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Abstract

This study evaluates the impacts of the Uruguay Round Agreement (URA) on Canadian agriculture in a single-country general equilibrium framework. For this purpose a computable general equilibrium model of the Canadian economy that involves six agricultural and two non-agricultural sectors was constructed and calibrated on 1991 data. To assess whether Canadian agriculture benefits from the URA, two sets of anticipated changes in world prices, taken from studies of the global effects of the URA, were introduced into the model exogenously. The simulation experiments show that the minimum increases in world prices from global studies are too small to offset the negative effects on agriculture of the reductions in tariffs, export subsidies and domestic support. However, if world prices were to change by the maximum level of global projections, Canadian agricultural producers gain from the URA. The sectors that benefit the most are wheat, other grains, and processed foods, for which production and exports increase appreciably. Imports of milk and poultry products increase substantially and livestock sector imports also increase. Labour and capital demand increase in agriculture, particularly in the wheat and other grains sectors. The highest increase in factor returns in agriculture is for agricultural land. Since the export prices applied above are exogenously determined, a third experiment is conducted to determine the extent of the world price changes for agricultural exports that would offset the negative effects on sectoral domestic production of the URA policy commitments. This would require world prices that are about eleven per cent higher than in the base period for wheat and about ten per cent higher for other grains. The greatest increase in prices--by nearly thirteen per cent--would be required for the milk and poultry sector. More modest changes in world prices for the other agricultural sectors are needed to offset the impacts of the reductions in sectoral support necessitated by the URA. Most of these price changes lie within the ranges of world price projections from studies of the global effects of the URA.

1. Introduction

A major achievement of the Uruguay Round (UR) was that it brought the liberalization of trade in agricultural products into the domain of the General Agreement on Tariffs and Trade (GATT) and its successor, the World Trade Agreement (WTO). Agriculture had effectively been excluded from previous GATT rounds; consequently world markets for some farm products had become highly distorted. The risk of an international subsidy war, primarily between the US and EC, contributed to bringing agriculture into the GATT discussions (Roningen and Dixit 1989). Recognition that trade disputes involving agricultural products were difficult to settle without some formal legal framework was also a factor (IATRC, 1994), as was increased concern regarding government expenditures to maintain protectionist policies and the recognition of the lack of effectiveness of much budgetary expenditure (Baker et al, 1989). According to

Meilke and Larue's (1989) calculation, 50 per cent of the agricultural policy expenditure in Canada, for example, was necessary to offset the price depressing effect of other countries' policies. Roningen and Dixit (1989), calculated that 65 per cent of agricultural policy expenditure by Canada was necessary to offset the price depressing effects of its own and other countries' policies. Consequently it was generally agreed that agricultural trade liberalization would have a positive and substantial impact on the economies of all participants.

The 1994 UR Agreement on Agriculture (URA) incorporates three main provisions; these relate to market access, export competition, and internal support.[1] Regarding agricultural market access, with the exception of a few countries, the participants agreed to convert all non-tariff trade restrictions into tariff restrictions. Furthermore, all tariffs are bound and thus can not unilaterally be raised without consultation. Countries must allow minimum access opportunities, as through tariff rate quotas, thus allowing a minimum amount of imports to occur without tariffs or at lower levels of tariffs. The Agreement requires developed countries to reduce existing and new tariffs by 36 per cent on average, from the 1986-88 base period, over the 6 year implementation period of 1995 to 2001. A minimum tariff reduction of 15 per cent is required on each listed import item.[2]

With respect to export competition, the agreement banned the introduction of new subsidies on agricultural exports and required the reduction of existing subsidies, in terms of both expenditure and volume. Developed countries must cut subsidy expenditures by 36 per cent (from the 1986-90 level base) over the six year implementation period. They must also reduce the volume of exports that obtain subsidies by 21 per cent over the implementation period. The UR Agreement also put quantitative restrictions on certain types of domestic support. In developed countries, domestic agricultural support considered to be "amber" (i.e., subsidies viewed to distort production and trade) are subject to 20 per cent reduction from

[1]A fourth component involved the development of sanitary and phytosanitary provisions.

[2] Correspondingly, developing countries are required to make a overall tariff reduction of only 24 per cent, with a minimum requirement for each import item of 5 per cent, over a ten year period.

the 1986-88 base level.[3] If current support levels are less than 5 percent they are exempted from this provision.

Numbers of studies were conducted prior to the UR to assess the impact of agricultural trade liberalization. Modelling exercises to simulate liberalized trade in many of the major studies involved the linking of country/region specific supply and demand relations of the main agricultural commodities. Such studies include Valdes and Zietz (1980), Anderson and Tyers (1987, 1988), OECD (1987), USDA (1987), Parikh et al (1988), Roningen and Dixit (1989), Burniaux et al (1989, 1990) and Cahill (1991). Some of these global studies applied general equilibrium models but most were partial in nature; some were static and others varied in the way that dynamics was introduced. Other differences arise from the way policy interventions were modelled and the choice of elasticity estimates incorporated into the models (Gardner, 1989).

The most generous projection of world prices following a multilateral trade liberalization was from results of the Static World Policy Simulation (SWOPSIM) (Roningen and Dixit, 1989). Taking 1986/87 as a base year, multilateral trade liberalization by industrial market economies was projected to raise average world agricultural price by 22 per cent. Wheat, coarse grain, oilseeds and products, dairy products, ruminant meat and non-ruminant meat prices were each projected to rise by 36.7, 26.3, 6.4, 65.3, 21, and 12.4 per cent respectively. These price increases are related to the level of support that each commodity was getting under the base scenario. Frohberg (1989) used SWOPSIM results (Roningen, 1988) and a 1986 base period. It was forecast that total agricultural output would increase in Canada by 7 per cent in year 2000, induced by a 4 per cent increase in agricultural prices. The study by Cahill (1991) was based on a liberalization scenario and a base period which was close to the final agreement of the UR. Using a Trade Analysis Simulation System (TASS), this study projected a modest increase in the world price of grains

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[3] Developing countries are required to reduce expenditure on subsidies by 24 per cent and to reduce the volume of subsidized exports by 14 per cent over a 10 year period. For these countries, domestic agricultural

and oilseeds (a maximum of 5 per cent for wheat for the base period). Substantial changes were simulated for dairy product prices (maximum of 27 per cent). Other studies that used different base periods have obtained qualitatively similar results regarding the positive impact of multilateral trade liberalization on world prices. These include Tyers and Anderson (1987, 1988), and Parikh, et al (1988).[4]

A common conclusion of the majority of the studies previous to the UR is that, in spite of a positive impact on world prices and other benefits,[5] trade liberalization would bring less gain to farmers than would be lost as a result of complete liberalization, involving removal of all distortionary policies (Burniaux et al, 1989). From a sectoral viewpoint, partial liberalization could be preferred (Robinson, 1990). This was in fact the outcome of the UR Agreement on Agriculture.

