, (ii) reduction of tariffs after three years and (iii) final reduction after six years Tariffs are introduced in the initial year of 1993 and are subsequently reduced by 6% per year over six years following the phase out period proposed in GATT In order to capture significant tendencies, the computation procedure was recursively solved for three distinct periods insteadof an annual computation Thus, the first period is the initial tariff application in 1993, the second is the mid-course situation with 18% tariff reduction by 1996, and third, is the final phase-out period with a tariff reduction of 36% by 1999

Table 9 provides a summary of trade flow quantities in matrix form for the three periods of tariff implementation The format of presentation is the same as described in SECTION 4 4 Some changes were made to the validated base model Trade flow upper bound were eliminated reflecting import quota elimination Import quotas were replaced with specific tariffs However trade flow lower bounds were maintained at their historical import quota levels in order to ensure minimum market access for the other country Otherwise, the solution algorithm eliminates non-optimal trade flow patterns and minimum import access may be driven to zero which would be contrary to GATT proposition on tariffication stating a minimum market access of initially 3% and eventally raise to 5% of domestic comsumption

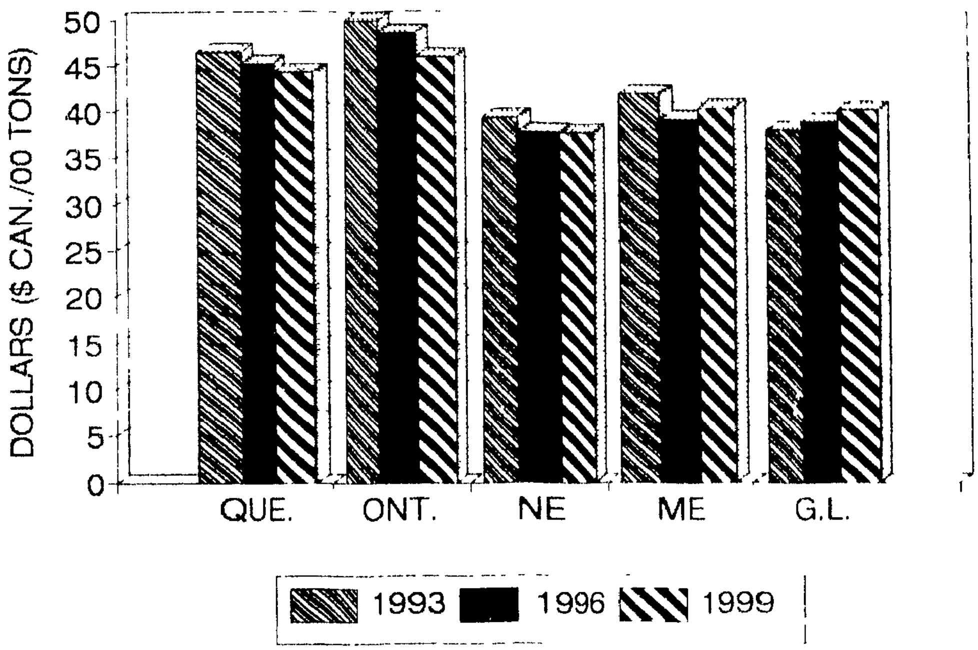
FIGURE 15: SUPPLY OF MILK BY REGION

TARIFFICATION - SCENARIO ONE



	INITIAL 1993	18% REDUCTION 1996	36% REDUCTION 1999
		'00 tons	
QUEBEC	27480	26992	24934
ONTARIO	24952	25221	26034
NORTHEAST	75614	75029	75135
MIDEAST	74840	73800	74538
GREAT LAKES	202030	197170	193355

FIGURE 16: PRICE OF MILK BY REGION
TARIFFICATION - SCENARIO ONE



	INITIAL 1993	18% REDUCTION 1996	36% REDUCTION 1999
		$ can /00 tons	
QUEBEC	46470	45180	44380
ONTARIO	49900	48630	46020
NORTHEAST	39410	37790	37630
MIDEAST	42030	39180	40380
GREAT LAKES	38160	38890	40090

TABLE 9 TRADE FLOW PATTERNS WITH PRODUCER PRICES

(00 TONS)

1997 — IMPORTERS

EXPORTERS	QUEBEC	ONTARIO	NORTHEAST	MIDEAST	GR LAKES	RESIDUAL 1	RESIDUAL 2	TOTAL EXPORTS
QUEBEC	10927	882	192	192		8272		20465
ONTARIO		14173						14173
NORTHEAST			41373					41373
MIDEAST				38561				38561
GREAT LAKES					47660	5108	116663	169431
TOTAL IMPORTS	10927	15055	41565	38753	47660	13380	116663	284003

1998 — IMPORTERS

EXPORTERS	QUEBEC	ONTARIO	NORTHEAST	MIDEAST	GR LAKES	RESIDUAL 1	RESIDUAL 2	TOTAL EXPORTS
QUEBEC	11077	721	192	192		7754		19936
ONTARIO		14547						14547
NORTHEAST			42183					42183
MIDEAST				40354			1341	41695
GREAT LAKES					47124	5853	114054	167031
TOTAL IMPORTS	11077	15268	42375	40546	47124	13607	115395	285392

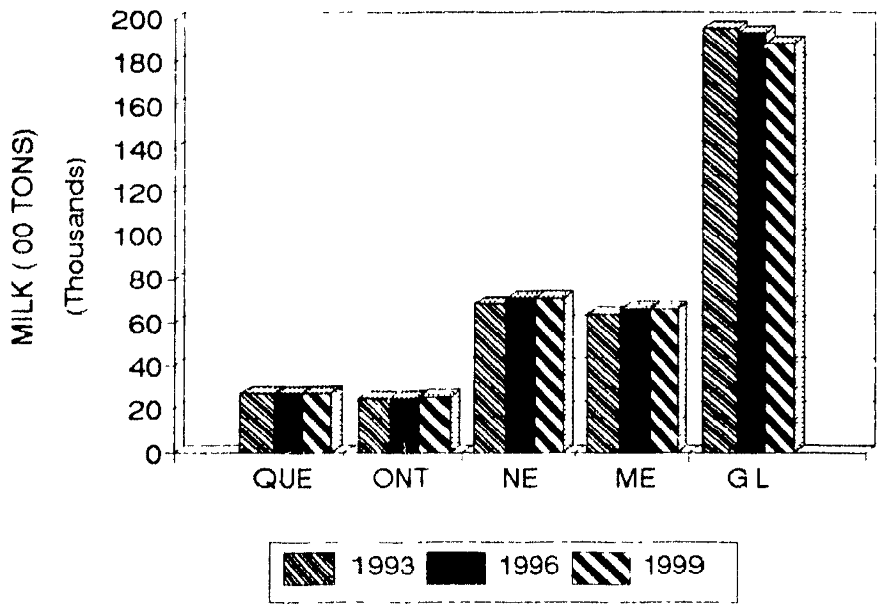
1999 — IMPORTERS

EXPORTERS	QUEBEC	ONTARIO	NORTHEAST	MIDEAST	GR LAKES	RESIDUAL 1	RESIDUAL 2	TOTAL EXPORTS
QUEBEC	11171		192	192		6298		17853
ONTARIO		15707				262		15969
NORTHEAST			42263					42263
MIDEAST				39597			3137	42734
GREAT LAKES					46234	7188	110151	163573
TOTAL IMPORTS	11171	15707	42455	39789	46234	13748	113288	282392

4.5.2 SCENARIO TWO

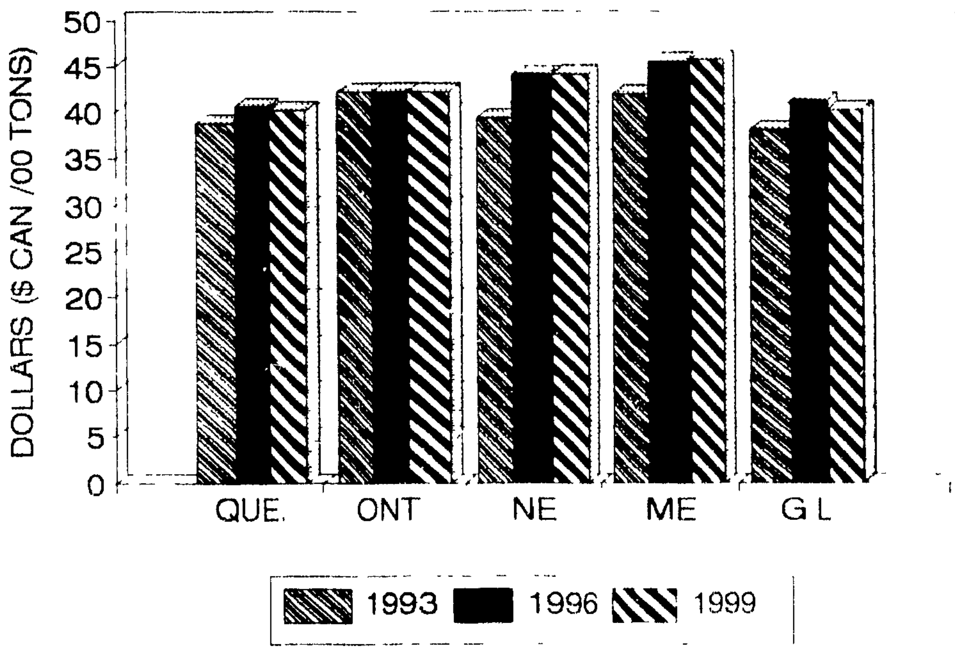
The frameworks of analysis for scenario one and two are very similar The differences lie in the use of shadow prices instead of producer prices for Quebec and Ontario and Residual 1 The argument justifying the use of shadow prices implies a better estimation of producer responses towards price changes in an environment of supply management Producer prices are the policy-induced prices facing producers, but shadow prices are the ones reflecting their supply response behaviour The spread between these two milk prices was estimated at 15% of producer prices which was converted into specific values based on 1989 milk prices in order to decrease specific tariffs by the same magnitude In scenarioone, the protection provided by specific tariffs was based on producer prices In scenario two, the price differential between Canadian and American prices is diminished, since shadow prices are lower It is necessary to decrease specific tariffs, accordingly, to maintain the same protection level given the smaller difference between Canadian and American prices in this scenario These changes with regard to specific tariffs and shadow prices do not affect the solution procedure

