

IMPACTS OF THE WESTERN HEMISPHERE FREE TRADE AREA ON THE INTERNATIONAL TRADE OF SOYBEAN OIL, SOYBEAN MEAL AND SOYBEANS

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ABSTRACT

A major multi-country free trade agreement currently under negotiation is the Free Trade Area of the Americas (FTAA). The agreement is proposed to be operational by January 2005 and will encompass 34 countries in the Western Hemisphere. Soybeans and soybean products are important export commodities in the Western Hemisphere. It is expected that tariffs and duties on these commodities will be intensely negotiated. The purpose of this paper is to analyze effects of the FTAA implementation on international trade of soybean oil, soybean meal and soybeans. Emphases of investigations are on how the implementation of FTAA is affected by Brazil's soybean output expansion and China's accession into the World Trade Organization. The method of analysis is via the spatial equilibrium model that includes all countries in the Western Hemisphere and several regions outside the hemisphere. Four alternative trade scenarios were simulated and their results were compared with those from the baseline model. All scenarios indicated that the U.S. and Brazil would be able to at least expand their exports of soybean oil or soybean meal.

ABSTRAK

Sebuah perjanjian perdagangan bebas pelbagai negara yang sedang diperundingkan sekarang ialah Kawasan Perdagangan Bebas Benua Amerika (FTAA). Perjanjian ini dijangka berkuatkuasa pada Januari 2005 dan akan meliputi 34 negara di Hemisfera Barat. Kacang soya dan keluaran barang kacang soya merupakan komoditi eksport yang penting di rantau hemisfera barat. Dijangkakan bahawa tarif dan duti ke atas komoditi-komoditi tersebut akan dirunding dengan serius. Tujuan kajian kertas ini adalah untuk menganalisis kesan penubuhan FTAA ke atas perdagangan antarabangsa

minyak kacang soya, mil kacang soya dan kacang soya. Penekanan penyelidikan ditumpukan juga kepada kesan peningkatan pengeluaran kacang soya Brazil dan kemasukan China dalam Pertubuhan Perdagangan Sedunia ke atas penubuhan FTAA. Kaedah analisis yang digunakan ialah model keseimbangan ruangan yang merangkumi semua negara di Hemisfera Barat dan beberapa rantau di luar Hemisfera itu. Simulasi untuk empat senario perdagangan alternatif telah dilaksana dan keputusan daripada simulasi itu dibandingkan dengan keputusan daripada model asas. Semua senario menunjukkan bahawa Amerika Syarikat dan Brazil akan dapat meningkatkan eksport sekurang-kurangnya minyak kacang soya atau mil kacang soya.

INTRODUCTION

In the last ten years, there have been proliferations of regional trade agreements. Practically all countries in the world now belong to at least one regional trade bloc or at the very least a regional economic cooperation community such as the Asian Pacific Economic Cooperation (Frankel, 1997). These regional agreements range from simple tariff reduction agreements on selected commodities, such as the Association of South East Asian Nations Free Trade Area (AFTA), to comprehensive free trade agreements such as the North American Free Trade Agreement (NAFTA), to deeply integrated economic unions such as the European Union (EU).

Despite being at different levels of economic development, there are several factors that have impelled nations to become members of regional preferential trade agreements. One factor is greater acceptance of the benefits of trade. Nations have recognized that successful economic development requires integration into the world economy through trade and investment. The second factor is the globalization of trade. This is very much related to the first factor where increasing interdependence of economies has encouraged nations to liberalize trade and promote investments. Finally, regional agreements are more preferred to multilateral negotiations because regional agreements are less complicated. Therefore, negotiating countries can come to commonly agreeable terms in a shorter time period (Bergsten, 1996).