Some assessments have been conducted following the conclusion of the UR that focus on interpretation of the commitments; others provide preliminary quantitative findings. These studies include Ingco (1994), Hathaway (1994), IATRC (1994), Miner (1994), Brooks and Kraft (1994), Provincial and Federal Officials (1994), and Government of Canada (1994). It is generally believed that Canada's major gain from the URA arises from increased export prices arising from export subsidy reduction commitments, especially for grain exports. Canadian assessments report very favourable price projections due to the URA (Agriculture and Agri-Food Canada, 1993; Provincial and Federal Officials, 1994). Provincial and Federal Officials (1994) projected the price of wheat to increase by 10 to 25% by the year 2000. Price increase projections for oilseeds, dairy and feed grains were 0 to 5%, 5 to 10%, and 0 to 10%, respectively. The implication of the Canadian export subsidy commitment was the reduction of expenditure to subsidize rail shipment of grains under the Western Grain Transportation Act (WGTA), leading to

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support must be reduced by 14 per cent over a 10 year period. If current support levels are less than 10 per cent they are exempted from provisions.

[4] The exception is the OECD (1987) study, which assumed a 10 per cent reduction in border protection by all industrial countries from a 1981 base. The projection from this assessment was a fall in the world price of wheat and coarse grain for the year 1996.

[5] These benefits include a more predictable and rule oriented trading environment as a result of the market access agreement (Miner, 1994; IATRC, 1994; Government of Canada, 1994).

producers having to pay higher freight costs. Subsequently, and largely for budgetary purposes, Canadian grain transportation subsidies were terminated.

The URA puts quantitative restrictions on certain types of domestic support. Some major Canadian support programs were believed to have production and trade effects, including the National Tripartite Stabilization Program, the Gross Revenue Insurance Program, and the National Income Stabilization Account (NISA) (Brooks and Kraft, 1994). Major reductions in these programs did not have to be made due to Canada's URA commitments since they have been cut since the late 1980s. In any event, some of these programs have subsequently been deleted for budgetary reasons or to avoid US countervail actions, and the remaining income safety net program, NISA, has been adjusted to avoid countervail actions.

What can be assessed from the studies noted above regarding the implications of the URA for the Canadian agricultural sector? One thing is clear, there is a welfare gain for society at large. This also appears to be true for Canada, as for other industrialized economies. On the issue of the welfare of agricultural producers, there is less agreement and less clarity. This research study is directed at the analysis of the effects of world price changes and domestic agricultural policy commitments, arising from the URA, on the agricultural sector of Canada. Specifically, interest is focused on: i) quantifying the gains from the multilateral trade agreement to Canadian grain producers; ii) evaluating the impacts on the non-grain agricultural and related non-farm sectors; and iii) evaluating the implications for factoral income distribution and intersectoral transfer of factors of production.

2. Methodology: Development of the CGE Model

A computable general equilibrium (CGE) model of the Canadian economy that emphasizes the agricultural sectors of this economy is developed. The model is an operational representation of an abstract Walrasian economic system. Thus there are two main classes of agents, consumers and firms; government is also included as an explicit agent, but without optimization behaviour. Consumers have sufficiently regular preferences over different bundles of final goods to be expressed by utility functions;

they earn incomes from the sale of factor services, distributed profits of firms and rents from property. Taking product and factor prices as given, consumers attempt to maximize utility subject to their income constraint, while firms, taking product and factor prices as given, attempt to maximize profits subject to a technology constraint.The usual assumptions apply that markets exist for all products and that these are competitive. System constraints hold at the aggregate level but are not taken into account by individual agents in making their decisions. Prices are the equilibrating variables that vary to achieve market clearing, and equilibrium is defined as a set of prices that if attained, will result in the decisions of all agents that will jointly satisfy the system constraints.

In defining the CGE model, the Canadian economy is divided into eight sectors, six of which are agricultural and two are non-agricultural. Categorization of the agricultural sectors was based on the magnitudes of various commodities and the availability of data. The sectors include: 1) wheat, 2) other grains (including barley, oats, rye, corn, mixed grains, mustard seed, soybeans, canola and other oilseeds), 3) fruits and vegetables, 4) livestock, 5) milk and poultry, 6) other agriculture, 7) food industries (including meats, other than poultry, and dairy and fish products, fruit and vegetable preparations and other processed foods) and 8) the rest of the economy.

There are three primary factors of production and the aggregate supply of each is assumed to be fixed. These are labour, capital, and agricultural land; the latter is specific to the agricultural sectors. Labour and capital are assumed to be mobile among the eight sectors, while agricultural land shifts freely among the six agricultural sectors. Since capital is freely mobile, rental rates of capital are equalized across sectors. Therefore, the equilibrium position of the model defines a long run equilibrium.

Production technology in each sector is represented by a Cobb-Douglas value-added function with labour, capital and, where appropriate, agricultural land as its arguments. Domestic suppliers make their decisions based on the value-added price, which is the output price less indirect taxes and the cost of intermediate inputs plus production subsidies. Primary input demands are derived from first order

conditions for profit maximization. Intermediate inputs are assumed to be demanded in all sectors according to the fixed input-output coefficients that were derived for this model.