FIGURE 17: SUPPLY OF MILK BY REGION
TARIFFICATION - SCENARIO TWO



	INITIAL 1993	18% REDUCTION 1996	36% REDUCTION 1999
		'00 tons	
QUEBEC	27160	27807	27111
ONTARIO	25003	25002	25832
NORTHEAST	68511	70836	70948
MIDEAST	64192	66686	66821
GREAT LAKES	195260	193153	188985

FIGURE 18: PRICE OF MILK BY REGION
TARIFFICATION - SCENARIO TWO



	INITIAL 1993	18% REDUCTION 1996	36% REDUCTION 1999
		$ can /00 tons	
QUEBEC	38750	40610	40180
ONTARIO	42210	42250	42220
NORTHEAST	39410	43960	44130
MIDEAST	42030	45510	45770
GREAT LAKES	38210	41270	40240

TABLE 10 TRADE FLOW PATTERNS WITH SHADOW PRICES

(00 TONS

1993 — IMPORTERS

	QUEBEC	ONTARIO	NORTHEAST	MIDEAST	GR LAKES	RESIDUAL 1	RESIDUAL	TOTAL EXPORTS
EXPORTERS								
QUEBEC	11030	972	192	192		7733		20119
ONTARIO		14015						14015
NORTHEAST			41373					41373
MIDEAST				38561				38561
GREAT LAKES					47618	5399	116564	169581
TOTAL IMPORTS	11030	14987	41565	38753	47618	13132	116564	283649

1996 — IMPORTERS

	QUEBEC	ONTARIO	NORTHEAST	MIDEAST	GR LAKES	RESIDUAL 1	RESIDUAL	TOTAL EXPORTS
EXPORTERS								
QUEBEC	10831		347	192		9448		20818
ONTARIO		15080						15080
NORTHEAST			38857					38857
MIDEAST				35354				35354
GREAT LAKES				863	46124	3395	113030	163412
TOTAL IMPORTS	10831	15080	39204	36409	46124	12843	113030	273521

1999 — IMPORTERS

	QUEBEC	ONTARIO	NORTHEAST	MIDEAST	GR LAKES	RESIDUAL 1	RESIDUAL	TOTAL EXPORTS
EXPORTERS								
QUEBEC	10772		192	192		8982		20138
ONTARIO		15074				839		15913
NORTHEAST			39098					39098
MIDEAST				36314				36314
GREAT LAKES					45369	2934	116564	164867
TOTAL IMPORTS	10772	15074	39290	36506	45369	12755	116564	276330

4.6 DISCUSSION

The contrasting results between scenario 1 and scenario 2 are logically consistent In scenario one, milk prices (Figure 16) for Québec and Ontario are initially higher than their American prices and show a slight decline as tariffs decrease over time This adjustment was expected in light of higher pricing policy enforced by supply management in Canada In United States, the Northeast also demonstrates a reduction in producer prices for the study period Producer prices in the Mideast initially decreased and then increased slightly again because of new export flows into Residual 2 Conversely, the Great Lakes region increased its milk price because of its established position as important exporter to Residual 2 and because of developing trade linkages with the Canadian deficit region Residual 1

Figure 15 provides an overall picture regarding relative supply stability for all five dairy exporting regions during tariff reduction. Dairy production in both Canadian and American regions is maintained despite tariffication This is an explicit argument in favor of the Canadian dairy industry suggesting a respectable ability to withstand American competition and to develop more trade potentials extending beyond the time frame of the present study Surprisingly, the quantity produced in the Great Lakes, a low cost region, declines with tariff reduction However, exports to Residual 1, as observed in Table 9, increase by 2080 units while a decline of 6512 units is observed in quantity exported to Residual 2 The price increase observed in the Great Lakes as opposed to a price decline in the other two U S regions (Northeast and Mideast) or the important surplus status of the Great Lakes likely to make this region first affected by a shrinking export market may provide partial explanations to why the Great Lakes loses a part of their market share, to the profit of a less important exporter, the Mideast, in the deficit region, Residual 2

A summary of trade flow patterns with the first scenario is presented in Table 9 and shows that all seven regions, with the exception of the Great Lakes and Residual 2 (supplied by Great Lakes), increased their milk consumption following six years of tariffication The Mideast experienced an increase in exports to Residual 2 (the U S deficit region) for the second (1996) and third (1999) period. This explained the reversal in price trend, though minor, for the Mideast, where it increased from 1996, as opposed to decreased in 1993 Quebec and Great Lakes, two important exporting regions, are affected relatively more as shown by larger export decreases Such a situation may be explained by the surplus status of the American dairy industry The U S dairy industry being eight times the size of the Canadian industry (Dion, 1992) puts a downward pressure on milk production, consequences causing large producing regions to be more severely affected

Results for supply, prices, and trade flow patterns appear logical Milk production in Canada is tiny when compared to American production Current prices in Canada are significantly higher than their American counterparts, driven by the Canadian milk pricing policy and enforced by stringent border controls on imports. Thus, the conversion of import quotas to equivalent tariffs, followed by a phase-out period, was expected to affect Canadian prices, production and trade flows The hypothesis that *tariffication would decrease milk production in eastern Canada to the extent that U.S producers will increase their exports to Canada* was partially verified In scenario one using producer prices in the supply responses milk prices did decrease as a result of tariff reduction from $46 47/hl to $44 38/hl (Figure 16), and so did milk supply, from 27480 to 24934 hundred tons Cross border trade flows from Great Lakes to Residual 1 showed an increase Exports rose from 5108 to 7188 units at the expense of Québec which reduced exports to this market from 8272 to 6298 hundred tons, while Ontario captured a small market share of 262 hundred tons of milk in this residual region However, American imports did not displace milk production in Eastern Canada during the time frame provided in this analysis This analysis suggest that the tariffs used in the study are large enough to prevent imports from the U S into Québec and Ontario but small enough to allow exports from the Great Lakes into Residual 1 and permit milk price and production to decline Eastern Canada Hence, Canadian producers are negatively affected by tariffication but not to a great extent The overall picture shows ability to withstand American competition when using scenarios in which tariff are not highly protective since the tariffs used in this study merely represent price diferentials between American and Canadian milk prices The downward adjustment in the Canadian dairy industry over the six year phase-out period reveals a requisite adaptation from Canadian regions to improve their competitiveness in face of trade liberalization in the dairy industry

In scenario two, the outcome is slightly different Milk price and production remain practically unchanged for the province of Ontario during the six-year study In Québec, production stays the same while milk prices increase when comparing the initial time period (1993) with the second and with the third period of analysis Exports from Québec and Ontario to Residual 1 increase by 1249 and 839 units, respectively but to the detriment of the Great Lakes region which loses 2465 units to Residual 1 As a result, the hypothesis is not verified with tariffs applied in scenario two (Table 10) Exports from Great Lakes to Residual 1 initially at 5399 hundred tons (Table 10) were reduced to 2934, mainly due to exports of Québec which had risen from 7733 to 8962 hundred tons This did not represent a full displacement by Québec exports since the quantity demanded by Residual 1 had slightly fallen

Table 10 exhibits trade flow patterns using shadow prices for milk in Canada In Québec, total exports reach their highest point in 1996 at 20818 hundred tons Québec was able to increase its market share to Residual 1 and to export up to 347 hundred tons to Northeast in 1996 with initial tariff schemes reduced by 18% With this scenario, trade flow patterns between Québec, Ontario and the Great Lakes are reversed as opposed to scenario 1 The Great Lakes decreases its exports in Residual 1 which are partly compensated by increased imports from Québec and Ontario Similarly to scenario 1, the Great Lakes area decrease its milk production during the six-year period (Figure 15 and 17) Such a result for a low cost region facing trade liberalization is counter-intuitive A partial answer to this finding may be provided by shadow prices In scenario 2, the rental value of quota accumulated in producer price is removed The resulting lower price makes Québec more competitive for the residual 1 market Instead of decreasing its exports to this market, as observed in scenario 1, it increases its market share to Residual 1 which also displaces the Great Lakes production and reduces the latter's demand

The use of shadow prices makes Canadian prices relatively more competitive with American typically lower prices As shown in Table 10, Ontario maintains its price level for the period studied Québec demonstrates ability to maintain its milk supply and increase its shadow prices and its exports as tariff reduction takes place in the second and third period of analysis This supportsthe argument that Québec, an important net surplus region, is competitive with American regions in an hypothetical framework of partial trade liberalization in which quota values captured in the milk price are removed Similarly, the Northeast and the Mideast, two non-surplus regions, also show a similar pattern of price and milk production increases during the tariff phase-out period but do not greatlyaffect Québec and Ontario exports because of their self-sufficiency status

The methodological approach for this research considered two plausible tariff scenarios The first one is based on the actual price structure where producer prices include quota values entrenched in Canadian prices However, in the light of tariffication, quota values would be expected to decrease as tariffs declineand, therefore, cause prices to follow a declining trend Such a price decrease would be misleading because it implies that quota values decline Lower quota values are then reflected in producer milk prices However, the gross effect on producer revenues may not decline in the same manner This argument is justified with the results of scenario two Prices, quantities, and trade flows increased during the phase-out period of tariff implementation Shadow prices reflect marginal costsof Canadian producers and are therefore better suited to capture supply responses in face of trade liberalization when comparisons are to be made with U S producers Thus, scenario two is more appropriate to evaluate changes of prices, supply, and trade flows induced by tariffication The resulting output with scenario two does not support the hypothesis that *American imports displace a portion of Canadian milk production due to the conversion of import quotas into specific tariffs* After tariff implementation, the province of Québec experiences increasing shadow prices, maintenance of quantity supplied, and increasing export flows towards the Residual 1 and the Northeast

In summary, the results obtained over the six-year period using producer prices (scenario one) show that Québec and Ontario, in order to be competitive and to be able to develop export markets with United States, would need to adjust producer prices downward. Milk production would decrease because of its positive supply-elasticity (unless one wants to estimate an updated supply curve which would consider rightward shift in the supply responses). A specific tariff of $11 00/hl prevents imports from the U S into Québec and Ontario but not into Residual 1 In a scenario of quota value being excluded from producer milk price (scenario 2), Québec and Ontario basically maintain their production and prices and, they increase their market share as exports to Residual 1 (the Canadian deficit region) to the detriment of the Great Lakes.

