RURAL ECONOMY

**GATT Liberalization and World Grain Markets:
Potential and Constraints for Western Canada**

Michele Veeman, Terrence Veeman and Shiferaw Adilu

Project Report 98-03
Farming For the Future Project 950605

Project Report

Department of Rural Economy
Faculty of Agriculture & Forestry,
and Home Economics
University of Alberta
Edmonton, Canada

GATT Liberalization and World Grain Markets:
Potential and Constraints for Western Canada

Michele Veeman, Terrence Veeman and Shiferaw Adilu

Project Report 98-03
Farming For the Future Project 950605

Table of Contents

Summary

This project evaluates the impacts of the Uruguay Round Agreement (URA) on the grains sector and on other major subsectors of Canadian agriculture in a single-country general equilibrium framework. For this purpose a computable general equilibrium model of the Canadian economy that consists of six agricultural and two non-agricultural sectors was constructed. Categorization of the agricultural sectors was based on the magnitudes of various commodities, the focus of the study 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. The model was calibrated on 1991 data and a series of simulation experiments were conducted to assess the impacts of the URA and various other policy interventions. For some of these, a recursive dynamic model structure was developed and applied, in order to better assess the staged adoption, over the six-year implementation period, of the URA commitments. In the dynamic simulations, provision was made for sectoral productivity growth and year-by-year adjustment in factor inputs. In the other simulations the usual CGE model procedure of a comparative static approach was followed.

To assess whether Canadian agriculture benefits from the URA, two sets of anticipated changes in world prices, taken from global studies of multilateral trade liberalization, were simulated, together with the URA policy commitments by Canada. These simulation experiments show that the minimum increases in world prices projected by global studies of the URA are too small to offset the negative effects on Canadian agriculture of the reductions in tariffs, export subsidies and domestic support from the URA

commitments, relative to the base period. However, if world prices were to change by the maximum level of projections of global URA effects, Canadian agricultural producers in aggregate 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 was conducted to determine the extent of the world price changes for agricultural exports that would just 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.

Other components of the project compared the relative importance of the three Canadian URA policy commitments (i.e. reductions in tariffs, export subsidies and domestic support). In terms of these URA commitments for Canada, the domestic support reductions were found to have the largest impact on domestic production, factor allocations and exports. Canada's tariff reduction commitments had the least negative impact on Canadian agriculture.

Three further experiments involved i) attributing export subsidy reductions by Canada to other reasons than the URA, ii) introducing compensatory transfers to agricultural households in the amount of

the domestic support reduction commitment, and iii) simulating the total withdrawal of the grain export subsidy that was previously delivered through grain transportation subsidies, with an accompanying $1.6 billion dollars compensation payment to prairie land owners.

The latter experiment embodies major changes associated with the deletion of grain transportation subsidies in 1995 and the associated one-time compensatory payment to land owners that was introduced in that year. This experiment is conducted over a simulated 6-year period. The results of this experiment again point to the importance of the exogenously determined world prices on the Canadian grain and livestock sectors. With the minimum level of world grain prices, the results for the livestock sector from lower levels of feedgrain prices are marked and are seen in higher levels of production and exports; these increase, but to a lesser extent, with the maximum levels of world prices. If the world price increase from trade liberalization is to the maximum level of global projections, prairie farm household income quickly recovers from the effects of higher grain transportation costs and production and exports of wheat and other grains recover, although more slowly, from the subsidy removal.

The final section of the study involved consideration of the various constraints that limit full achievement of the potential benefits to Western Canadian farmers of multilateral trade liberalization. The identified constraints include those associated with physical, regulatory and institutional features of Canadian grain production, handling and exportation. Other constraints arise from the limitations of the partial liberalization of world trade that was in fact achieved in the URA. The URA maintained the use of export subsidization by major trading countries, since this was subject to only partial roll-back; the URA provided only for partial roll-backs of domestic support. Both of these constraints adversely affect the world market for grains in particular.

One major implication from the results of this study is that there are very clear positive gains to Canadian agriculture from a multilateral trade agreement that achieves the "maximum" level of potential world price increases from trade liberalization. In these circumstances, total agricultural production and exports increase, as do household income and factor returns.

In general the benefits from trade are greatest in grains and oilseeds (wheat and other grains), other agriculture, and food processing sectors. 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.