In addition, the model includes equations that describe the flow of income from value added to institutions such as firms, workers and landowners. Households are assumed to appropriate all net income obtained by the workers and the land-owners, and dividends from firms. Transfers from government and remittances from non-residents also enter into the income of households. Government derives income (revenue) in the form of taxes and foreign borrowing. Other income equations define the various taxes and subsidies.[6]

Savings are made by households, enterprises and the government. Government earns revenue through taxes and make expenditures on consumption goods and transfers. The savings it makes are determined residually. Savings by enterprises depend on fixed enterprise saving rates, while savings by households are determined by their propensity to save. Foreign saving is determined exogenously. Total saving is, then, the sum of the savings made by the different institutions, plus depreciation allowance. The expenditure equations of the model describe the demands for goods by the various agents of the domestic economy. These include private consumption, government consumption and investment demand.

Finally the equilibrium equations define the system constraints which the model must satisfy in equilibrium. These are the product and factor market clearing conditions and the macro-economic balances of government deficit, the balance of trade and the savings-investment balances. A neo-classical rule applies in the savings-investment relation; since the components of aggregate savings are determined either exogenously or residually, aggregate investment is determined by aggregate savings, that is, investment is

[6] Sectoral tariff revenue and export subsidy are determined by multiplying the domestic value of imports and exports, respectively, by the appropriate tariff rate and export subsidy rate. These sectoral revenues and outlays are each summed over the sectors to obtain the total tariff revenue and total export subsidy that enter in the government revenue and expenditure equations. Indirect taxes and domestic subsidies are proportional to domestic production, the indirect tax rates and subsidy rates defining those proportions. Firms deduct depreciation allowance from capital income and add any net transfers and pay business tax on the balance, according to fixed business tax rates.

savings driven.

2.1 The Incorporation of International Trade Effects

As discussed in the introduction, the URA is expected to bring about changes in world prices, particularly for grain products. These price changes can be viewed to be largely exogenous to the Canadian economy. In order to simulate the effects of such price changes on the Canadian agricultural sector, together with the effects of the direct policy changes to which the Canadian government has committed pursuant to the URA, the suggestion by Robinson, et al (1990) is adopted. Consequently, this is pursued within the single-country (Canada-specific) CGE model by relating domestic import and export prices to world import and export prices.

The domestic import price of commodity i, (PM_i) is given by the exogenously given world import price (pwm_i) adjusted for tariff (t_{mi}) and the exchange rate (EXR):

$$PM_i = pwm_i * (1 + t_{mi}) * EXR \qquad (1)$$

where t_{mi} is the tariff rate on imports of commodity i.

The domestic price of exports is specified symmetrically, where import tariffs are replaced by export subsidies. If PWE_i denotes the world price of an export commodity, and t_{ei} is the subsidy rate on the exports of sector i, then the domestic price of commodity i, PE_i , is given by:

$$PE_i = PWE_i * (1 + t_{ei}) * EXR \qquad (2)$$

The "small country" assumption holds for the case of all Canadian imports and exports except for wheat exports. Canada's wheat exports are assumed to face a downward-sloping world demand curve. Therefore, for the wheat sector, PWE_i is endogenous.

Import demand and export supply functions are derived as follows: imports and domestic goods are viewed as imperfect substitutes (Armington assumption). A Constant Elasticity of Substitution (CES) function is specified to define a composite good X_i (which is composed of imports, M_i, and domestic supply,

XXD_i). Import demand for good i, M_i , is then obtained by minimizing the cost of purchasing X_i subject to the CES aggregation function for X_i . Thus,

$$M_i = XXD_i \left[\frac{d_{mi}}{(1-d_{mi})} * \frac{PD_i}{PM_i} \right]^{\frac{-1}{(1+r_{mi})}} \tag{3}$$

where PD_i is the price of domestic goods sold on the domestic market.

On the export side, each export sector is treated as a two-product firm producing an export good and a good to be delivered to the domestic market with non-perfect substitution between the two types of goods. Exports, E_i, and domestic supply, XXD_i are aggregated into a composite good XD_i by a Constant Elasticity of Transformation (CET) function. Export supply, E_i , is then obtained by maximizing revenue from the sale of the CET good XD_i subject to the CET aggregation function for XD_i . Thus,

$$E_i = XXD_i \left[\frac{(1-d_{ei})}{d_{ei}} \frac{PD_i}{PE_i} \right]^{\frac{1}{(r_{eie}-1)}} \tag{4}$$

For Canadian wheat exports alone, a downward sloping world demand function is fitted which takes the following form:

$$E_{ied} = A_{ied} \left[\frac{PWE_{ied}}{pwse_{ied}} \right]^{-r_{ied}} \tag{5}$$

where E_{ied} is the export demand for Canadian wheat, A_{ied} is the shift parameter in the export demand equation, $pwse_{ied}$ is the exogenous world price for substituting, and thus competing, exports from other countries, and D_{ied} is the elasticity of export demand for Canadian wheat.

Finally the balance of trade which enters into the model as one of the equilibrium conditions of the system is given by:

$$\sum_i (PWM_i * M_i) = \sum_i (PWE_i * E_i) + FSAV + NETENTROW + NETHHROW + NETGOVROW \tag{6}$$

FSAV (foreign savings), *NETENTROW* (net enterprise transfers to non-residents, *NETHHROW* (net household remittances), and *NETGOVROW* (net government transfers to non-residents) are all exogenously fixed. Thus the balance of trade is set exogenously, the equilibrating variable being the nominal exchange rate.

The Canada-specific CGE model is calibrated using the 1991 base period values for the different variables. Calibration is aided by literature search to determine values of the elasticities. The solution method followed to solve the CGE model is to treat the model as a collection of non-linear algebraic equations and solve the system using GAMS (General Algebraic Modelling System) and the MINOS solver.[7] The full representation of the CGE model, the calibration procedures and the GAMS format of the model is presented in Adilu (1998).

3. The Data and its Compilation

It was necessary to assemble two sets of data for the CGE model. The first set consists of income and expenditure accounts of agents in the model, data on savings and investment, trade and balance of payments, and input-output data. These data were collected or derived for 1991, which is chosen as the base year. The second set of data consists of key parameter values that reflect the structure of the economy. These are the various elasticity measures and calibrated parameters.