The development of trade linkages across the Canada-U.S border is likely to represent an interesting opportunities to increase the market demand for Canadian dairy producers In this study, it was shown that price differentials between Canadian and American producers make this venture less enticing

Nevertheless, the possibility to find profitable cross-border markets for Canadian producers is enhanced with a scenario of tariffication where the quota value is excluded from producer price (scenario 2) In such a situation Canadian producers are in a better competitive position, as shown by stable production, an upward trend in shadow prices and a partial displacement of Great Lakes exports to the Canadian deficit region (Residual 1)

4.7 CONCLUSION

The objectives of this research were to estimate the impacts of tariffication on producer milk prices on milk production and on potential trade flows between Canada and United States In scenario one the results of this analysis indicate that Canadian dairy producers (from Québec and Ontario) need to adjust prices downward and consequently production in face of tariffication The Great Lakes partly displace Québec and Ontario in exports to Residual 1 (Canada deficit region) In scenario two regional milk production remained stable after tariff implementation Shadow prices in all regions have increased betweeen 1993 and 1999 tariff phase-out period Trade flow patterns between importing Québec Ontario and the Great Lakes regions, and the importing region Residual one are reversed from results of the previous scenario Québec exports displace the Great Lakes in Residual one

The spatial model allows elementary insights into trade potentials with the American producers From compiled results it is apparent that potential for trade exists and that subsequent investigations are required to measure the capacity for trade flows This spatial price equilibrium model is a simple model which tries to optimize trade flows in a competitive manner However, the real world in dairy trade does not exhibit competitive behaviour Furthermore, GTP is a partial equilibrium model which considers milk as being an homogeneous commodity Milk quality standards differ between the two countries and present potential trade limitations for cross-border trade Supply and demand equations are function of price and do not consider other variables that may influence results

In Canada the estimation of supply functions is made even more difficult due to supply management Moschini and Meilke (1988) develop a remedial method using capital values of quotas to estimate supply responses from shadow prices But the capital value of quota itself is likely to be overestimated since published prices of quotas are representative of small scale quota purchases only Farm buyouts cause quotas to trade at a significantly lower value Original quota licenses in the early 70's were given to producers according to production level After the initial installment, subsequent quotas licenses have had to be purchased at increasing prices boosted by quota rents captured by the initial recipient farmers

Another argument which may have been overlooked in supply response estimation deals with the risk premium entrenched in supply equations Canadian producers would face increasing risk when moving from the actual insulating system to more competitive and uncertain future with tariffs, since price fluctuations on foreign markets would affect Canadian prices Such a risk premium is very hard to quantify and add to supply response models

The discrepancy in pricing structure between cost of production formula existing in Canada and shadow price highlights the importance of capturing farm level price response properly GTP provided insights about the implications of trade liberalization but the development of more specific models able to handle stringent trade barriers will provide further insights into this complex issue In Canada, producer and shadow prices are different Producer prices reflect returns to quota and other assets whereas shadow prices represent value of efficient milk production The impacts of tariffication were measured with both producer and shadow prices Direct consequences on producer farm-gate prices are estimated via producer prices, whereas shadow prices would better reflect trade practices under tariffication since they better reflect efficient milk production as opposed to producer prices which capture the rental value of production quotas

Caution should be used in placing too much significance to the results of this analysis The tariff schemes used are based on raw milk and are assumed to be the same for both fluid and industrial milk Any further studies in the field of tariffication using effective rates of tariffs for each dairy product which could better link the production with the consumption level would grealty broaden our understanding of this complex issue of tariffication applied to the dairy industry Subsequent research work in the sphere of supply function estimation is likely to improve the present limited capabilities to model Canadian supply responses The quadratic solution procedures used by the spatial model in this study, searching for optimum producer and consumer surplus from which transport costs have been incorporated, are suitable to provide insights about trade liberalization in the dairy industry, an industry subjected to government regulations and insulated from international competition To this end, findings of this research may be helpful as a benchmark to a wide array of tariff possibilities bearing in mind the simplifications that had to be incorporated in the model

BIBLIOGRAPHY

Agriculture Canada. 1991. "Dairy market review " Agri-Food development Branch, Dairy Division Ottawa

Anderson, D.R.; D.J. Sweeney and T.A. Williams. 1986. *An Introduction to Management Science Quantitative Approaches to Decision Making* Fourth Edition, West Publishing Co , St-Paul, Minnesota

Anderson. James E. 1985 "The relative inefficiency of quotas The cheese case " *The American Economic Review*, 4 178-190

Barichello, Richard R. 1981. "The Economics of Canadian Dairy industry regulation " Economic Council of Canada, The Institute for Research on Public Policy, Technical Report No E/12, March 1981

Barichello, R.R. 1984. "Analyzing an Agricultural Marketing Quota " Paper presented at the XIV European Congress of Agricultural Economists, Kiel, Federal Republic of Germany

Bhagwati, Jagdish. 1965. "On the equivalence of tariffs and quotas " In *Trade, Growth, and the Balance of Payment* Essays in Honour of Gottfried Haberler Rand McNally & Co , Chicago, Illinois, 53-67

Bradley S.P., A.C. Hax, and T.L. Magnanti. 1977. *Applied Mathematical Programming.* Addison-Wesley, Reading, Mass

Bressler, R.G.; and R. King. 1970. *Markets, Price, and International trade* Chapter five Price Equilibrium in Spatially Separated Markets Wiley and sons, inc U S A

Buxton, Boyd M. 1985 "Factors Affecting U S Milk Production "United States Department of Agriculture, Economic Research Service Report No 527 Washington, D C

Commodity Research Bureau. 1988. "Commodity Yearbook " Knight-Ridder Business Information Service New York, NY

Conboy,P., E.W. Goddard and M.L. McCutcheon. 1992. "Does it Matter to Advertising Investment Levels if Advertising is considered a Fixed or a Variable Cost?" Department of Agricultural Economics and Business Working Paper WP92/06, University of Guelph

Dairy Farmers of Canada. 1991. "L'Etat Actuel des Négociations du GATT" Ottawa, octobre

Dairy Farmers of Canada. 1990. " L'état actuel des négociations du Gatt" Report, October

Dairy Farmers of Canada. 1990 "Facts and Figures, at a glance, 1992" Ottawa, Ontario

Deloitte and Touche, Management Consultants. March 1992. "Potential Implications of Tariffication on Existing Border controls" Prepared for the Canadian International Trade Tribunal

Deloitte and Touche, Management Consultants. March 1992. "Import Quota Rents on Supply Managed Products" Prepared for the Canadian International Trade Tribunal

Dion, M. and A. Rioux. 1992. "The Future of Québec's Dairy Industry Winning New Markets" *Agricultural News*, Vol 16 No 1, January

Forbes, J.D.; R.D. Hughes; and T.K. Warley. 1982. "Economic Intervention and Regulation in Canadian Agriculture" Economic Council of Canada, and the Institute for Research on Public Policy, Ottawa

Fréchette, Jean-Denis. 1987. "Canada's trade in agricultural products 1983, 1984 and 1985", *Backgrounder*, Library of Parliament, Research Branch, Economic division

Gillis, W.R. 1989. *Profitability and Mobility in Rural America Successful Approaches to Tackling Rural Transportation Problems* The Pennsylvania State University Press, University Park and London.

Graham, J.D.; B. Stennes; R.J. MacGregor; K. Meilke and G. Moschini. 1990. "The Effects of Trade Liberalization on the Canadian Dairy and Poultry Sectors" Working Paper, Agriculture Canada

Grant, Wyn. 1991. *The Dairy Industry, An International Comparison* Darmouth Publishing Company Ltd, England

Groupe Lactel. 1992. "Transport General-Canada/Etats-Unis "Transportation broker St- Hubert, P Q

Hammond, Jerome and Karen Brooks. 1985. "Federal Price Programs for the American Dairy Industry Issues and Alternatives " NPA Food and Agricult ure Committee report #214, National Planning Association

Hazel, B.R., and R.D. Norton. 1986. *Mathematical Programming for Economic Analysis in Agriculture* Macmillan Publishing Company, London

Holland, Forrest D. 1985. "GTP A Microcomputer Program for the Spatial Equilibrium Problem " International Economics Division, Economic Research Service, U S Department of Agriculture Washington, D C , ERS Staff Report No AGES850514

Kilmer, R.L. 1987. "Price and Income Elasticities for Dairy Products A Research Overview " Staff Paper #319, Food and Resource Economics Department, University of Florida, Gainesville

Lebeau, S.; M. Morriset; M. Doyon; D-M. Gouin, and J. Boisvert "Les Faits saillants laitiers québécois, 1989 " Groupe de Recherche en Économie et Politiques Agricoles, Département d'économie rurale, Université Laval

Lebeau, S.; M. Doyon; M. Morriset; D. Gouin, and R. Lamoureux "Les Faits saillants laitiers québécois, 1990 " Groupe de Recherche en Economie et Politiques Agricoles, Département d'économie rurale, Universite Laval

Lebeau, S.; M. Morin; M. Doyon; M. Morriset; J. Boisvert and D-M. Gouin "Les Faits saillants laitiers québécois, 1991 " Groupe de Recherche en Économie et Politiques Agricoles, Département d'économie rurale, Université Laval

Lebeau, S.; M. Morin; M. Morriset; J. Boisvert and D-M. Gouin "Les Faits saillants laitiers québécois, 1992 " Groupe de Recherche en Économie et Politiques Agricoles, Département d'économie rurale, Université Laval

Lebeau, S. and M. Morisset. 1987. "Le Système des Milk Marketing Orders aux États-unis" Groupe de Recherche en économie rurale, Departement d'économie rurale Université Laval