Our study of constraints indicates that a variety of national and international influences may constrain the beneficial impacts of multilateral trade liberalization on Canadian agriculture. The compelling evidence of the importance of world price influences on Western Canadian agriculture, and particularly on the grains sector, highlights the importance of achieving a more complete liberalization of world trade. Currently, the prairie grains sector also faces difficulties associated with very sluggish and uncertain demand prospects in Eastern Europe and Asia wherein retarded economic growth is greatly compounding the effects of incomplete world trade liberalization. More complete trade liberalization would be achieved by the complete elimination of export subsidies by major exporters, specifically the EU and US, more open access to restricted markets in the EU and a more effective discipline on domestic support to the farm sector in both nations.

1.1   Introduction: Rationale for the Study

This research project focused on the effects of the outcome of the Uruguay Round multilateral trade agreement of the General Agreement on Tariffs and Trade (GATT), effected through the World

4

Trade Organisation (WTO). The 1994 Agreement on Agriculture provided the promise of improvements in export prices and revenues arising from reductions in export subsidies and greater opportunities for exports to less distorted markets for Canadian grains and other commodities. However, the uncertainties about the nature of these impacts, the possibility that constraints might impede their achievement, and the importance of both the grains and livestock sectors for the Western Canadian economy pointed to the need for a comprehensive analysis of the impact of the multilateral trade agreement on the Western Canadian agriculture.

1.2   Objectives of the Study

The objectives of this project were:

(1) to provide an initial qualitative assessment of the impact of the Uruguay Round provisions for grains on the Western Canadian and Alberta grain sectors, based on a review of previous simulations and studies of world trade liberalization and an assessment of the GATT Agricultural Agreement provisions.

(2) to develop a quantitative assessment of the potential impact of the GATT Agricultural Agreement provisions for grains on grain producers in Western Canada and Alberta.

(3) to provide a general qualitative assessment of the impact of potential changes in export market prospects for grains on the Western Canadian and Alberta livestock sectors; and

(4) to identify technical and institutional constraints perceived by knowledgeable trade participants that may constrain achievement of grain export market potentials.

The AARI research committee that reviewed the proposal requested that we assess the discontinuation of the western grain transportation subsidy, this was also accommodated within our research plan.

1.3   Research Plan

The research plan that was followed involved:

Step 1. Previous studies assessing impacts of various scenarios of world trade liberalization on price levels and traded volumes of grains were reviewed; this included a critical assessment of their implications for Western Canadian agriculture.

Step 2. An initial qualitative assessment of the nature and impacts of the Agricultural Agreement provisions of GATT on world grain markets was developed. This focused on major categories of import markets and major competing export sources.

Step 3. A review was made of alternative major methodologies and concepts to assess the impact, on the Western Canadian grains sector, of the Agriculture Agreement provisions of the Uruguay Round of GATT. Based on this assessment it was determined that the most appropriate way to accommodate the objectives of the study was to develop a computable general equilibrium (CGE) model of the Canadian economy, focusing primarily on the agriculture sector.

Step 4. Based on steps 1-3 above, we developed a CGE model, disaggregated into major agricultural subsectors, in order to assess potential major impacts arising from the GATT agreement provisions on both the Canadian grains and livestock sectors. The details of this model and the simulation experiments performed on it in order to achieve the objectives of the project are summarised later in this report.

Step 5. In addition, we used the CGE model to assess the implications of the GATT agreement for the livestock sector. The choice and development of the CGE model facilitated this assessment. In the course of the assessment, as had been requested by the AARI research committee, we analysed the

impact of discontinuance of the Western Grain Transportation subsidy on both the grain and livestock sectors.

Step 6. Finally, we conducted an extensive review of literature and engaged in a series of informal interviews with qualified analysts and other people knowledgeable about the agricultural sector in order to identify technical and institutional constraints that may limit the achievement of the potential impacts of the multilateral trade liberalization for grains. We have assessed these constraints in the light of the findings from the analysis summarised above.

The major components of the project were encompassed in the PhD thesis research project of Shiferaw Adilu (Adilu, 1998); subsequent extensions of his thesis research project were undertaken to accommodate the request of the AARI committee relating to discontinuance of the grain transportation subsidy and to assess limiting constraints of the 1994 URA for grains.