Data were necessary for each of the eight sectors into which the Canadian economy is divided. The Statistics Canada convention that a sub-sector is identified by the commodity that constitutes more than 50 per cent of the activities of that sector is followed. The construction of a disaggregated input-output table of intermediate inputs emphasizing the agricultural sector was the biggest challenge in the organization of the data for this model. The existing Statistics Canada input output table has agriculture as just one sector at the M (medium) level or as just two sub-sectors at the L (large) level of disaggregation. In constructing

[7] The sensitivity of the model to the elasticity parameters was assessed by altering the values of these parameters and observing the changes in the comparative static results. Import and export levels are moderately sensitive to the choice of the values of the elasticity parameters (Adilu, 1998).

the disaggregated input-output table, the procedure of Thomassin and Andison (1987) was adapted and applied to the national input-output table of Statistics Canada for 1991, in conjunction with 1991 agricultural census data, also published by Statistics Canada. Other data sources include "Agricultural Financial Statistics", "National Income and Expenditure Accounts", "Canadian Economic Observer", "Fixed Capital Flows and Stocks", and various other Statistics Canada publications.

4. The Implications of Multilateral Trade Agreements for Canadian Agriculture

4.1. Introduction and Background

Anticipated world price changes of the commodities under consideration are simulated together with domestic policy changes to obtain the comparative static (or counterfactual) results of the endogenous variables. The policy changes simulated are the UR agricultural policy change commitments by the Canadian government, including reductions in export subsidies, tariffs and domestic support in Table 1. World price changes for the agricultural products were taken from studies on the global effects of multilateral trade liberalization and introduced exogenously. Since these vary from one study to another, the simulation experiments are conducted twice, once simulating the effect of "minimum" rises in world prices together with the policy change commitments. The second simulation incorporates the effect of "maximum" rises in world prices, with the domestic policy changes of the URA commitments.

Table 1. Summary of Policy and World Price Changes Used in Simulations[a]

	Export Subsidy Reduction (%)	Tariff Rate Reduction (%)	Domestic Support Reduction (%)	World Price Changes (%)	
				"Minimum"	"Maximum"
Wheat	36	64.155	20	4	36.7
Other grains	36	49.928	20	4	16.3
Fruits and Vegetables	36	15.000	20	0	0
Livestock[b]	36	46.613	20	0	0
Milk and Poultry[b]	36	37.141	20	0	0
Other Agriculture	36	15.000	20	4	10
Food[b]	10	22.257	6	1	7.5
"Rest of Economy"	0	37.289	0	0	0

[a] The figures on tariff reduction commitments were as compiled for Zhi Wang (1997), from version 3 (pre-release) Global Trade Analysis Project database, with necessary adjustments for differences in sectoral classifications. The "minimum" world price changes were taken from Frohberg's projection results (1989), while the "maximum"

prices were as reported in the SWOPSIM (1988) model. Other projections, including those of Cahill (1993), and the Provincial and Federal Officials (1994) generally fall within the range as defined by the "minimum" and "maximum" price changes presented in this table for the product groupings used here. Note that the world price changes are assumed to apply for both export and import goods.

[b] Note that processed dairy products are in the food sector, as are meats, other than poultry.

4.2 Scenario 1: The Effects of Changes in Domestic Policy and " Minimum" Increases in World Prices

From the results reported in Tables 2 and 3, it can be seen that the "minimum" increases in world prices from trade liberalization are too small to offset the negative effects on agricultural producers of domestic policy commitments (i.e., the reductions in production associated with reduced tariffs, domestic support and export subsidy). Domestic production (XD) declines in all the agricultural and the food sectors (Table 2). The other grains and wheat sectors in particular experience substantial drops in domestic production. In these two sectors production declines by 13.7 and 9.6 per cent below the base year level, respectively. The least affected is "other agriculture" where production declines by only 0.6 per cent below the base level. Aggregate agricultural production declines by close to 5 per cent while non-agricultural production (which includes food processing and "the rest of the economy") rises by a tenth of one per cent.

Table 2. Results of Simulation 1: Changes in Sectoral Output and Disposition from Base Values[a]

	XD	INT	CONS DD	INVE-ST	INVEN-TORY	GOVDD	E	M
				Per cent				
Wheat	-9.566	-2.834	-4.478	5.072	9.566	-4.592	-12.24	22.587
Other Grains	-13.712	-2.890	-6.981	7.899	13.712	-7.092	-28.74	4.596
Fruit & Vegetables	-2.555	-0.860	-0.729	1.104	2.555	-0.847	-9.211	0.096
Livestock	-4.002	-2.222	-3.788	4.319	-4.002	-3.903	-9.761	5.957
Milk & Poultry	-2.870	-1.704	-3.770	4.299	-2.870	-3.885	-10.29	28.315
Other Agriculture	-0.597	-3.118	-0.456	0.826	-0.597	-0.574	3.647	-15.886
Food Processing	-1.639	-1.110	-0.801	1.177	-1.639	-0.919	-1.547	3.292
Rest of Economy	0.188	0.031	0.209	0.157	0.188	0.090	0.996	0.500
Agriculture	*-4.754*	*-2.266*	*-1.891*	*4.069*	*6.508*	*-3.802*	*-13.22*	*1.389*
Non-agriculture	*0.114*	*-0.005*	*0.138*	*0.160*	*0.299*	*0.087*	*0.910*	*0.599*

[a] The simulation involved the reduction of export subsidies, import tariffs and domestic support pursuant to the Uruguay Round Agreement, and "minimum" increases in world prices of agricultural products.

The changes in sectoral production in agriculture reported above are consistent with the changes in sectoral value added prices (PVA). Under Scenario 1, PVA declines in all the agricultural sectors. In the wheat and other grains sectors this price declines by 2.0 and 1.4 per cent, respectively (Table 3). The value added terms of trade for agriculture decline by 0.2 per cent below the base year level.