A major multi-country free trade agreement currently under negotiation is the Free Trade Area of the Americas (FTAA). The FTAA is proposed to be operational by January 2005 and would encompass all 34 countries in the Western Hemisphere, excluding Cuba. When implemented, the FTAA will be the largest trade pact in the world with a

market size of 755 million people or 13% of the world population (United States Department of Agriculture, 1998; Frankel, 1997). In terms of output, the trading bloc would have a collective gross domestic product of over \$10 trillion, which represents about one-third of total world output (Association of American Chambers of Commerce in Latin America, 1998; Frankel, 1997). The formation of FTAA would also replace many of the existing regional trade agreements in the Western Hemisphere.¹

Soybeans, soybean oil, and soybean meal are some of the most heavily traded agricultural commodities in the Western Hemisphere. The Western Hemisphere accounts for more than 80% of the world's soybean production. The three largest producers of soybeans are the United States, Brazil, and Argentina. In international trade, the Western Hemisphere accounts for more than 90% of world soybean exports. The three leading producers of soybeans are also the world's top three exporters. The largest market for soybeans is Asia, with China and Japan being major net importers. The European Union and the Western Hemisphere are second and third respectively. In the Western Hemisphere, the largest net importer is Mexico (FAS On-line).

At the world level, soybean crushing to produce soybean oil and soybean meal is almost 86% of total domestic consumption. In the U.S., Brazil and Argentina, over 90% of domestic soybean consumption is by the crushing industry. The main objective of this study is to investigate the impacts of implementation of the FTAA on international trade of soybean oil, soybean meal, and soybeans. The impacts of FTAA implementation will be investigated under four alternative trade scenarios. The first trade scenario assumes full liberalization of trade in soybean oil, soybean meal, and soybeans within the FTAA. The second scenario assumes Brazil expands soybean output on implementation of the FTAA. The third trade scenario assumes China liberalizes market access on soybean oil, soybean meal, and soybeans with the implementation of the FTAA. The final trade scenario assumes full liberalization of soybean oil, soybean meal, and soybeans trade within the FTAA, and Brazil expands soybean output while at the same time China liberalizes market access. Results of this study will indicate sectors within the industry that will potentially gain from trade liberalization.

Subsequent sections in this paper will proceed as follows. The next section presents the formulation of the spatial equilibrium framework. Then, the sources of data are discussed. This is followed by a discus-

sion on the model implemented and validation. The final section presents conclusion of the paper.

THE MODEL

In this section, a multi-country optimization model is developed to capture the spatial elements of trade. Details of the multi-country model, however, rely heavily on Johnson *et al.* (1996). The model treats soybeans as a primary product and soybean oil and meal as intermediate products. It is also assumed that there are no structural changes in supply and demand as soybeans are transformed to soybean oil and soybean meal. The objective function is constructed on the basis of net social monetary gain.² As defined by Takayama and Judge (1971), net social monetary gain (or net social revenue) is equal to total social revenue minus total social production cost and transportation cost. To accommodate the objective of this study, the definition of net social revenue (*NSR*) is modified slightly and is defined as total social revenue (*TSR*) minus total social production cost (*TSPC*) and transfer cost (*TC*). Based on the above, the objective function is written as follows:

$$NSR = TSR - TSPC - TC \quad (1)$$

The net social revenue function (*NSR*) can be expanded into:

$$NSR = \sum_i PO_i \cdot QOD_i + \sum_i PM_i \cdot QMD_i - \sum_i PB_i \cdot QBPC_i - \sum_i cm_i \cdot QBC_i - TC \quad (2)$$

In the model, all capitalized variables are endogenous and lowercase letters represent fixed parameters.³ The subscript *i* represents regions of the world, where $i = 1, 2, \dots, n$. A region can consist of one country or an aggregation of two or more countries. Price variables are in units of U.S. dollars per hundred metric tons and quantity variables are in units of hundred metric tons. In equation (2), the variable definitions are as follows:

- PO_i is the price of soybean oil in region *i*;
- QOD_i is quantity of soybean oil consumed in region *i*;
- PM_i is the price of soybean meal in region *i*;
- QMD_i is quantity of soybean meal consumed in region *i*;
- PB_i is the price of soybean seeds in region *i*;
- $QBPC_i$ is quantity of soybeans crushed in region *i*;
- cm_i denotes the per-unit soybean crushing cost in region *i*.