2. Overview of the Uruguay Round Agreement

A major achievement of the Uruguay Round Agreement (URA) was that it brought the liberalization of trade in agricultural products into the domain of the General Agreement on Tariffs and Trade (GATT) and 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 United States (US) and the European Union (EU) 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 URA also put quantitative restrictions on certain types of domestic support for agriculture. In developed countries, domestic agricultural support considered to be

---

[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.

"amber" (i.e., subsidies viewed to distort production and trade) are subject to 20 per cent reduction from 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 conclusion of the URA 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 on average. 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)

---

[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 support must be

was based on a liberalization scenario and a base period which was close to the final agreement of the

URA. Using a Trade Analysis Simulation System (TASS), this study projected a modest increase in the

world price of grains and oilseeds (a maximum of 5 per cent increase for wheat from the base period).

Substantial increases were projected for dairy product prices (a 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 Anderson and Tyers (1987, 1988), and

Parikh, et al (1988).[4]

A common conclusion of the majority of the studies previous to the conclusion of the URA 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 Agreement on Agriculture.

Some assessments have been conducted following the conclusion of the URA 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).

---

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).

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 producers having to pay higher freight costs. Subsequently, and largely for budgetary purposes, Canadian grain transportation subsidies were terminated in 1995.

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 was 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

livestock and other agricultural sectors; and iii) evaluating the implications for factoral income distribution and intersectoral transfer of factors of production.

## 3.	Methodology: Development of the CGE Model

### 3.1	*The General Features of the Model*

A computable general equilibrium (CGE) model of the Canadian economy that emphasizes the agricultural sectors of the 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, the focus of the study 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 net 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]

---

[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 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 savings driven.

3.2   The Incorporation of International Trade Effects

As discussed previously, 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 prices of imports and exports to world prices of the same. More specifically, the domestic import price of a given commodity is equal to the exogenous

world import price adjusted for tariff and the exchange rate. Likewise, the domestic price of an export product is equal to the world price of the same product adjusted for export subsidies and the exchange rate. 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, the world price of Canadian wheat is endogenous to the system. Sensitivity analysis was applied to assess the impact of this assumption of the model.

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 (which is an aggregation of imports and domestic supply). Import demand for a given good is then obtained by minimizing the cost of purchasing imports and domestic goods subject to the CES aggregation function. 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 and domestic supply are aggregated into a composite good by a Constant Elasticity of Transformation (CET) function. Export supply of a given product is then obtained by maximizing revenue from the sale of exports and domestic deliveries subject to the CET aggregation function. For Canadian wheat exports alone, a downward sloping world demand function is fitted. Finally the balance of trade enters into the model as one of the equilibrium conditions of the system.

The Canada-specific CGE model was calibrated using the 1991 base period values for the different variables. Calibration was aided by literature search to determine values of the elasticities.[7] The solution method to solve the CGE model involved treating the model as a collection of non-linear algebraic

---

[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).

equations and solving the system using GAMS (General Algebraic Modelling System) and the MINOS solver. The full representation of the CGE model, the calibration procedures and the GAMS format of the model is presented in Adilu (1998).

4.   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.[8] 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.

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 medium level of disaggregation or as just two sub-sectors at the large level of disaggregation. In constructing 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.

---

[8] Since this was, at the time, the most recent year for which census data were available.

5.   The Implications of the Multilateral Trade Agreement for Canadian Agriculture

5.1   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 URA agricultural policy change commitments by the Canadian government, including reductions in export subsidies, tariffs and domestic support as reported 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	Tariff Rate	Domestic Support	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.

5.2   *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.

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.

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

18

increase in the world prices. Furthermore, the domestic price of exports (PE) of other agriculture

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, resulting in 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.

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

	XD	INT	CONS	INVEST	INVEN	GOVDD	E	M
				Per cent				
Wheat	-9.566	-2.834	-4.478	5.072	9.566	-4.592	-12.24	22.587
Other Grains	-	-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.
XD is output; INT is intermediate inputs; CONS is domestic consumption; INVEST is investment demand; INVEN is inventory demand; GOVDD is government demand; E is exports and M is imports.