Table 3. Results of Simulation 1: Changes in Sectoral Prices from Base Values [a]

	PX	PD	P	PVA	PK	PE	PM	PWE	PWM
					Per cent				
Wheat	4.144	5.425	4.813	-1.979	-0.044	3.367	-1.094	8.624	4.000
Other Grains	5.767	8.492	7.633	-1.421	-0.012	0.827	2.126	4.000	4.000
Fruit & Vegetables	1.149	1.362	0.855	-0.406	-0.079	-0.625	0.432	0.000	0.000
Livestock	3.472	4.318	4.061	-0.757	0.219	-0.709	-1.526	0.000	0.000
Milk & Poultry	4.383	4.594	4.042	-0.461	0.022	-1.000	-12.95	0.000	0.000
Other Agriculture	0.539	0.231	0.577	-1.052	-0.061	3.381	4.385	4.000	4.000
Food Processing	1.187	1.182	0.928	0.111	0.171	1.219	-0.459	1.000	1.000
Rest of Economy	0.033	-0.048	-0.090	0.133	-0.090	0.435	-0.283	0.000	0.000

[a] The simulation involved the reduction of export subsidies, import tariffs and domestic support pursuant to the Uruguay Round Agreement, and "minimum" increases in world prices of agricultural products.

The changes in exports are more pronounced than the changes in production, particularly in the agricultural sectors. For other grains, wheat, milk and poultry, livestock, and fruits and vegetables, exports (E) decline by 28.7, 12.2, 10.3, 9.8, and 9.2 per cent, respectively. However, the exports of "other agriculture" rise by 3.6 per cent. This may reflect the small levels of export subsidies and domestic support in other agriculture in the base period such that their reduction was more than made up for by the increase in the world prices. Furthermore, the domestic price of exports of other agriculture (PE) increases above the base year level and this increase exceeds the rise in the domestic price of other agriculture delivered to

the domestic market (PD), stimulating an increase in exports in this sector. The domestic price of exports of wheat and other grain , fruit and vegetables, livestock and milk and poultry all rise in Scenario 1, but PD rises even more, giving a decline in exports following the simulated changes in domestic policies and the "minimum" increases in world prices. Aggregate exports of agricultural products decline by 13. 2 per cent while exports of non-agricultural products rise nearly one per cent above base year levels.

Import levels (M) of almost all products increase compared to levels in 1991, the base year. This increase is largest for the milk and poultry sector, where imports increase by 28.3 per cent and may be indicative of the relatively high level of import protection accorded to this sector in the base scenario. It is also consistent with the 13 per cent fall in the domestic price of imports (PM) of milk and poultry, the largest fall in PM for any sector. Wheat imports increase by 22.6 per cent, the second highest increase. This reflects the simulated high reduction in tariffs on wheat imports. Imports of the products of the remaining agricultural sectors also increase, except for "other agriculture", though modestly. The domestic price of imports (PM) does not decline for all products in Scenario 1. However, where PM increases, the increase in PD is larger, giving an incentive to import more. Aggregate imports of agricultural products increase by 1.4 per cent, while imports of non-agricultural products increase by 0. 6 per cent above base year levels.

Comparison of the changes in import levels reported above with the URA "minimum access commitments" adopted by Canada is not straightforward since the simulation results are in value terms, while the minimum access commitments apply to quantities. Due to differences in units of measurement, it was only possible to aggregate minimum access commitments according to the sectoral classification of the simulation model for wheat and other grains. Canada's minimum access commitment for wheat is 227,000 MT which exceeds the 171,865 MT increase in imports that occurs in Scenario 1. Imports of "other grains" in the base year are dominated by imports of corn. However, the minimum access commitment for barley is 399,000 MT, which exceeds the 56,910 MT increase in "other grains" in Scenario 1.

Table 4 summarizes the effects of the simulated changes in domestic policies and world prices on factor allocations and the returns to those factors. In Scenario 1, the demand for labour and capital declines in all agricultural sectors but most notably in the other grains and wheat sectors. These economy-wide mobile factors are not picked up by the food industry which also experiences a small decline in the demand for labour and capital. In contrast, primary factor employment increases for both labour and capital in the rest of the economy, since the value added terms of trade deteriorate for agriculture.

Table 4. Results of Simulation 1: Changes in Value Added, Factor Use, and Factor Incomes from Base Values[a]

	VAL-ADDM	VAL-ADDF	LABR	YFLABR	CAPTL	YFCAPL	AGLND	YF-AGLND
				Per cent				
Wheat	-0.121	-11.355	-11.537	-11.355	-11.363	-11.355	-2.344	-11.355
Other grains	2.456	-14.939	-15.113	-14.939	-14.945	-14.939	-6.291	-14.939
Fruit & Vegetables	-1.007	-2.950	-3.149	-2.950	-2.958	-2.950	6.916	-2.950
Livestock	9.961	-4.728	-4.924	-4.728	-4.736	-4.728	4.957	-4.728
Milk & Poultry	13.352	-3.317	-3.516	-3.317	-3.325	-3.317	6.511	-3.317
Other Agriculture	0.197	-1.643	-1.845	-1.643	-1.651	-1.643	8.356	-1.643
Food Industry	-1.384	-1.530	-1.732	-1.530	-1.538	-1.530	0.000	0.000
Rest of Economy	0.314	0.321	0.116	0.321	0.313	0.321	0.000	0.000
Agriculture	*3.491*	*-6.017*	*-5.591*	*-5.397*	*-7.641*	*-6.026*	*0.000*	*-7.719*
Non-agriculture	*0.272*	*0272*	*0.074*	*0.280*	*0.292*	*0.258*	*0.000*	*0.000*

[a] The simulation involved the reduction of export subsidies, import tariffs and domestic support pursuant to the Uruguay Round Agreement, and "minimum" changes in world prices of agricultural products.

Agricultural land use decreases in the wheat and other grains sectors and increases in the remaining agricultural sectors, reflecting the relative changes in value added prices among the agricultural sectors. Value added price falls most in other grains and wheat. There is an increase in the demand for land in the other agricultural sectors, which experience relatively lower declines in value added prices.

Projected changes in returns for labour and capital are similar to the changes in the demand for these factors. Thus, labour and capital income decline more in other grains and wheat than in livestock,

milk and poultry, fruits and vegetables and other agriculture. In the food processing sector, labour and capital income fall while in the rest of the economy the demand for labour and capital increases.[8] In agriculture, aggregate returns to labour, capital and agricultural land decline by 5.4, 6.0 , and 7.7 per cent, respectively. In the food processing sector, labour and capital income each falls by 1.5 per cent, while each increases by 0.3 per cent in the rest of the economy.