Lemay, D. 1990. *L'Agriculture et le GATT* Lévis-Lauzon, octobre

Lermer, G., and Standury, W.T. 1985. "Measuring the Cost of Redistributing Income by Means of Direct Regulation " *Canadian Journal of Economics*, 18:190-207

MacDonald, J. 1991. "Dairy Statistical Handbook 1989-1990 " The Ontario Milk Marketing Board, 6th Edition

MacDonald, J. 1990. "Dairy Statistical Handbook 1988-1989 " The Ontario Milk Marketing Board, 5th Edition

McCutcheon, M.L. 1992. "Optimal Producer and Social Payoffs From Generic dvertising -The Case of Fluif Milk in Ontario and Québec " Unpublished M Sc thesis, Department of Agricultural Economics and Business, University of Guelph

McNally, R. 1990. *Road Atlas, United States, Canada and Mexico, 1990* New York, NY

Melvin, James R. 1986. "The Non-Equivalence of Tariffs and Import Quotas " *American Economic Review*, 76· 1131-1134

Metzger, H.B. 1982. "Costs of Transporting Packaged Dairy Products by Tractor-trailer in the Northeast " LSA Experiment Station Bulletin 781, University of Maine,Orono

Moschini, Giancarlo. 1988. "A Model of Production with Supply Management for the Canadian Agricultural Sector " *American Journal of Agricultural Economics* 70 318-329

Moschini, G., and Meilke, K.D. 1988. "Sustainable Rates of Return for Milk Quotas in Ontario." *Canadian Journal of Agricultural Economic*, 36·119-126.

Moschini, G., and Meilke, K.D. 1990 "Tariffication with Supply Management: The Case of the U S -Canada Chicken Trade." *Canadian Journal of Agricultural Economics*, 39 55-68

Moschini, Giancarlo. 1991. "Economic Issues in Tariffication. An Overview " *Agricultural economics*, 5 101-120

Nelson, R., and S. Winter. 1978(Autumn). "Forces Generating and Limiting The Growth of Concentration Under Schumpeterian Competition." *The Bell Journal of Economics*, pp 524-548

Novakovic, Andrew M., and Maura Keniston. 1989. "Regional Differences in the Industry and Their Use in Evaluating Dairy Surpluses " The Cornell Dairy Program of the National institute for livestock and dairy policy Department of Agricultural Economics, Cornell University

Price Waterhouse. 1991. "A Comparison of the Canadian and U S Dairy Industries". Report of the Task Force on the National Dairy Policy

Phillips, Rick; James White and Peter Stonehouse. 1989. "The International Competitive Status of Canada's Milk Production Sector " Working Paper, Agriculture Canada

Pratt, James; Maura Keniston, and Andrew Novakovic. 1989. "Geographical Price Relationships in the U S Fluid Milk Industry A Mathematical Programming Analysis," Cornell Agricultural Economics staff Paper, May 1989, No 89-16

Proulx, Yvon, and Daniel-M. Gouin. 1989. "Interprovincial Milk Quota Allocation " GREPA, Département d'économie rurale, Université Laval, Juin

Proulx, Yvon, Daniel-M. Gouin, and Robert Saint-Louis. 1991 "La gestion de l'offre: un examen de sa performance," GREPA, Département d'économie rurale, Université Laval.

Roningen, V.O. and P.M. Dixit. 1988. "Economic Implications of Agricultural Policy Reform in Industrial Market Economics " Paper presented at International Agricultural Trade Research Consortium Symposium, Annapolis, Maryland, August 19-20

Rude, J., M.V. Massow, and L.J. Martin. 1992. "Implications of the Dunkel Proposal for an Agreement in G A T T on the Canadian Agriculture and Food Sector " George Morris Centre

Samuelson, P.A. 1952. *Reading in Economics, First edition* McGraw-Hill, New York

Schmitz, Andrew. 1983. "Supply Management in Canadian Agriculture An Assessment of the Economic Effects " *Canadian Journal of Agricultural Economics* 31: 135-152

Stonehouse, D.P. 1987. "A Profile of the Canadian Dairy Industry and Goverment Policies." Working Paper 1/87, Agriculture Canada, Policy Branch

Sweeney, D.J. 1986. *What is deregulated and what is not* National Agricultural Statistic Service, Washington, D C

Takayama,T. and G.G. Judge. 1972. *Spatial and Temporal Price and Allocation Models* North-Holland Publishing Company, Amsterdam

Thompson, Robert L. 1982. "A Survey of Recent U S Developments in International Agricultural Trade Models " International Economics Division, Economic Research Service, U S Department of Agriculture. Bibliographies and Literature of Agriculture Number 21 Washington, D C

Tielu, Apelu.(unpublished). "Optimal Advertising Rules· a Case Study of the Canadian Dairy Industry", Ph.D. thesis. Department of Agricultural Economics and Business, University of Guelph

Tomek, W.G. and K.L. Robinson. 1972. *Agricultural Product Prices*, Second Edition, Cornell University Press, Ithaca and London

United States Department of Agriculture, Agricultural Marketing Service. various issues. "Federal Milk Order Market Statistics for June 1987 " Washington, D C

United States Department of Agriculture, Economic Research Service, various issues. "Dairy Outlook and Situation report " Washington, D.C

United States Department of Agriculture, Foreign Agricultural Service. June 1992. "Dairy Monthly Imports" Circular Series FD-MI7-92 Washington, D C

United States Department of Agriculture, National Agricultural Statistics Service. 1992. "Milk, Final Estimates 1986-91" Statistical Bulletin No 802 Washington D.C

United States General Accounting Office. 1988. "Milk Marketing Orders Options for Changes " Report to the Congress, GAO/RCED-88-9, Washington, D.C

United States Trade representative. 1988. "A Framework for Agricultural Reform " Discussion Paper, July

United States Trade representative. 1989. "Submission of the United States on Comprehensive Long-Term Agricultural Reform, October.

Union des Producteurs Agricoles. 1990. "Éléments d'analyse sur les relations actuelles entre le Québec et le Canada." Commission sur l'avenir constitutionel du Québec, Rapport Préliminaire, novembre.

Veeman, M.M. 1988. "Supply Management Systems: Impacts on Interprovincial Trade " *Canadian Journal of Agricultural Economics, 36*: 711-723

Williams, R.E. and P. Mikkelson. 1992. "The GATT Uruguay Round and the Dairy Sector " International Dairy Federation, Annual Session in Munich, Germany Commission C-Economics, Marketing and Management

Ward, J.B. and D.E. Farris. 1989. "Estimated Truck Rates for Refrigerated Food Products " Working paper College Station Texas A & M University, Department of Agricultural Economics

Zietz, J. and A. Valdes. 1988. "Agriculture in the GATT An Analysis of Alternative Approaches to Reform IFPRI Res Rep 70, International Food Policy Research Institute, Washington D C

APPÉNDIX 1: MARKET SHARE QUOTA

	PEI	NS	NB	Qué	Ont	Man	Sask	Alb	BC
50 52	1 49	2 14	2.75	31.56	33 46	7 04	9 29	9 61	2 67
53 57	1 53	1.89	2 54	35.25	32.71	6 52	7 53	8 91	3 04
58 62	1 54	2 07	1 96	36.44	33 49	6.02	6 12	9 41	3 00
63-67	1 50	0 96	1.37	38.11	36.58	4 83	4 76	9.13	2 76
68 72	1 39	0 96	0 95	44 62	33 77	4 08	3 46	7 81	2 96
73 77	1 39	1 02	0.75	47 64	32.72	4.04	2 38	6 98	3 08
78-82	1 74	1 38	1 04	48.60	31.69	3 85	2.12	6 26	3.32
83 87	1 78	1.31	1 31	46.96	31 43	3 92	2 65	6.90	3 74
% de variation									
68-72/50 52	-6.7	-55 1	-65 5	41.4	0.1	-42.0	-62.8	-18 7	10 9
83 87/68-72	28 0	36 5	37.9	5 2	-7 0	-4.0	-23 4	-11 6	26 4

Sources Statistics Canada, cat 23-201, cat 23-001 plus our calculations

SOURCE Proulx and Gouin, 1989

APPENDIX 2: SUPPORT PRICE STRUCTURE

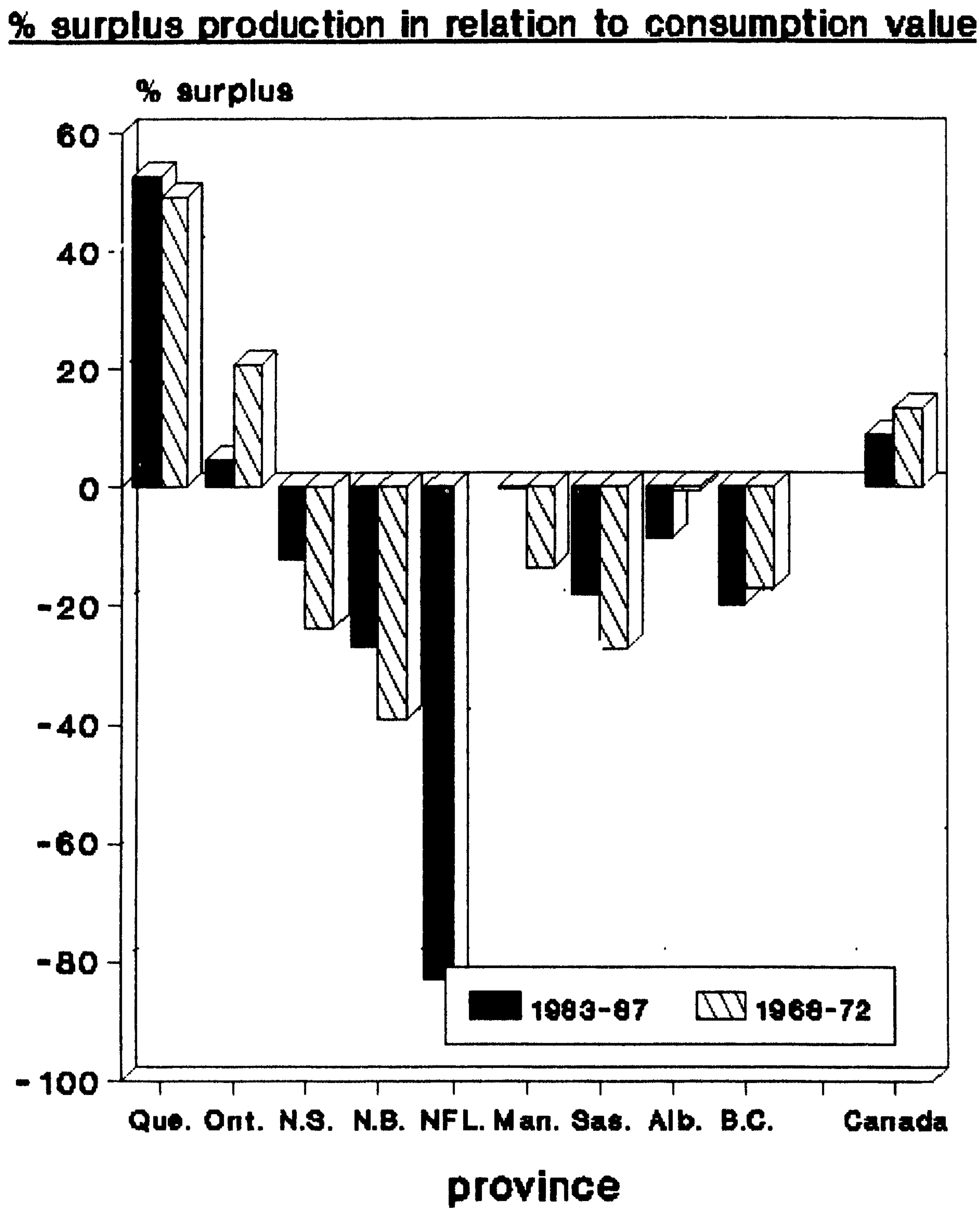
STRUCTURE DES PRIX DE SOUTIEN, CANADA, 1991/92
1er AOÛT 1991