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.
PX is the aggregate price of output; PD is the price of domestic deliveries; P is the aggregate price of imports and domestic
deliveries; PVA is the value added price; PK is the price of capital; PE is the domestic price of exports; PM is the domestic price
of imports; PWE and PWM are the world prices of exports and imports, respectively.

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. This 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 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 (Table 2). However, where PM increases, the

20

increase in PD is larger, giving an incentive to import more, i.e., imports declined only when the rise in PM is greater than the rise in PD. 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 (LABR) and capital (CAPTL) 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, for which the value added terms of trade improve.

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. VALADDM is value added of market price; VALADDF is value added at factor cost; LABR is labour usage; YFLAB is labour income; CAPTL is capital usage; YFCAP is capital income; AGLND is agricultural land use; YFAGLND is agricultural land income.

Agricultural land (AGLND) 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 in this simulation.

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 labour and capital income increases.[9] 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 labour and capital income each increase 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 in the base period, value added at market prices (VALADDM) differs substantially from value added at factor costs (VALADDF) 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.[10]

5.3   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

---

[9] 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.

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

various sectors and the disposition of these, while Table 6 gives the resulting sectoral price changes. Table 7 gives the results for value added, factor use and factor income. In 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 5. Results of Simulation 2: Changes in Sectoral Output and Disposition from base Values[a]

	XD	INT	CONSD	INVEST	INVEN	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.
XD is output; INT is intermediate inputs; CONSD is domestic consumption; INVEST is investment demand; INVEN is inventory demand; GOVDD is government demand; E is exports and M is imports.

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 (this increases 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.

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
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.
PX is the aggregate price of output; PD is the price of domestic deliveries; P is the aggregate price of imports and domestic deliveries; PVA is the value added price; PK is the price of capital; PE is the domestic price of xports; PM is the domestic price of imports; PWE and PWM are the world prices of exports and imports, respectively.

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 and import results reflect the changes in the domestic price of exports (PE) and the domestic price of imports (PM). Thus (PE) and (PM) increase for those products with increased exports and decreased imports, respectively, 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 increase by 4.8 per cent.

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

	VAL-ADDM	VAL-ADDF	LABR	YFLABR	CAPTL	YFCAPTL	AGLND	YFAGLND
	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. VALADDM is value added of market price; VALADDF is value added at factor cost; LABR is labour usage; YFLAB is labour income; CAPTL is capital usage; YFCAP is capital income; AGLND is agricultural land use; YFAGLND is land income.

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 most 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.[11]

5.4   Scenario 3: Estimating "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 to that taken in the preceding two scenarios. There are wide differences between the

---

[11] 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.

"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, given 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 criterion chosen for this purpose is the level of domestic production (XD) for each sector. [12] 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, 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 tatonnment type procedure is used to determine the "break-even" world prices of agricultural products.[13]

---

[12] 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.

[13] 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.

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
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.

At these "break-even" prices, 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 the other 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, respectively, 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.

31

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. 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.

5.5   Scenarios 4 Through 7: Various Analyses and Extensions of the CGE Model

Other scenarios that were analysed in the course of the project compared the relative importance of the three Canadian URA policy commitments (i.e. reductions in tariffs, export subsidies and domestic support). In terms of these URA commitments for Canada, the domestic support reductions were found to have the largest impact on domestic production, factor allocations and exports. Canada's tariff reduction commitments had the least negative impact on Canadian agricultural production, factor allocations and exports. Three further experiments involved i) attributing export subsidy reductions by Canada to other reasons than the URA, ii) introducing compensatory transfers to agricultural households in the amount of the domestic support reduction commitment, and iii) simulating the total withdrawal of the grain export subsidy that was previously delivered through grain transportation subsidies, with an accompanying $1.6 billion dollars compensation payment to prairie land owners. (The latter embodies the changes associated with the deletion of grain transportation subsidies in 1995 and the associated one-time compensatory payment to land owners that was introduced in that year). Further details on all these, except for (iii) above, are given in Adilu (1998). One extension of the CGE model that was developed in the course of the

project departed from the comparative static approach that is a standard form of CGE models. In this extension, a recursive dynamic model structure was developed and applied, in order to better assess the staged adoption, over the six-year implementation period, of the URA commitments. In these simulations, provision was made for sectoral productivity growth and year-by-year adjustment in factor inputs.