Due to the high level of domestic subsidy in agriculture, relative to indirect taxes, value added at market prices (VALADDM) differs substantially from value added at factor costs in most of the agricultural sectors in the base period. As a result, the changes in domestic policies and world prices have differential effects on VALADDM and VALADDF (see Table 4).

In Scenario 1, aggregate variables, such as gross national product, total household income and government revenue show very small changes from base values. For example, gross national product in value added terms increases by less than a tenth of a per cent, while total investment demand increases by 0.3 per cent due to increases in inventory demand. Government revenue declines by 0.2 per cent while total household income increases by a tenth of one per cent.[9]

4.3 Scenario 2: The Effect of Changes in Domestic Policies and " Maximum" Increases in World Prices

The second simulation experiment involves the assumption that world prices for agricultural products increase as a result of the URA by the "maximum" amount indicated in Table 1. The policy changes with respect to reductions in tariffs, export subsidy, and domestic support remain the same as in Scenario 1. Table 5 summarizes the percentage changes from the base period value for the output of the various sectors and the disposition of these, while Table 6 gives the resulting sectoral price changes. In

[8] Because of the technological assumption of constant returns to scale (CRS) in production, the exponents of the Cobb-Douglas production functions for each sector represent factor income distributive shares. Since these parameters are treated as fixed in the simulation experiments, the percentage changes in factor returns are the same across factors within a sector. Consequently, percentage changes in agricultural land income across the agricultural sectors are exactly the same as those for labour and capital. Furthermore, from the CRS assumption, the percentage changes in value added at factor cost are the same as those of the factor incomes across sectors.

view of the wide difference in the simulated changes in world prices in the two scenarios, it is not surprising that the two simulations yield very different results. Table 7 gives the results for value added, factor use and factor income.

Table 5. Results of Simulation 2: Changes in Sectoral Output and Disposition from base Values[a]

	XD	INT	CONSDD	INVEST	INVEN-TORY	GOVDD	E	M
				Per cent				
Wheat	41.108	4.458	-1.724	1.315	-41.108	-1.804	59.436	-60.514
Other Grains	16.496	4.103	-5.189	5.017	-16.496	-5.266	36.283	-8.497
Fruit & Vegetables	-4.626	2.655	-0.906	0.478	4.626	-0.986	-17.166	2.630
Livestock	1.427	5.127	-4.434	4.188	1.427	-4.512	-6.381	14.770
Dairy & Poultry	3.818	5.587	-4.282	4.022	3.818	-4.359	-5.861	39.883
Other Agriculture	5.446	3.212	-2.200	1.807	5.446	-2.279	15.074	-22.541
Food Processing	5.897	2.762	-0.808	0.379	5.897	-0888	24.962	-11.166
Rest of Economy	-0.413	-0.011	0.307	-0737	0.413	0.226	-0.830	1.621
Agriculture	*9.088*	*4.694*	*-2.336*	*3.714*	*-24.38*	*-3.281*	*29.615*	*-1.106*
Non-agriculture	*-0.155*	*0.077*	*0.229*	*-0.735*	*0.795*	*0.223*	*0.049*	*1.171*

[a] The simulation involved the reduction of export subsidies, import tariffs and domestic support pursuant to the Uruguay Round Agreement, and "maximum" changes in world prices of agricultural products.

Table 6. Results of Simulation 2: Changes in Sectoral Prices from Base Values[a]

	PX	PD	P	PVA	PK	PE	PM	PWE	PWM
				Per cent					
Wheat	7.208	0.311	1.837	4.148	-0.206	10.531	29.047	17.014	36.70
Other Grains	7.617	4.466	5.559	3.031	-0.168	11.921	13.364	16.300	16.30
Fruit & Vegetables	2.182	2.591	0.996	1.040	-0.212	-1.357	-0.307	0.000	0.000
Livestock	3.967	5.049	4.725	1.722	0.142	-1.440	-2.252	0.000	0.000
Milk & Poultry	4.897	5.153	4.558	1.147	-0.096	-1.729	-13.59	0.000	0.000
Other Agriculture	2.398	1.715	2.332	2.300	-0.116	8.540	9.594	10.000	10.00
Food Industry	1.199	0.186	0.896	0.050	0.061	6.940	5.167	7.500	7.500

[9] Detailed results for these variables are in Adilu (1998).

Rest of Economy	-0.095	-0.053	-0.226	-0.010	-0.226	-0.304	-1.018	0.000	0.000

[a] The simulation involved the reduction of export subsidies, import tariffs and domestic support pursuant to the Uruguay Round Agreement, and "maximum" changes in world prices of agricultural products.

Table 7. Results of Simulation 2 : Changes in Value Added, Factor Use, and Factor Incomes from Base Values[a]

	VAL-ADDM	VAL-ADDF	LABR	YF-LABR	CAPTL	YF-CAPTL	AG-LND	YF-AGLND
				Per cent				
Wheat	67.105	46.961	47.149	46.961	46.601	46.961	21.913	46.961
Other Grains	45.853	20.026	20.179	20.026	19.732	20.026	-0.431	20.026
Fruit & Vegetables	-1.706	-3.634	-3.511	-3.634	-3.869	-3.634	-20.058	-3.634
Livestock	19.220	3.174	3.306	3.174	2.922	3.174	-14.411	3.174
Milk & Poultry	23.661	5.009	5.143	5.009	4.752	5.009	-12.889	5.009
Other Agriculture	9.801	7.871	8.009	7.871	7.607	7.871	-10.514	7.871
Food Processing	6.108	5.951	6.086	5.921	5.691	5.921	0.000	0.000
Rest of Economy	-0.410	-0.403	-0.276	-0.403	-0.647	-0.403	0.000	0.000
Agriculture	*24.613*	*14.549*	*10.108*	*9.968*	*15.059*	*15.644*	0.000	*22.257*
Non-agriculture	*-0.247*	-0.*233*	*-0.135*	*-0.262*	*-0.576*	*-0.185*	0.000	*0.000*

[a] The simulation involved the reduction of export subsidies, import tariffs and domestic support pursuant to the Uruguay Round Agreement, and "maximum" changes in world prices of agricultural products.