Elements of TC are transportation costs, tariffs and duties. Total transportation cost for soybean oil, soybean meal, and soybeans are given by the following:

$$TTC = \sum_i \sum_j XO_{ji} \cdot tco_{ji} + \sum_i \sum_j XM_{ji} \cdot tcm_{ji} + \sum_i \sum_j XB_{ji} \cdot tch_{ji} \quad (3)$$

for all i where $i = 1, 2, \dots, n$ and $i \neq j$. Parameters tco_{ji} , tcm_{ji} , and tch_{ji} are unit shipping costs (U.S. dollars per 100 metric ton) of soybean oil, soybean meal, and soybeans from region j to region i , respectively.

All are to be converted to its *ad valorem* equivalents. The total value of tariffs is given by,

$$TTAF = \sum_i \left(\frac{ito_i}{1 + ito_i} PO_i, QO_i + \frac{itm_i}{1 + itm_i} PM_i, QMI_i + \frac{itb_i}{1 + itb_i} PB_i, QBI_i \right) \quad (4)$$

where $i = 1, 2, \dots, n$. Parameters ito_i , itm_i , and itb_i are region i 's *ad valorem* tariff rates for soybean oil, soybean meal, and soybeans, respectively. The variables QOI_i , QMI_i , and QBI_i are region i 's quantity of soybean oil, soybean meal, and soybean imports, respectively.

The total value of *ad valorem* export duties is given by,

$$TEXD = \sum_i (edo_i, PO_i + edm_i, PM_i, QME_i + edb_i, PB_i, QBE_i), \quad (5)$$

where $i = 1, 2, \dots, n$. Parameters edo_i , edm_i , and edb_i are region i 's *ad valorem* export duties for soybean oil, soybean meal, and soybeans, respectively. The variables QOE_i , QME_i , and QSE_i are region i 's quantity of soybean oil, soybean meal, and soybean exports, respectively. To summarize, $TC = TTC + TTAF + TEXD$.

Solutions to endogenous variables are obtained by maximizing the objective function subject to quantity (or material balance), price and non-negativity constraints. The material balance constraints ensure regional inflows of all commodities are equal to regional outflows. Specifically, for each region:

$$QOI_i + QOP_i = QOE_i + QOD_i, \quad (6)$$

$$QMI_i + QMP_i = QME_i + QMD_i, \text{ and} \quad (7)$$

$$QBI_i + QBPC_i = QBE_i + QBC_i, \quad (8)$$

where $i = 1, 2, \dots, n$. Variables QOP_i , QMP_i and QBC_i are given by

$$QOP_i = k_{i1} \cdot QBC_i, \quad (9)$$

$$QMP_i = k_{i2} \cdot QBC_i, \quad (10)$$

$$QBC_i = a_{i3} + b_{i3} (k_{i1}PO_i + k_{i2}PM_i - PB_i) \quad (11)$$

$$QOD_j = a_{j2} - b_{j1} PO_j \quad (12)$$

$$QMD_i = a_{i2} - b_{i2} PM_i, \text{ and} \quad (13)$$

where $i = 1, 2, \dots, n$ and k_{i1} and k_{i2} in equations (9) and (10) respectively are the soybean oil and soybean meal extraction rates in region i . Note that demand functions specified in equations (12) and (13) do not explicitly include other oilseed substitutes. These functions are collapsed demand functions because other demand variables, such as income, substitutes or complements, are collapsed into the respective constant terms. Implicitly, this amounts to assuming other demand variables do not interact with changes in prices of soybean oil price or soybean meal.⁴ Other variables in equations (6), (7) and (8) are defined as follows:

$$QOI_i =, \sum_j XO_{ij} \quad (14)$$

$$QMI_i =, \sum_j XM_{ij} \quad (15)$$

$$QBI_i =, \sum_j XB_{ij} \quad (16)$$

$$QOE_i =, \sum_j XO_{ij} \quad (17)$$

$$QME_i =, \sum_j XM_{ij} \quad (18)$$

$$QBE_i =, \sum_j XB_{ij} \quad (19)$$

where $i = 1, 2, \dots, n$ and $i \neq j$.