5.6   Scenario 8: Total termination of WGTA Subsidy and $1.6 Billion Payment to Landowners

Following the repeal of the Western Grain Transportation Act (WGTA), and the elimination of the associated Western grain transportation subsidy, which was recognized to be analogous to an export subsidy for grain, the Government of Canada extended a one-time payment to owners of farmland of C$ 1.6 billion under the Western Grain Transportation Payments Program (WGTPP). The impacts of the elimination of the Western Grains Transportation Subsidy and this one-time payment to owners of farmland were assessed using the CGE model, as discussed below. This simulation was built upon the framework of the recursive dynamic version of the model, noted in general above and discusssed in detail in Adilu (1998). The effect on farm household incomes and other endogenous variables of the termination of the transportation subsidy and the one-time compensatory payment is modelled in the following way. In view of the total elimination of the transportation subsidy, which was the main form of export subsidy for Prairie grain producers, the one-time payment compensatory payment is introduced into the CGE model in the first year of the six-year projection period. The transportation (or export) subsidies also are entirely removed in the first year. The model is then solved in a dynamic recursive manner over the six years, with the dynamic features coming from the annually updated factor supplies and the technological change that is assumed for the sector, based on the evidence of previous trends in productivity. All other URA policy and world price changes are introduced in a piecemeal manner. The advantage of the recursive dynamic

model over the static model in this context is that the base scenario changes every year, capturing the effect of resource reallocations arising from the changes in certain parameters in the previous year. However, in order to be able to compare these results with the comparative static simulation results presented previously, in the following discussion, the direct effect on the different endogenous variables of the changes in factor supplies and technology have been deducted.

5.6.1 *The Findings from Scenario 8*

Effects on Household Income: The one-time payment is granted directly to owners of farmland and thus reaches farm households indirectly. Households were grouped into three groups: Prairie farm households, other farm households, and non-farm households. Labour is also grouped into three groups: Prairie agricultural labour, other agricultural labour, and non-agricultural labour.

Assuming that world prices increase by the minimum level, and that the other URA policy commitments are in place, the income of prairie farm households increases by some 22 per cent, compared to the base (1991) level, in the year of the introduction of the compensatory payment. In the minimum price scenario, in the remaining years of the projection period, prairie farm household income declines slightly relative to the base year, due to the termination of export subsidies and the other URA policy commitments. This decline is in the order of three to four per cent below the base level. However, if world prices were to change by the maximum level, due to the URA, the income of prairie farm households increases by 24 per cent in the first year. In the following two years, prairie farm household income declines only marginally below base level, and in the remaining years of the projection period, this shows a rising trend, becoming four per cent higher than the base level by the end of the six-year projection period. Incomes of other (i.e. non-prairie) agricultural households are negatively affected

throughout the projection period, with minimum increases in world prices, although this is not a substantial effect. With the maximum increases in world prices, the incomes of the non-prairie farm households rise above the base level in the last three years of the projection period.

Effects on Other Variables: While the compensatory payment can be expected not to have any significant effect on such variables as domestic production and exports, the total removal of the transportation (export) subsidy has a substantial effect on these variables. With minimum increases in world prices, exports of wheat and other grains remain below the base year levels throughout the projection period. Starting with a 23 per cent decline in the first year, wheat exports are about 10.5 per cent below the base level, by the end of the projection period. Likewise, exports of other grains decline by about 35 per cent in the first year. By the end of the projection period these are 17 per cent below the base levels. Production of wheat and other grains are less adversely affected by the total elimination of the WGTS. Production of wheat and other grains decline, respectively, by 15.5, and 14 per cent in the first year, but show a rising trend over the remaining years of the projection period.