Beurre Prix de soutien federal le kilogramme	5,331 $/kg			
Quantite de beurre dans un hectolitre de lait	x 4,365 kg			
	23,27 $	23,27 $		
Poudre de lait ecreme Prix de soutien federal le kilogramme	3,301 $/kg			
Quantite de lait ecreme en poudre dans un hectolitre de lait	x 8,51 kg			
	28,12 $	+ 28,12 $		
Prix garanti sur le marche (par hectolitre)		51,39 $		
Contribution par les transformateurs (1)		+ 0,02 $		
revenu estimatif des transformateurs (par hectolitre)		- 7,52 $		
Revenu des producteurs provenant du marche (par hect.)		43,89 $	43,89 $	
Subvention directe (par hectolitre)			+ 6,03 $	
Prix visé			49,92 $/hl	49,92 $/hl
Montant pour couvrir les frais de mise en marche du beurre				0,14 $
Prix de soutien au producteur visé par le gouvernement du Canada (par hectolitre)				49,78 $

(1) Contribution par les transformateurs à un programme de remise pour couvrir une partie du cout des ingredients laitiers utilisés par les fabricants de produits alimentaires

Sources: Commission canadienne du lait
Compilation GREPA, Université Laval, Quebec, 1991

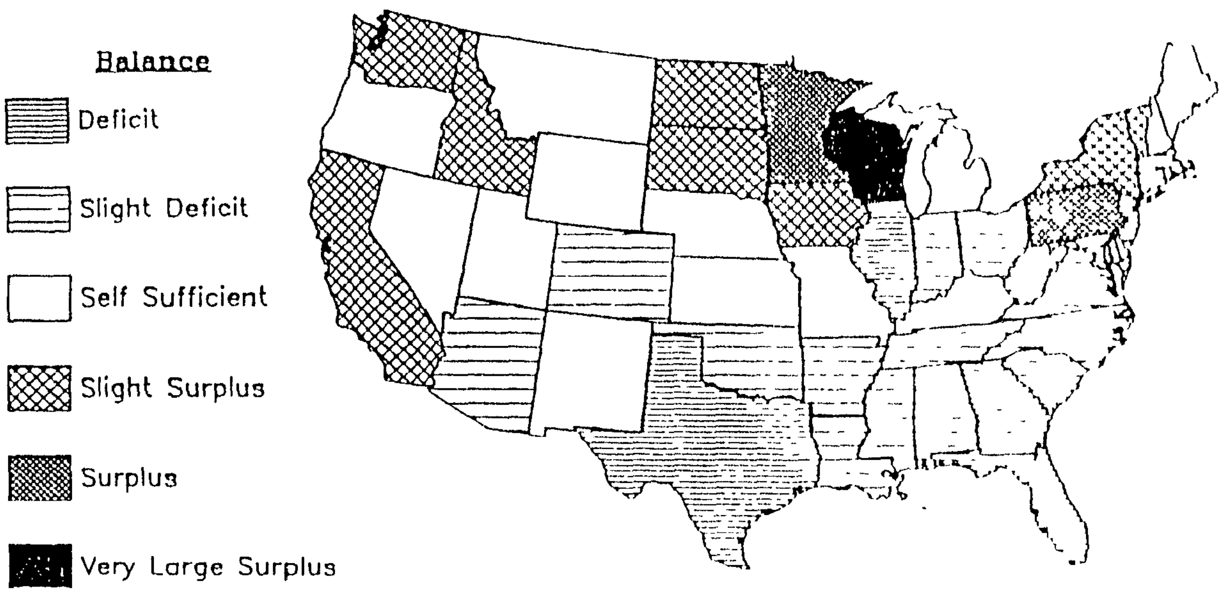
APPENDIX 3: NET MILK PRODUCTION SURPLUS



SOURCE: Proulx and Gouin, 1989

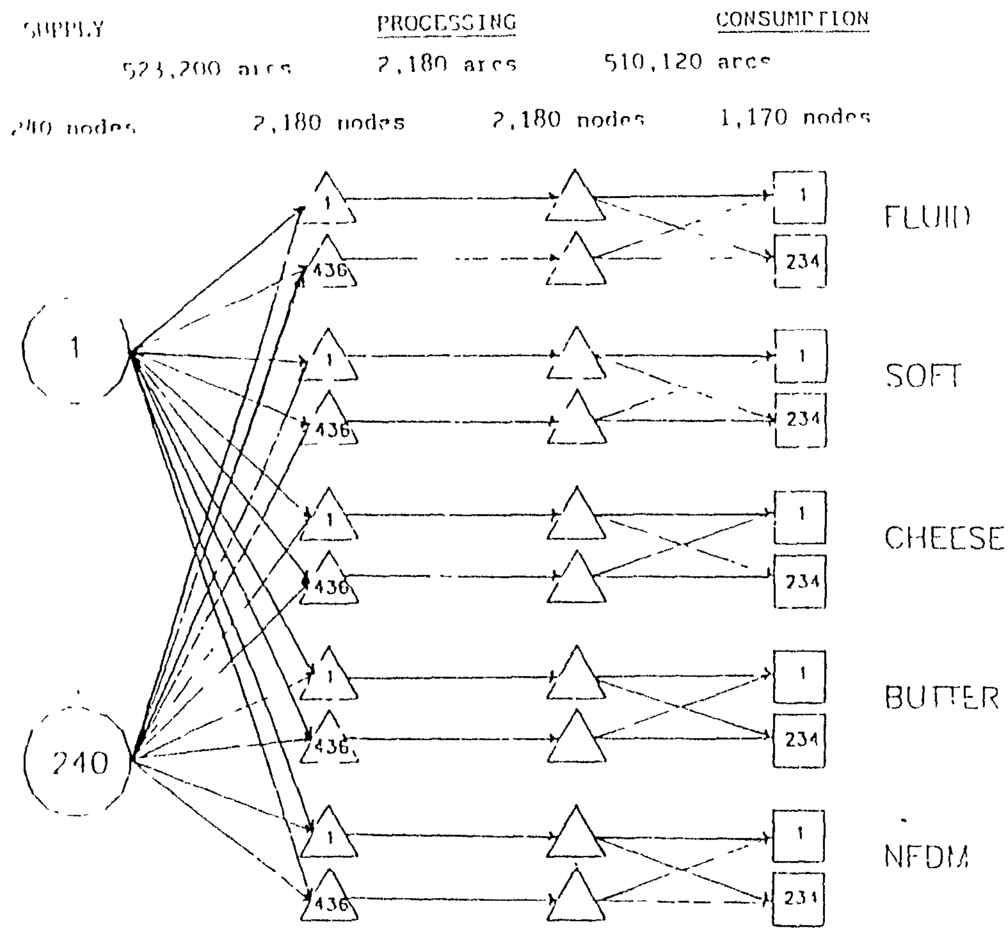
APPENDIX 4:

Net Balance Between Milk Production and Approximate Dairy Product Consumption by State, 1987



SOURCE: Novakovic and Keniston, 1989

APPENDIX 5: TRANSSHIPMENT NODES



Transshipment formulation of the U S. dairy industry

SOURCE: Pratt et al, 1989

APPENDIX 6: TARIFF CALCULATIONS

AVERAGE 1986-88

SPECIFIC TARIFF:

PRIX CANADA - PRIX U.S.A. - TRANSPORT = $

$52.57/hl - $39.93/hl - $1.50/hl = $11.00/hl

EQUIVALENT TARIFFS

Ad Valorem tariffs (%)

	CANADA	U.S.A.
BUTTER:	209	156
CHEESE:	178	101
S.M.P.:	93	72

S.M.P.: skimmed milk powder

SOURCE: Dairy Farmers of Canada, 1991

APPENDIX 7: SCENARIO 1, 1993

Export (Source) Flows and Values - Base Currency: TARIFF CASE:1107, 1989 MERGED SUPPLY