Note that for each commodity in equations (6) through (8), its summation over all i will yield the market clearing identity. That is,

$$\sum_i \sum_j XO_{ij} + \sum_i QOP_i = \sum_i \sum_j XO_{ij} + \sum_i QOD_i, \quad (20)$$

$$\sum_i \sum_j XM_{ij} + \sum_i QMP_i = \sum_i \sum_j XM_{ij} + \sum_i QMD_i, \text{ and} \quad (21)$$

$$\sum_i \sum_j XB_{ij} + \sum_i QBPC_i = \sum_i \sum_j XB_{ij} + \sum_i QBC_i. \quad (22)$$

For each commodity in equations (20) through (22), total volume of import must equal total volume of export. Therefore, total import and export terms on the left and right hand side of equations (20) through (22) cancel out, yielding the market clearing identities.

Additionally, if each region were identified either as an exporting or importing country, then for each importing country the following should hold.

$$QOI_i + QOP_i = QOD_i \text{ or } \sum_j XO_{ij} + QOP_i - QOD_i = 0; \quad (23)$$

$$QMI_i + QMP_i = QMD_i \text{ or } \sum_j XM_{ij} + QMP_i - QMD_i = 0; \quad (24)$$

$$QBI_i + QBPC_i = QBC_i \text{ or } \sum_j XB_{ij} + QBPC_i - QBC_i = 0; \quad (25)$$

For the exporting region, the following is true:

$$QOP_i = QOE_i + QOD_i \text{ or } -\sum_j XO_{ij} - QOD_i + QOP_i = 0; \quad (26)$$

$$QMP_i = QME_i + QMD_i \text{ or } -\sum_j XM_{ij} - QMD_i + QMP_i = 0; \text{ and} \quad (27)$$

$$QBPC_i = QBE_i + QBC_i \text{ or } -\sum_j XB_{ij} - QBC_i + QBPC_i = 0; \quad (28)$$

The spatial price constraints are as follows:

$$[PO_i (1 + edo_i) + tco_{ij}] (1 + ito_j) \geq PO_j \quad (29)$$

$$[PM_i (1 + edm_i) + tcm_{ij}] (1 + itm_j) \geq PM_j \text{ and} \quad (30)$$

$$[PB_i (1 + edb_i) + tcb_{ij}] (1 + itb_j) \geq PB_j \quad (31)$$

where $i = 1, 2, \dots, n$ and $i \neq j$.

Equations (29) through (31) can be simplified if each region or country is predetermined as an importing or exporting region. For an importing region, export duties on the three commodities would be zero. As such, spatial price constraints for these regions will be reduced to:

$$\frac{PO_j}{(1+ito_j)} - PO_i \leq tco_{ij} \quad (32)$$

$$\frac{PM_j}{(1+itm_j)} - PM_i \leq tcm_{ij} \text{ and} \quad (33)$$

$$\frac{PB_i}{(1+itb_i)} - PB_i \leq tcb_{ij} \quad (34)$$

On the other hand, import tariff for exporting regions do not apply. As such the equations are reduced to:

$$PO_i - PO_i(1+edo_i) \leq tco_{ij} \quad (35)$$

$$PM_i - PM_i(1+edm_i) \leq tcm_{ij}, \text{ and} \quad (36)$$

$$PB_i - PB_i(1+edb_i) \leq tcb_{ij} \quad (37)$$

The non-negativity constraints are:

$$PO_i \geq 0, PM_i \geq 0, PB_i \geq 0, \quad (38)$$

$$QOD_i \geq 0, QMD_i \geq 0, QBC_i \geq 0, \text{ and} \quad (39)$$

$$XO_{ij} \geq 0, XM_{ij} \geq 0, XB_{ij} \geq 0, \quad (40)$$

where $i = 1, 2, \dots, n$ and for (38) $i \neq j$.