With maximum increases in world prices, exports of wheat and other grains still decline, respectively, by 15 and 30 per cent in the first year. However, wheat exports recover faster with maximum world prices and rise above the base year level beginning in the third year. By the end of the projection period, these are 37 per cent higher than the base levels. Exports of other grains rise above base levels only in the last year of the projection period. Production of wheat is 9.4 per cent below the base level in the first year, but rises over the projection period to be 29 per cent higher than the base level by the end of the projection period. Likewise, the production of other grains trends upward after the first year, crossing the base level in the fourth year, and reaching about 9 per cent higher than the base level by the

35

last year of the projection period. The impacts of the removal of the grain transportation subsidy on the livestock and the milk and poultry sectors arise from the effects of lower prices for domestic feedgrain that result from removal of the grain transportation subsidy. Cheaper feedgrain prices benefit the livestock and milk and poultry sectors. The contrast in effect is intensified since the simulations incorporate constant world prices for livestock and milk and poultry and price increases (to either minimum or the maximum levels) for grains. Under the assumption of minimum increases in world prices, the production of livestock rises steadily over the projection period, reaching a level about seven per cent higher than the base level by the last year of the projection period. Livestock exports also grow, at a moderate rate, over the projection period. In the last year of the projection period, exports of livestock rise to a level that is 5.5 per cent higher than in the base period. Milk and poultry production also exhibits a rising trend, comparable to that of the livestock sector. In the last year of the projection period, milk and poultry production has risen by 6.2 per cent. Exports of the same have risen modestly; in the last year of the projection period these have risen only by 2.5 per cent relative to the base levels.

Under the assumption that the world price of grains and processed food products increase by the maximum levels, and ignoring restraints on domestic production from supply management in the milk and poultry sectors, the production of the milk and poultry sectors as well as livestock increases over the projection period. In the last year of the projection period, livestock production has risen by close to nine per cent above the base level, while production of milk and poultry has risen by close to 11 per cent. However, exports of these sectors increase by a smaller proportion. Exports of livestock rise by only one per cent in the last period of the projection period, while exports of milk and poultry increase only by 0.9 per cent, relative to the base period. These results contrast with the relatively substantial increase in grain

exports that occurs under the assumption of maximum increases in world prices.

Factor Demand

In the wheat sector of the Prairies, labour demand declines in the first year following total removal of the grain transportation subsidy under both assumptions of world price changes. With minimum increases in world prices, the demand for labour in the wheat sector of the Prairies declines by 8.5 per cent in the first year and remains below the base level, albeit showing a steadily rising trend, throughout the projection period. With maximum increases in world prices, labour demand rises above the base level in the second year of the projection period, and reaches 17 per cent above the base level in the last year of the projection period. In the "other grains" sector of Prairie agriculture, labour demand remains below the base level throughout the projection period, under both assumptions of world price changes. Labour demand in the remaining sectors is above base year levels.

With the total removal of the grain transportation subsidies and under the assumption of minimum increases in world prices, capital demand in agriculture declines more than labour demand. Furthermore, unlike the demand for labour, the demand for capital declines in all agricultural sectors. With the maximum increases in world prices, the demand for capital in the wheat sector rises above the base level in the third year, to be 19 per cent higher than the base level in the last year of the projection period. In other sectors too, the demand for capital increases over the projection years, but not substantially. The exceptions are the fruits and vegetables, and the "other agriculture" sectors, where the demand for capital in the last year of the projection period is, respectively, 9 and 8.5 per cent higher than the base levels.

The demand for land is adversely affected in the wheat and other grains sector under the assumption of minimum increases in world prices, and remains below base level throughout the projection

37

period. While a similar result obtains for the other grains sector, demand for land in the wheat sector increases under the assumption of maximum price changes. In the latter situation, the demand for land in the wheat sector reaches a level that is 12 per cent above the base-year level by the last year of the projection period. In the remaining sectors, the demand for land steadily declines over the projection period although in the first year this is above the base level.

6.   Summary of Assessment of Constraints on Achievement of Gains from Multilateral Trade Liberalization

A final objective of this research project was to identify the various constraints that limit full achievement of the potential benefits to Western Canadian farmers of multilateral trade liberalization. We conducted an extensive survey of literature, focusing in particular on the grains sector, and conducted a series of informal consultations with numbers of people who are knowledgeable about the sector and the potential gains from trade liberalization. This inquiry led to a listing of constraints that impinge on production, marketing and exportation of Western Canadian grains. These include the physical constraints of geography and climate as well as a variety of economic and institutional constraints. The latter category of factors includes widely debated features of the regulatory and institutional environment for Canadian grains. Numbers of people associated with the sector disagree about the impact of these features, including the institutional features of delivery quotas/contracts, price pooling, single desk selling, and features of the grain transportation and handling system. There is also debate about some features of the grading, licensing and quality control systems for Western Canadian grains. There is more consensus among observers on some specific economic constraints that arise from outside the sector. These include concerns about under-funding of agricultural research. Specific constraints about which there is unanimity

are the deleterious effects on Western Canadian agriculture from maintenance of export subsidies by major exporters (including the EU and US) and the import restrictions imposed by the EU.