If world prices were to increase by the "maximum" amount, the URA would affect domestic production (XD) positively in all sectors except for fruits and vegetables and the rest of the economy. The highest increase in XD occurs in the wheat sector which, compared to base year levels, increases by 41.1 per cent. The next highest increase in XD is in other grains (by 16.5 per cent). Aggregate agricultural production increases by 9.1 per cent above the 1991 level. Although production in the food industry increases by close to 6 per cent, output in the non-agriculture sector as a whole drops by 0.2 per cent.

Reflective of the changes in sectoral outputs are the changes in sectoral value added prices (PVA) presented in Table 6. These rise in all sectors except in the "rest of the economy". Corresponding to sectoral output results, the largest rise in PVA is for wheat, followed by that of other grains.

In Scenario 2, exports increase and imports decrease in the wheat, other grains, other agriculture, and food processing sectors. In the remaining agricultural sectors, exports decrease and imports increase. Aggregate agricultural exports increase by close to 30 per cent, while aggregate agricultural imports decline by 1.1 per cent. The export/import results reflect the changes in the domestic price of exports (PE) relative to the domestic price of imports (PM). The ratio (PE)/(PM) increases for those products with increased exports and decreased imports, and vice versa (Table 6).

Productive investment demand by sector of origin (ID) increases in all but the "rest of the economy". Both private and government consumption of all agricultural products decline in Scenario 2, but consumption increases for "rest of the economy" products, due to the comparative price advantage of non-agricultural products over agricultural products; in this scenario the domestic price terms of trade for agriculture increased by 4.8 per cent.

Both value added measures (VALADDM and VALADDF) increase in all sectors except for fruits and vegetables, and the rest of the economy. Their highest increase occurs in the wheat sector where VALADDM increases by 67.1 per cent while VALADDF increases by 46.9 per cent. The next highest increase is in "other agriculture". Value added at factor cost increases by an average of 14.5 per cent in agriculture, and declines by 0.3 per cent in the non-agricultural sector (see Table 7).

Percentage changes in sectoral demand for labour and capital inputs are closely related to the changes in sectoral value added at factor cost. Thus, by far the largest percentage increase in the demand for the two primary inputs occurs in the wheat sector where the demand for labour and capital increases by 47.2 and 46.6 per cent, respectively. The next largest increases in the demand for the two factors of production are in other grains and other agriculture.

The specificity of agricultural land to agricultural activities means that the change in demand for agricultural land need not follow the same pattern as the demand for labour and capital. Consequently, the demand for agricultural land increases only in the wheat sector (by 22.9 per cent). In the fruits and vegetables sector, demand for agricultural land declines by 20 per cent. In the livestock, dairy and poultry,

other agriculture, and other grains sectors, the demand for land declines (by 14.4, 12.9, 10.5 and 0.4 per cent, respectively).

The effect of the URA domestic policy commitments when "maximum" increases in world prices of agricultural products apply raises the returns to agricultural land by (22.3 per cent), followed by increases in the returns to capital (15.6 per cent). Labour income increases by 9.9 per cent. In the non-agricultural sector, both labour and capital income decline slightly by 0.3 per cent each, although in the food processing sector these returns increase by close to 6 per cent each. Nominal GNP at value added prices and aggregate investment decline by a fraction of one per cent and by half a per cent, respectively. Total household income increases by less than a tenth of one per cent, while government revenue decreases by 0.5 and 1.8 per cent, respectively. Total savings decline by 0.9 per cent.[10]

4.4 Scenario 3: The "Break-even" Changes in World Prices

For several reasons, it is of interest to pursue an alternate approach to the treatment of changes in world prices than in the preceding two scenarios. There are wide differences between the "minimum" and "maximum" changes in world prices simulated in the previous two scenarios and very different results obtain from them. In addition, since the world price changes are introduced exogenously, there is no theoretical basis to justify either set, and their derivation in previous global studies may have related more to the interests of particular researchers in particular commodities than to the entire set of commodities that are assessed in this model. Thus it is of interest to determine the percentage changes in world prices which, together with the domestic policy commitments used in the previous two simulations of the UR Agreement, would leave Canadian agricultural producers neither "worse off" nor "better off" by some criterion. The

[10] Some changes in the macro variables in Scenario 2 contrast with those under Scenario 1, since these variables are sensitive to situations in the "rest of the economy". This is by far the largest of the eight sectors in the model and decisively dominates the values and related percentage changes in the macro variables.

criterion chosen for this purpose is the level of domestic production (XD) for each sector.[11] The world prices that would be required for this are termed "break-even" price changes.

Two experiments are conducted in this scenario. In the first of these, the world prices of the two crop sectors, and other agriculture, and the meat and dairy products included in the processed foods sector are adjusted. Thus the objective of Experiment 1 is to find the required world price changes that would counterbalance the effects of the simulated policy changes for producers in the wheat, other grains, other agriculture and food processing sectors. The restriction of world price changes to these sectors allows comparisons with the results of the first two scenarios. This sectoral restriction of price changes is removed in Experiment 2. In the second experiment, the world prices of all agricultural products are adjusted. In each case, a Walrasian tatonment type procedure is used to determine the "break-even" world prices of agricultural products.[12]

Table 8 presents the results of the two experiments, in terms of the percentage changes in the world prices of agricultural products that would be required to offset the negative effects of reductions in domestic agricultural support, export subsidies and import tariffs on the domestic production of agricultural products.

Table 8. Estimated "Break-even" Changes in World Prices[a]

Commodity	Experiment 1	Experiment 2
	Per cent	
Wheat	10.829	10.865
Other Grains	10.586	10.318
Fruits and Vegetables	0.000	2.640
Livestock	0.000	5.889

[11] It is maintained that the response of farmers to the simultaneous changes in world prices and domestic policies is better reflected in their decision of how much to produce, than any other measure in the context of the CGE model used in this study. Given the assumption that the base year defines an equilibrium state in production, as in any other economic activity, a zero change in domestic production under the present exercise would imply that producers are neither "worse off" nor "better off" as a result of the simultaneous changes in world prices and domestic policies.