ID	Exporter (Source)	ID	Importer (Sink)	Export (Source) Quantity	Export (Source) Value	Export (Source) Price	Export Tariff Specific	Export Tariff Ad Valorem	Trans. Cost
01	xQuebec	01	Quebec i	10926.772	507522649.455	46447.628	.000	.000	10926.772
		02	Ontario i	881.660	40951023.577	46447.628	.000	.000	3047017.541
		03	Northeast i	192.000	8917944.592	46447.628	.000	.000	1787712.000
		04	Mideast i	192.000	8917944.592	46447.628	.000	.000	2522688.000
		06	Residual 1i	8272.173	384222826.703	46447.628	.000	.000	105246860.304
			Global (All Sinks)	20464.606	950532388.917	46447.628	.000	.000	112615204.617
			Weighted Average		46447.628	46447.628	.000	.000	5502.926
02	xOntario	02	Ontario i	14173.530	707296411.746	49902.628	.000	.000	14173.530
			Global (All Sinks)	14173.530	707296411.746	49902.628	.000	.000	14173.530
			Weighted Average		49902.628	49902.628	.000	.000	1.000
03	xNortheast	03	Northeast i	41373.630	*************	39408.739	.000	.000	41373.630
			Global (All Sinks)	41373.630	*************	39408.739	.000	.000	41373.630
			Weighted Average		39408.739	39408.739	.000	.000	1.000
04	xMideast	04	Mideast i	38561.464	*************	42033.321	.000	.000	38561.464
			Global (All Sinks)	38561.464	*************	42033.321	.000	.000	38561.464
			Weighted Average		42033.321	42033.321	.000	.000	1.000
05	xGreat Lakes	05	Great Lakes i	47659.994	*************	38158.628	.000	.000	47659.994
		06	Residual 1i	5108.289	194925303.217	38158.628	.000	.000	107335370.115
		07	Residual 2i	116663.097	*************	38158.628	.000	.000	959320645.151
			Global (All Sinks)	169431.380	*************	38158.628	.000	.000	*************
			Weighted Average		38158.628	38158.628	.000	.000	6295.786
	Global (All Sources)		Global (All Sinks)	284004.610	*************	40050.219	.000	.000	*************
			Weighted Average		40050.219	40050.219	.000	.000	4152.795

Import (Sink) Flows and Values - Base Currency: TARIFF CASE:1107, 1989 MERGED SUPPLY

ID	Importer (Sink)	ID	Exporter (Source)	Import (Sink) Quantity	Import (Sink) Value	Import (Sink) Price	Import Tariff Specific	Import Tariff Ad Valorem	Trans. Cost
01	Quebec 1	01	xQuebec	10926.772	507533576.227	46448.628	.000	.000	10926.772
			Global (All Sources)	10926.772	507533576.227	46448.628	.000	.000	10926.772
			Weighted Average		46448.628	46448.628	.000	.000	1.000
02	Ontario 1	01	xQuebec	881.660	43998041.117	49903.628	.000	.000	3047017.541
		02	xOntario	14173.530	707310585.276	49903.628	.000	.000	14173.530
			Global (All Sources)	15055.190	751308626.393	49903.628	.000	.000	3061191.071
			Weighted Average		49903.628	49903.628	.000	.000	203.331
03	Northeast 1	01	xQuebec	192.000	10705656.592	55758.628	.000	.000	1787712.000
		03	xNortheast	41373.630	*************	39409.739	.000	.000	41373.630
			Global (All Sources)	41565.630	*************	39485.258	.000	.000	1829085.630
			Weighted Average		39485.258	39485.258	.000	.000	44.005
04	Mideast 1	01	xQuebec	192.000	11440632.592	59586.628	.000	.000	2522688.000
		04	xMideast	38561.464	*************	42034.321	.000	.000	38561.464
			Global (All Sources)	38753.464	*************	42121.282	.000	.000	2561249.464
			Weighted Average		42121.282	42121.282	.000	.000	66.091
05	Great Lakes 1	05	xGreat Lakes	47659.994	*************	38159.628	.000	.000	47659.994
			Global (All Sources)	47659.994	*************	38159.628	.000	.000	47659.994
			Weighted Average		38159.628	38159.628	.000	.000	1.000

06	Pesidual 1i	01	xQuebec	8272.173489469687.006	59170.628	.000	.000105246860.304
		05	xGreat Lakes	5108.289302260673.332	59170.628	000	.000107335370.115
			Global (All Sources)	13380.462791730360.339	59170.628	.000	.000212582230.419
			Weighted Average	59170.628	59170.628	.000	.000 15887.510
07	Residual 2i	05	xGreat Lakes	116663.097*************	46381.628	.000	.000959320645.151
			Global (All Sources)	116663.097*************	46381.628	.000	.000959320645.151
			Weighted Average	46381.628	46381.628	.000	.000 8223.000
	Global (All Sinks)		Global (All Sources)	284004.610*************	44203.014	.000	.000*************
			Weighted Average	44203.014	44203.014	.000	.000 4152.795

APPENDIX 8: SCENARIO 1, 1996

Export (Source) Flows and Values - Base Currency: TARIFF CASE:9575, 1993 MERGED SUPPLY

ID	Exporter (Source)	ID	Importer (Sink)	Export (Source) Quantity	Export (Source) Value	Export (Source) Price	Export Tariff Specific	Export Tariff Ad Valorem	Trans. Cost
01	\Quebec	01	Quebec i	11077.234	500410543.919	45174.683	.000	.000	11077.234
		02	Ontario i	721.322	32585500.528	45174.683	.000	.000	2492889.458
		03	Northeast i	192.000	8673539.045	45174.683	.000	.000	1547712.000
		04	Mideast i	192.000	8673539.045	45174.683	.000	.000	2282688.000
		06	Residual Ii	7754.111	350289522.684	45174.683	.000	.000	98655559.882
			Global (All Sinks)	19936.668	900632645.221	45174.683	.000	.000	104989926.574
			Weighted Average		45174.683	45174.683	.000	.000	5266.172
02	\Ontario	02	Ontario i	14547.723	707451158.411	48629.683	.000	.000	14547.723
			Global (All Sinks)	14547.723	707451158.411	48629.683	.000	.000	14547.723
			Weighted Average		48629.683	48629.683	.000	.000	1.000
03	\Northeast	03	Northeast i	42183.333	*************	37789.333	.000	.000	42183.333
			Global (All Sinks)	42183.333	*************	37789.333	.000	.000	42183.333
			Weighted Average		37789.333	37789.333	.000	.000	1.000
04	\Mideast	04	Mideast i	40354.632	*************	39175.683	.000	.000	40354.632
		06	Residual Ii	1340.186	52502709.661	39175.683	.000	.000	10631697.226
			Global (All Sinks)	41694.818	*************	39175.683	.000	.000	10672051.868
			Weighted Average		39175.683	39175.683	.000	.000	255.956

ID	Importer (Sink)	ID	Exporter (Source)	Quantity	Value	Price	Specific	Ad Valorem	Trans. Cost
05	xGreat Lakes	05	Great Lakes i	47124.034*************		38885 683	.000	000	47124.034
		06	Residual 1i	5852.681227585480.130		38885.683	.000	.000111271163.762	
		07	Residual 2i	114054.813*************		38885.683	.000	.000937872723.914	
			Global (All Sinks)	167031.527*************		38885.683	.000	.000*************	
			Weighted Average		38885.683	38865.683	.000	.000	6281.395
	Global (All Sources)		Global (All Sinks)	285394.069*************		39702.022	.000	.000*************	
			Weighted Average		39702.022	39702.022	.000	.000	4081.759

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Import (Sink) Flows and Values - Base Currency: TARIFF CASE:9575, 1993 MERGED SUPPLY

ID	Importer (Sink)	ID	Exporter (Source)	Import (Sink) Quantity	Value	Price	Import Tariff Specific	Ad Valorem	Trans. Cost
01	Quebec i	01	xQuebec	11077.234500421621.153		45175.683	.000	.000	11077 234
			Global (All Sources)	11077.234500421621.153		45175.683	.000	.000	11077.234
			Weighted Average		45175.683	45175.683	.000	.000	1.000
02	Ontario i	01	xQuebec	721.322	35078389.986	48630.683	.000	.000	2492889.458
		02	xOntario	14547.723707465706.134		48630.683	.000	.000	14547.723
			Global (All Sources)	15269.045742544096.120		48630.683	.000	.000	2507437.181
			Weighted Average		48630.683	48630.683	.000	.000	164.217
03	Northeast i	01	xQuebec	192.000	10221251.045	53235.683	.000	.000	1547712.000
		03	xNortheast	42183.333*************		37790.333	.000	.000	42183.333
			Global (All Sources)	42375.333*************		37860.315	.000	.000	1589895.333
			Weighted Average		37860.315	37860.315	.000	.000	37.519

04 Mideast i	01	xQuebec	192.000 10956227.045	57063.683	.000	.000	2282688.000
	04	xMideast	40354.632*************	39176.683	.000	.000	40354.632
		Global (All Sources)	40546.632*************	39261.383	.000	.000	2323042.632
		Weighted Average	39261.383	39261.383	.000	.000	57.293
05 Great Lakes i	05	xGreat Lakes	47124.034*************	38886.683	.000	.000	47124.034
		Global (All Sources)	47124.034*************	38886.683	.000	.000	47124.034
		Weighted Average	38886.683	38886.683	.000	.000	1.000
06 Residual 1i	01	xQuebec	7754.111448945082.565	57897.683	.000	.000 98655559.882	
	05	xGreat Lakes	5852.681338856643.892	57897.683	.000	.000111271163.762	
		Global (All Sources)	13606.792787801726.458	57897.683	.000	.000209926723.644	
		Weighted Average	57897.683	57897.683	.000	.000	15428.083
07 Residual 2i	04	xMideast	1340.186 63134407.097	47108.683	.000	.000 10631697.236	
	05	xGreat Lakes	114054.813*************	47108.683	.000	.000937872723.914	
		Global (All Sources)	115394.999*************	47108.683	.000	.000948504421.150	
		Weighted Average	47108.683	47108.683	.000	.000	8219.632
Global (All Sinks)		Global (All Sources)	235394.069*************	43783.781	.000	.000*************	
		Weighted Average	43783.781	43783.781	000	.000	4081.759

Export (Source) Flows and Values - Base Currency: TARIFF CASE 0745, 1996 MERGED SUPPLY