In summary, our study of constraints indicates that a variety of national and international influences may constrain the beneficial impacts of multilateral trade liberalization on Canadian agriculture. The compelling evidence of the importance of world price influences on the Canadian agriculture, and particularly on the grains sector, highlights the importance to the Western Canadian agricultural sector of achieving a more complete liberalization of world trade. This would require the complete elimination of export subsidies by major exporters, specifically the EU and US, more open access to restricted markets in the EU and a more effective discipline on domestic farm support in both nations.

7. Summary and Conclusions

This report summarizes the research of this project which is given in more detail in Adilu (1998) and related working papers. The study evaluates the impacts on 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 commitments. 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 from the URA are too small to offset the negative effects of the URA commitments for 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 is greatest for the milk and poultry sector. The food processing sector is 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 change by the "maximum" amount, however, there are clear aggregate gains for Canadian agricultural producers from the 1994 URA commitments. In this situation, total agricultural production and total agricultural exports increase. This increase in domestic production and exports is largest for wheat, followed by 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 situation, mobile factors move from the non-agriculture sector into agriculture. Within agriculture, the increase in labour and capital demand 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 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.

One major implication from the results of this study is that there are very clear positive gains to

Canadian agriculture from a multilateral trade agreement that achieves the "maximum" level of potential world price increases from trade liberalization. In these circumstances, total agricultural production and exports increase, as does household income and factor returns. In general the benefits from trade are greatest in grains and oilseeds (wheat and other grains), other agriculture, and food processing sectors. 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.

Our study of constraints indicates that a variety of national and international influences may constrain the beneficial impacts of multilateral trade liberalization on Canadian agriculture. The compelling evidence of the importance of world price influences on Western Canadian agriculture, and particularly on the grains sector, highlights the importance of achieving a more complete liberalization of world trade. This would be achieved by the complete elimination of export subsidies by major exporters, specifically the EU and US, more open access to restricted markets in the EU and more effective discipline on domestic support to the farm sector in both nations.

References

Adilu, S. (1998). The Implication of Multilateral Trade Liberalization for Canadian Agriculture: A Computable General Equilibrium Evaluation. A Ph.D. Thesis, Department of Rural Economy, University of Alberta.

Anderson, K. and R. Tyers (1987). *Global Effects of Liberalizing Trade in Agriculture.* Thames Essay, Aldershot: Gower : Trade Policy Research Centre.

Anderson, K. and R. Tyers (1988). Liberalizing OECD Agricultural Policies in the Uruguay Round: Effects on Trade and Welfare. Reprinted Series No. 379, Institute for International Economic Studies, (Reprinted from *Journal of Agricultural Economics* Vol. 39, May, 1988).

Armington, P. S. (1969). A Theory of Demand for Products Distinguished by Place of Production. *IMF Staff papers* 16: 159-176.

Baker, D., M. Hallberg, and D. Blandford (1989). U.S. Agriculture Under Multilateral and Unilateral Trade Liberalization- What the Models Say. Paper A.E & R.S 200, Department of Agricultural Economics and Rural Sociology, The Pennsylvania State Univ. Park, PA.

Brooke, A., D. Kendrick, A. Meeraus (1988). GAMS: A User's Guide. New York: The Scientific Press.

Brooks, H. And D. Kraft (1994). "The 1994 Uruguay round GATT Agreement and the Canadian Grains and Oilseeds Industry." In *World Agriculture in a Post-GATT Environment: New Rules, New Strategies* (editors, Richard Gray, Tilman Becker and Andrew Schmitz). University of Saskatchewan Extension Press, 1995.

Burniaux, J.M., F. Delorme, I. Lienert, J.P. Martin, and D. Van der Mensbrugghe (1989). Economy-Wide Effects of Agricultural Policies in OECD Countries: Final Results. Economics and Statistics Department, OECD, Paris.