[12] In this process, after changing the domestic policy parameters by the magnitudes involved in the Uruguay Round policy commitments, the world prices of the relevant commodities are adjusted on a piecemeal basis until the model reproduces the relevant (XD) base-year values for the specific sectors.

Milk and Poultry	0.000	12.974
Other Agriculture	3.918	1.880
Food Processing	2.530	2.299
Rest of Economy	0.000	0.000

[a] Note that the food sector also processes products other than livestock and dairy products. Since the world prices of other food products than processed livestock and dairy products are assumed to remain fixed in Experiment 1, the 2.5 per cent average sectoral increase understates the world price increase for processed livestock and dairy products. To estimate the increase actually required in the world price of processed livestock and poultry products, it is necessary to multiply 2.5 by the reciprocal of the share of meat and dairy products in total exports of processed food products. By a conservative estimate, the world price of meat and dairy products would be three times as high, i.e., would need to increase by 7.5 per cent, in terms of this particular experiment.

From Experiment 1, a 10.8 per cent rise in the world prices of Canadian wheat is required to offset the effect of agricultural trade policy changes on Canadian wheat producers. The world price of other grains must increase by 10. 6 percent to leave the producers of other grains unaffected by the policy changes. Required world price changes for producers in the “other agriculture” and food processing sectors are 3.9 and 2.5, respectively.

Exports increase and imports decline for the wheat, other grains, other agriculture and food processing sectors, for which world prices increase. Opposite changes take place in the exports and imports of the other agricultural sectors. The factor allocations results are of interest. In the wheat, other grains, and remaining agriculture sectors, the demand for agricultural land tends to increase more than for labour and capital in this scenario, while in the food processing sector, where agricultural land is not a factor of production, capital is substituted for labour. In the rest of the economy, both capital and labour demand increase. In the fruits and vegetables, livestock, and milk and poultry sectors, demand for both factors declines.

In Experiment 2, world prices of all commodities except for the products of the rest of the economy are adjusted to leave the sectoral production levels of agricultural producers and the food processing industry unaffected from the URA policy commitments. For this to occur, the world price of wheat has to rise by 10.9 per cent, while the world prices of other grains, other agriculture and processed food products have to rise, respectively, by 10.3, 1.9, and 2.3 per cent (Table 8). The largest increase in world prices -- close to 13 per cent -- is required for milk and poultry products. Since this sector is relatively highly subsidized and protected in the base period, this outcome is consistent with expectations.

World prices for fruits and vegetables and livestock have to increase by 2.6 and 5.9 per cent, in order to offset the effects of domestic policy changes on production in those sectors.

Other results for this experiment, specifically the effects on the various endogenous variables, are only briefly discussed here. Domestic production (XD) does not change in any sector. This is also true for intermediate inputs and inventory demands. Since domestic production is unchanged in each sector, the assumption of profit maximization dictates that resource allocations also remain unchanged in each sector. Hence, no changes occur in primary input demands in any sector. Factor returns, and thus by implication, value added at factor cost are also unchanged.

Exports increase in almost all sectors indicating that the world price changes have a greater positive impact on exports than the negative impact of reductions in export subsidy, domestic support and tariffs.[13] Exports rise most in the milk and poultry sector (by 10.3 per cent), and least in other agriculture (by -0.2 per cent). Imports of all agricultural products decline, except for milk and poultry products. Since the tariff rate on milk and poultry products is relatively high in the base year (1991), its reduction more than offsets the negative effect of increased world prices on imports. Exports and imports of processed food increase, respectively, by 3.6 and 0.3 per cent.

5. Summary and Conclusions

This paper evaluates the impacts on the Canadian agriculture of multilateral trade liberalization in a general equilibrium framework using a single-country CGE model. The impacts on the Canadian economy and the specified sectors were assessed by simulations involving changes in both external prices and domestic policy. The results show that the URA affects Canadian agriculture negatively if world prices increase by only the “minimum” of global projections. That is the “minimum” increases in projected world prices are too small to offset the negative effects of the reductions in tariffs, export subsidies and domestic support on farm production and income for Canadian agricultural producers. Production and exports are hardest hit within agriculture in the other grains and wheat sectors, in that order. Imports of most agricultural products increase and this was greatest for the milk and poultry sector. The food processing sector was affected similarly; production and exports of processed foods decline, while imports increase. The opposite is true of the “rest of the economy”. With the “minimum” increases in world export prices,

labour and capital use decline in all the agricultural sub-sectors, as do factor incomes and value added at factor cost.

If world prices were to change by the "maximum" amount, however, there are clear aggregate gains for Canadian agricultural producers from the 1994 URA commitments. In this scenario, total agricultural production and total agricultural exports increase . This increase in domestic production and exports is largest for wheat and then for other grains. Imports of crop products fall substantially, while imports of non-crop agricultural products increase, particularly in the case of milk and poultry. In this scenario, mobile factors move from the non-agriculture sector into agriculture. Within agriculture, the labour and capital demand increase is highest in the wheat sector. Value added at factor cost and factor incomes also increase the most in the wheat and other grains sectors, in that order. The increase in factor returns for land is higher than for capital and labour.

In summary, the effect of the 1994 URA on Canadian agriculture can be either negative or positive, depending on the extent of world price changes. A further inquiry was therefore pursued to determine the "break-even" world price changes, defined as the magnitude of price changes that would generate unchanged sectoral levels of output of Canadian agricultural producers; the highest level of price increases would be required for milk and poultry. The computed "break-even" price changes are in general closer to the "minimum" than the "maximum" world price changes. If equal probability is given to the occurrence of the "minimum" and " maximum" world price changes, the Canadian farm sector in aggregate has gained from the URA. In general the benefits from trade are greatest in grains and oilseeds (wheat and other grains), other agriculture, and food processing. In these sectors, factor demand and factor returns are appreciably increased for land, labour and capital. Benefits in the other agricultural sectors from trade liberalization are also evident if export prices increase due to trade liberalization.

[13] While domestic support reductions have a direct effect on domestic production (XD), their effect on exports is indirect.

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