ID	Exporter (Source)	ID	Importer (Sink)	Export (Source) Quantity	Export (Source) Value	Export (Source) Price	Export Tariff Specific	Export Tariff Ad Valorem	Trans. Cost
01	xQuebec	01	Quebec i	11170.856	495791884.470	44382.624	.000	.000	11170.856
		03	Northeast i	192.000	8521463.766	44382.624	.000	.000	1307712.000
		04	Mideast i	192.000	8521463.766	44382.624	.000	.000	2042688.000
		06	Residual 1i	6298.013	279522339.434	44382.624	.000	.000	80129618.794
			Global (All Sinks)	17852.869	792357151.436	44382.624	.000	.000	83491189.650
			Weighted Average		44382.624	44382.624	.000	.000	4676.626
02	xOntario	02	Ontario i	15706.863	722886765.305	46023.624	.000	.000	15706.863
		06	Residual 1i	261.886	12052929.072	46023.624	.000	.000	2902217.343
			Global (All Sinks)	15968.749	734939694.377	46023.624	.000	.000	2917924.206
			Weighted Average		46023.624	46023.624	.000	.000	182.727
03	xNortheast	03	Northeast i	42263.342	*************	37629.316	.000	.000	42263.342
			Global (All Sinks)	42263.342	*************	37629.316	.000	.000	42263.342
			Weighted Average		37629.316	37629.316	.000	.000	1.000
04	xMideast	04	Mideast i	39596.648	*************	40383.624	.000	.000	39596.648
		07	Residual 2i	3136.789	126674898.519	40383.624	.000	.000	24884145.127
			Global (All Sinks)	42733.437	*************	40383.624	.000	.000	24923741.776
			Weighted Average		40383.624	40383.624	.000	.000	583.237

05	xGreat Lakes	05	Great Lakes i	46233.580*************	40093.624	.000	.000 46233.580
		06	Residual 1i	7187.721288181801.138	40093.624	.000	.000122277517.341
		07	Residual 2i	110151.369*************	40093.624	.000	.000905774706.615
			Global (All Sinks)	163572.670*************	40093.624	.000	.000*************
			Weighted Average	40093.624	40093.624	.000	.000 6285.270
	Global (All Sources)		Global (All Sinks)	282391.066*************	40375.178	.000	.000*************
			Weighted Average	40375.178	40375.178	.000	.000 4035.091

Inport (Sink) Flows and Values - Base Currency: TARIFF CASE 0745, 1996 MERGED SUPPLY

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01 Quebec i	01	xQuebec	11170.856495803055.326	44383.624	.000	.000	11170.856
		Global (All Sources)	11170.856495803055.326	44383.624	.000	.000	11170.856
		Weighted Average	44383.624	44383.624	.000	.000	1.000
02 Ontario i	02	xOntario	15706.863722902472.168	46024.624	.000	.000	15706.863
		Global (All Sources)	15706.863722902472.168	46024.624	.000	.000	15706.863
		Weighted Average	46024.624	46024.624	.000	.000	1.000
03 Northeast i	01	xQuebec	192.000 9829175.766	51193.624	.000	.000	1307712.000
	03	xNortheast	42263.342*************	37630.316	.000	.000	42263.342
		Global (All Sources)	42455.342*************	37691.655	.000	.000	1349975.342
		Weighted Average	37691.655	37691.655	.000	.000	31.798
04 Mideast i	01	xQuebec	192.000 10564151.766	55021.624	.000	.000	2042688.000
	04	xMideast	39596.648*************	40384.624	.000	.000	39596.648
		Global (All Sources)	39788.648*************	40455.255	.000	.000	2082284.648
		Weighted Average	40455.255	40455.255	.000	.000	52.334
05 Great Lakes i	05	xGreat Lakes	46233.580*************	40094.624	.000	.000	46233.580
		Global (All Sources)	46233.580*************	40094.624	.000	.000	46233.580
		Weighted Average	40094.624	40094.624	.000	.000	1.000
06 Residual li	01	xQuebec	6298.013359651958.228	57105.624	.000	.000	80129618.794
	02	xOntario	261.886 14955146.414	57105.624	.000	.000	2902217.343
	05	xGreat Lakes	7187.721410459318.479	57105.624	.000	.000122277517.341	
		Global (All Sources)	13747.620785066423.121	57105.624	.000	.000205309353.477	
		Weighted Average	57105.624	57105.624	.000	.000	14934.174

07	Residual 2i	04	xMideast	3136.789151559043.646	48316.624	.000	.000	24884145.127
		05	xGreat Lakes	110151.369*************	48316.624	.000	.000905774706.615	
			Global (All Sources)	113288.158*************	48316.624	.000	.000930658851.742	
			Weighted Average	48316.624	48316.624	.000	.000	8214.970
	Global (All Sinks)		Global (All Sources)	282391.066*************	44410.269	.000	.000*************	
			Weighted Average	44410.269	44410.269	.000	.000	4035.091

APPENDIX 10: SCENARIO 2, 1993

Export (Source) Flows and Values - Base Currency: TARIFF CASE:3202, 1989 MERGED SUPPLY, SHADOW PRICE

ID	Exporter (Source)	ID	Importer (Sink)	Export (Source) Quantity	Export (Source) Value	Export (Source) Price	Export Tariff Specific	Export Tariff Ad Valorem	Trans. Cost
01	xQuebec	01	Quebec i	11030.019	427460218.752	38754.260	.000	.000	11030.019
		02	Ontario i	972.907	37704296.747	38754.260	.000	.000	3362367.119
		03	Northeast i	192.000	7440817.922	38754.260	.000	.000	827712.000
		04	Mideast i	192.000	7440817.922	38754.260	.000	.000	1562688.000
		06	Residual 1i	7732.887	299682315.606	38754.260	.000	.000	98385522.021
			Global (All Sinks)	20119.813	779728466.949	38754.260	.000	.000	104149319.158
			Weighted Average		38754.260	38754.260	.000	.000	5176.456
02	xOntario	02	Ontario i	14105.929	595400813.215	42209.260	.000	.000	14105.929
			Global (All Sinks)	14105.929	595400813.215	42209.260	.000	.000	14105.929
			Weighted Average		42209.260	42209.260	.000	.000	1.000
03	xNortheast	03	Northeast i	41373.630	*************	39408.739	.000	.000	41373.630
			Global (All Sinks)	41373.630	*************	39408.739	.000	.000	41373.630
			Weighted Average		39408.739	39408.739	.000	.000	1.000
04	xMideast	04	Mideast i	38561.464	*************	42033.321	.000	.000	38561.464
			Global (All Sinks)	38561.464	*************	42033.321	.000	.000	38561.464
			Weighted Average		42033.321	42033.321	.000	.000	1.000

05	xGreat Lakes	05	Great Lakes i	47618.247	*************	38215.260	.000	.000	47618.247
		06	Residual 1i	5399.070	206326870.019	38215.260	.000	.000	71602468.359
		07	Residual 2i	116564.322	*************	38215.260	.000	.000	958508417.410
			Global (All Sinks)	169581.639	*************	38215.260	.000	.000	*************
			Weighted Average		38215.260	38215.260	.000	.000	6074.705
	Global (All Sources)		Global (All Sinks)	283742.475	*************	39144.949	.000	.000	*************
			Weighted Average		39144.949	39144.949	.000	.000	3997.998

Import (Sink) Flows and Values - Base Currency: TARIFF CASE:3202, 1989 MERGED SUPPLY, SHADOW PRICE

ID	Importer (Sink)	ID	Exporter (Source)	Import (Sink) Quantity	Import (Sink) Value	Import (Sink) Price	Import Tariff Specific	Import Tariff Ad Valorem	Trans. Cost
01	Quebec i	01	xQuebec	11030.019	427471248.771	38755.260	.000	.000	11030.019
			Global (All Sources)	11030.019	427471248.771	38755.260	.000	.000	11030.019
			Weighted Average		38755.260	38755.260	.000	.000	1.000
02	Ontario i	01	xQuebec	972.907	41066663.866	42210.260	.000	.000	3362367.119
		02	xOntario	14105.929	595414919.144	42210.260	.000	.000	14105.929
			Global (All Sources)	15078.836	636481583.010	42210.260	.000	.000	3376473.047
			Weighted Average		42210.260	42210.260	.000	.000	223.921
03	Northeast i	01	xQuebec	192.000	8268529.922	43065.260	.000	.000	827712.000
		03	xNortheast	41373.630	*************	39409.739	.000	.000	41373.630
			Global (All Sources)	41565.630	*************	39426.625	.000	.000	869085.630
			Weighted Average		39426.625	39426.625	.000	.000	20.909
04	Mideast i	01	xQuebec	192.000	9003505.922	46893.260	.000	.000	1562688.000
		04	xMideast	38561.464	*************	42034.321	.000	.000	38561.464
			Global (All Sources)	38753.464	*************	42058.394	.000	.000	1601249.464
			Weighted Average		42058.394	42058.394	.000	.000	41.319
05	Great Lakes i	05	xGreat Lakes	47618.247	*************	38216.260	.000	.000	47618.247
			Global (All Sources)	47618.247	*************	38216.260	.000	.000	47618.247
			Weighted Average		38216.260	38216.260	.000	.000	1.000

06	Residual 1i	01	xQuebec	7732.887398067837.627	51477.260	.000	.000 98385522.021
		05	xGreat Lakes	5399.070277929338.377	51477.260	.000	.000 71602468.359
			Global (All Sources)	13131.957675997176.004	51477.260	.000	.000169987990.380
			Weighted Average	51477.260	51477.260	.000	.000 12944.604
07	Residual 2i	05	xGreat Lakes	116564.322*************	46438.260	.000	.000958508417.410
			Global (All Sources)	116564.322*************	46438.260	.000	.000958508417.410
			Weighted Average	46438.260	46438.260	.000	.000 8223.000
	Global (All Sinks)		Global (All Sources)	283742.475*************	43142.947	.000	.000*************
			Weighted Average	43142.947	43142.947	.000	.000 3997.998

Export (Source) Flows and Values - Base Currency: TARIFF CASE:2616, 1993 MERGED SUPPLY, SHADOW PRICE