Burniaux, J.M., F. Delorme, I. Lienert, and J.P. martin (1990). Walras: A Multi-sector, Multi-country Applied General Equilibrium Model for Quantifying the Economy-wide Effects of Agricultural Policies. *OECD Economic Studies*. 13: 205-236.

Cahill, S. (1991). A Implications for Canada of One Possible Uruguay Round Outcome: Results From a Multi Commodity Analysis With Trade Analysis Simulation System (TASS). Working Paper 10/91, Policy Branch, Agriculture Canada.

Frohberg, K. (1989) Economy wide Effects of a Multilateral Trade Liberalization In Agriculture by Industrialized Market Economies on Canada, Japan, and the European Communities. Working Paper 88-WP 40, Centre for Agricultural and Rural Development (CARD), Iowa State University, Ames, Iowa.

Gardner, B. (1988). Some Recent Studies of Agricultural Trade Liberalization. In *Agriculture and Governments in an Interdependent World*. Proceedings of the Twentieth International Conference of Agricultural Economists. 24- 31.

Government of Canada (1994). The Uruguay Round of the General Agreement on Tariffs and Trade, An Assessment of the Economic Impact on Canada. The Federal Finance Department, August.

Hathaway, D. (1994). The Treatment of Agriculture in the Uruguay Round: Matching Expectations With Reality. Unpublished Paper.

Ingco, M.D. (1994). How Much Agricultural Liberalization was Achieved in the Uruguay Round? Paper Prepared for Presentation to the Annual Conference of the IATRC, Washington D.C., Dec. 15-16, Unpublished.

The International Agricultural Trade Research Consortium (IATRC) (1994). The Uruguay Round Agreement on Agriculture: An Evaluation. Commissioned Paper No. 9.

Meilke, K.D., and B. Larue (1989b). A Quantitative Assessment of the Impacts of Trade Liberalization on Canadian Agriculture. In Agriculture in the Uruguay Round of GATT Negotiations: Implications For Canada's and Ontario's Agri-food System. AEB 89/6, Department of Agricultural Economics and Business, University of Guelph.

Organization For Economic Co-operation and Development (1987). *National Policies and Agricultural Trade*. OECD, Paris.

Parikh, K., G. Fischer, K. Frohberg, and O. Gubrandsen (1988). *Towards Free Trade in Agriculture*. International Institute of Applied Systems Analysis, Laxenburg, Austria: Martinus Nijhoff Publishers.

The Provincial and Federal Officials (1994). Impact of the GATT Agreement on Canadian Agriculture and Agri-Food. June.

Robinson, S. (1990). "Analysing Agricultural Trade Liberalization with Single Country CGE Models." Working Paper Series, University of California, Berkeley, Department of Agriculture and Resource Economics, No. 824, Berkeley, CA: California.

Robinson, S., M. Kilkenny, and K. Hanson (1990). The USDA/ERS Computable General Equilibrium (CGE)) Model of the United States. Agriculture and Rural Economy Division, ERS, USDA.

Roningen, V.O (1988). Trade Liberalization Results From ST86. Memorandum to IATRC Symposium Participants, Group II, May 17. ERS, USDA, Washington, D.C.

Roningen, V.O., and P.M. Dixit (1989). *Economic Implications of Agricultural Policy Reform in Industrial Market Economies.* USDA, ERS Staff Report No. AGES 89-36.

Thomassin, P. and A. Andison (1987). Agriculture Canada's Input-output Model, Part I: Disaggregation of the Agriculture Sector of Canada. Agriculture Canada, Policy Branch, Working Paper 6/87. Ottawa: Agriculture Canada.

USDA (1987). *Government Intervention in Agriculture: Measurement, Evaluation, and Implications for Trade negotiations.* ERS Staff Report No. AGES 861216, Washington, D.C., January.

Valdes, A., and J. Zietz (1980). *Agricultural Protection in OECD Countries: Its Costs to   Less Developed Countries.* Research Report No. 21, International Food Policy   Research Institute, Washington, D.C., December.

Wang, Zhi (1997). The Impact of China and Taiwan Joining the World Trade Organization on U.S and World Agricultural Trade: A Computable General Equilibrium Analysis. ERS, USDA, Technical Bulletin No. 1858.