ID	Exporter (Source)	ID	Importer (Sink)	Export (Source) Quantity	Export (Source) Value	Export (Source) Price	Export Tariff Specific	Export Tariff Ad Valorem	Trans. Cost
01	xQuebec	01	Quebec i	10831.758	435226498.955	40180.596	.000	.000	10831.758
		03	Northeast i	347.450	13960759.048	40180.596	.000	.000	1372776.025
		04	Mideast i	192.000	7714674.451	40180.596	.000	.000	1493568.000
		06	Residual 1i	9448.333	379639666.382	40180.596	.000	.000	120211145.287
			Global (All Sinks)	20819.542	836541598.837	40180.596	.000	.000	123088321.071
			Weighted Average		40180.596	40180.596	.000	.000	5912.153
02	xOntario	02	Ontario i	15080.148	636614861.230	42215.427	.000	.000	15080.148
			Global (All Sinks)	15080.148	636614861.230	42215.427	.000	.000	15080.148
			Weighted Average		42215.427	42215.427	.000	.000	1.000
03	xNortheast	03	Northeast i	38857.252	*************	44130.596	.000	.000	38857.252
			Global (All Sinks)	38857.252	*************	44130.596	.000	.000	38857.252
			Weighted Average		44130.596	44130.596	.000	.000	1.000
04	xMideast	04	Mideast i	35354.364	*************	45768.596	.000	.000	35354.364
			Global (All Sinks)	35354.364	*************	45768.596	.000	.000	35354.364
			Weighted Average		45768.596	45768.596	.000	.000	1.000

05	xGreat Lakes	04	Mideast i	863.214	34737120.624	40241.596	.000	.000	4771848.565
		05	Great Lakes i	46124.500	*************	40241.596	.000	.000	46124.500
		06	Residual 1i	3395.815	136653018.338	40241.596	.000	.000	42997810.323
		07	Residual 2i	113030.071	*************	40241.596	.000	.000	929446271.861
			Global (All Sinks)	163413.600	*************	40241.596	.000	.000	977262055.249
			Weighted Average		40241.596	40241.596	.000	.000	5980.298
	Global (All Sources)		Global (All Sinks)	273524.905	*************	41612.642	.000	.000	*************
			Weighted Average		41612.642	41612.642	.000	.000	4023.179

Import (Sink) Flows and Values - Base Currency: TARIFF CASE:2616, 1993 MERGED SUPPLY, SHADOW PRICE

ID	Importer (Sink)	ID	Exporter (Source)	Import (Sink) Quantity	Import (Sink) Value	Import (Sink) Price	Import Tariff Specific	Import Tariff Ad Valorem	Trans. Cost
01	Quebec 1	01	xQuebec	10831.758	435237330.713	40181.596	.000	.000	10831.758
			Global (All Sources)	10831.758	435237330.713	40181.596	.000	.000	10831.758
			Weighted Average		40181.596	40181.596	.000	.000	1.000
02	Ontario 1	02	xOntario	15080.148	636629941.378	42216.427	.000	.000	15080.148
			Global (All Sources)	15080.148	636629941.378	42216.427	.000	.000	15080.148
			Weighted Average		42216.427	42216.427	.000	.000	1.000
03	Northeast 1	01	xQuebec	347.450	15333535.074	44131.596	.000	.000	1372776.025
		03	xNortheast	38857.252	*************	44131.596	.000	.000	38857.252
			Global (All Sources)	39204.702	*************	44131.596	.000	.000	1411633.277
			Weighted Average		44131.596	44131.596	.000	.000	36.007
04	Mideast 1	01	xQuebec	192.000	9208242.451	47959.596	.000	.000	1493568.000
		04	xMideast	35354.364	*************	45769.596	.000	.000	35354.364
		05	xGreat Lakes	863.214	39508969.188	45769.596	.000	.000	4771848.565
			Global (All Sources)	36409.579	*************	45781.145	.000	.000	6300770.929
			Weighted Average		45781.145	45781.145	.000	.000	173.053
05	Great Lakes 1	05	xGreat Lakes	46124.500	*************	40242.596	.000	.000	46124.500
			Global (All Sources)	46124.500	*************	40242.596	.000	.000	46124.500
			Weighted Average		40242.596	40242.596	.000	.000	1.000

06	Residual 11	01	xQuebec	9448.333499850811.670	52903.596	.000	.000120211145 287
		05	xGreat Lakes	3395.815179650828.661	52903.596	.000	.000 42997810.323
			Global (All Sources)	12844.148679501640.331	52903.596	000	000163208955 611
			Weighted Average	52903.596	52903.596	.000	.000 12706.872
07	Residual 21	05	xGreat Lakes	113030.071*************	48464.596	.000	.000929446271.861
			Global (All Sources)	113030.071*************	48464.596	.000	.000929446271.861
			Weighted Average	48464.596	48464.596	.000	.000 8223.000
	Global (All Sinks)		Global (All Sources)	273524.905*************	45635.821	.000	.000*************
			Weighted Average	45635.821	45635.821	.000	.000 4023.179

Export (Source) Flows and Values - Base Currency: TARIFF CASE 2012, 1996 MERGED SUPPLY SHADOW PRICES

ID	Exporter (Source)	ID	Importer (Sink)	Export (Source) Quantity	Export (Source) Value	Export (Source) Price	Export Tariff Specific	Export Tariff Ad Valorem	Trans. Cost
01	\Quebec	01	Quebec 1	10772.753	437428629.997	40605.091	.000	.000	10772.753
		03	Northeast 1	192.000	7796177.467	40605.091	.000	.000	689472.000
		04	Mideast i	192.000	7796177.467	40605.091	.000	.000	1424448.000
		06	Residual 1i	8982.514	364735796.448	40605.091	.000	.000	114284525.094
			Global (All Sinks)	20139.267	817756781.378	40605.091	.000	.000	116409217.848
			Weighted Average		40605.091	40605.091	.000	.000	5780.211
02	\Ontario	02	Ontario 1	15074.076	636820785.752	42246.091	.000	.000	15074.076
		06	Residual 1i	838.618	35428352.503	42246.091	.000	.000	9293569.962
			Global (All Sinks)	15912.694	672249138.256	42246.091	.000	.000	9308644.038
			Weighted Average		42246.091	42246.091	.000	.000	584.982
03	\Northeast	03	Northeast 1	39098.486	*************	43959.028	.000	.000	39098.486
			Global (All Sinks)	39098.486	*************	43959.028	.000	.000	39098.486
			Weighted Average		43959.028	43959.028	.000	.000	1.000
04	\Mideast	04	Mideast 1	36314.498	*************	45614.143	.000	.000	36314.498
			Global (All Sinks)	36314.498	*************	45614.143	.000	.000	36314.498
			Weighted Average		45614.143	45614.143	.000	.000	1.000

05	xGreat Lakes	05	Great Lakes i	45369.276	*************	41266.091	.000	.000	45369.276
		06	Residual 1i	2934.297	121086948.809	41266.091	.000	.000	35393485.139
		07	Residual 2i	111243.190	*************	41266.091	.000	.000	914752748.260
			Global (All Sinks)	159546.762	*************	41266.091	.000	.000	950191602.674
			Weighted Average		41266.091	41266.091	.000	.000	5955.568
	Global (All Sources)		Global (All Sinks)	271011.708	*************	42245.641	.000	.000	*************
			Weighted Average		42245.641	42245.641	.000	.000	3970.252

Import (Sink) Flows and Values - Base Currency: TARIFF CASE 2012, 1996 MERGED SUPPLY SHADOW PRICES

ID	Importer (Sink)	ID	Exporter (Source)	Import (Sink) Quantity	Import (Sink) Value	Import (Sink) Price	Import Tariff Specific	Import Tariff Ad Valorem	Trans. Cost
01	Quebec i	01	xQuebec	10772.753	437439402.750	40606.091	.000	.000	10772.753
			Global (All Sources)	10772.753	437439402.750	40606.091	.000	.000	10772.753
			Weighted Average		40606.091	40606.091	.000	.000	1.000
02	Ontario i	02	xOntario	15074.076	636835859.828	42247.091	.000	.000	15074.076
			Global (All Sources)	15074.076	636835859.828	42247.091	.000	.000	15074.076
			Weighted Average		42247.091	42247.091	.000	.000	1.000
03	Northeast i	01	xQuebec	192.000	8485649.467	44196.091	.000	.000	689472.000
		03	xNortheast	39098.486	*************	43960.028	.000	.000	39098.486
			Global (All Sources)	39290.486	*************	43961.182	.000	.000	728570.486
			Weighted Average		43961.182	43961.182	.000	.000	18.543
04	Mideast i	01	xQuebec	192.000	9220625.467	48024.091	.000	.000	1424448.000
		04	xMideast	36314.498	*************	45615.143	.000	.000	36314.498
			Global (All Sources)	36506.498	*************	45627.813	.000	.000	1460762.498
			Weighted Average		45627.813	45627.813	.000	.000	40.014
05	Great Lakes i	05	xGreat Lakes	45369.276	*************	41267.091	.000	.000	45369.276
			Global (All Sources)	45369.276	*************	41267.091	.000	.000	45369.276
			Weighted Average		41267.091	41267.091	.000	.000	1.000

06	Residual 1i	01	xQuebec	8982.514479020321.542	53328.091	.000	.000114284525.094
		02	xOntario	838.618 44721922.465	53328.091	.000	.000 9293569.962
		05	xGreat Lakes	2934.297156480433.948	53328.091	.000	.000 35393485.139
			Global (All Sources)	12755.429680222677.955	53328.091	.000	.000158971580.195
			Weighted Average	53328.091	53328.091	.000	.000 12463.052
07	Residual 2i	05	xGreat Lakes	111243.190*************	49489.091	.000	.000914752748.260
			Global (All Sources)	111243.190*************	49489.091	.000	.000914752748.260
			Weighted Average	49489.091	49489.091	.000	.000 8223.000
	Global (All Sinks)		Global (All Sources)	271011.708*************	46215.893	.000	.000*************
			Weighted Average	46215.893	46215.893	.000	.000 3970.252