The non-negativity constraints exclude any negative solutions to the endogenous variables. Accordingly, all solutions to prices, consumption quantities and volume of shipments between regions will be either zero or positive. To reduce the complexity of the model, the world is categorized into 17 countries and regions. Countries outside the Western Hemisphere are aggregated the most. Some countries in the Western Hemisphere with low trade participation in soybean oil, soybean meal, and soybeans are also aggregated. All Caribbean island-nations (excluding Cuba) are grouped into a single region because consumption of soybeans and soybean products by each individual nation is very small. For the same reason, all Central American countries are grouped into a single region. For South America, Chile is combined with Peru (an Andean Group member) and Colombia, Ecuador and Venezuela are combined in another group.

Countries and regions outside the Western Hemisphere included in the model are the European Union, China, Japan, the Middle East and North Africa, and the rest of the world. These countries and regions are included because they are important export markets for soybean oil, soybean meal, and soybeans. For each country and region, a suitably located seaport is selected to serve as an out-going or an entry port. Port selection is primarily determined by the significance of the

region in terms of trade and proximity to other shipping points. Table 1 lists these countries and regions in detail.

Table 1
Regions and Ports Used in Study

1. Region: Canada	Ports: Montreal, Vancouver (exports to China & Japan)
2. Region: Mexico	Port: Puerto De Vera Cruz
3. Region: United States	Ports: (a) New Orleans (exports to ROW), (b) Seattle (exports to China & Japan), (c) Milwaukee (exports to Canada)
4. Region: CARIBBEAN	Port: Santo Domingo (Dominican Republic) Countries: Bermuda, Bahamas, Barbados, Cuba, Dominica, Dominican Republic, French West Indies, Grenada, Guadeloupe, Haiti, Jamaica & Dependencies, Martinique, Netherland Antilles, Puerto Rico, St. Lucia, St. Kitts & Nevis, St. Vincent & Grenadines, Trinidad & Tobago, U.S. Virgin Islands
5. Region: CENTAM	Port: Puerto Limon (Costa Rica) Countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama
6. Region: Brazil	Ports: Paranagua, Natal (exports to GUSU)
7. Region: Argentina	Port: La Plata
8. Region: PARU	Port: Montevideo (Uruguay) Countries: Paraguay and Uruguay
9. Region: Bolivia	Port: Callao (Peru)
10. Region: CEV	Port: Buenaventura (Colombia) Countries: Colombia, Ecuador, and Venezuela
11. Region: PECH	Port: Callao (Peru) Countries: Peru and Chile
12. Region: GUSU	Port: Georgetown (Guyana) Countries: Guyana, Suriname, and French Guiana
13. Region: EU	Port: Rotterdam (Netherlands) Countries: Austria, Belgium & Luxembourg, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, United Kingdom

(Table 1 continued)

14. Region: Japan	Port: Kobe
15. Region: China	Port: Dalian
16. Region: MENA	Port: Port Said (Egypt) Countries: Bahrain, Cyprus, Gaza Strip, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, West Bank, Yemen, Algeria, Libya, Egypt, Morocco, Tunisia
17. Region: ROW	Port: Rotterdam (Netherlands) Countries: Rest of the world

To further simplify the model, each country or region is identified as either an exporting or an importing region based on its historical position in the 1990's. This is justifiable because it is unlikely that an exporting country, say U.S. or Brazil, would become an importing country after regional integration. Similarly, countries such as Chile and Venezuela that have traditionally imported their soybean oil, soybean meal, and soybean needs would unlikely become exporting countries after regional integration.

Data Sources

The base model is intended to simulate the average level data for 1996, 1997, and 1998. An average base level is chosen in place of a one-period base year because a one period base year may not reflect the true trade pattern and volume. Production and trade in a particular year may be affected by a particular short-term policy of a country or abnormalities in weather conditions that affect supply and/or demand in a particular way.

Additionally, omission of trade data on commodities in shipment at the end of a recording period make one-period trade data less reliable than average level data. Hence, average level data are more likely to reflect long-run supply and demand conditions. Moreover, when disposition data are averaged, the average beginning stock generally equals the average ending stock. As such, inventory stocks can be ignored in the model. Further more, these years were chosen because reliable data were available for them.

Country-wise data on production, consumption, trade (import and export), soybean oil and meal conversion factors were taken from *PSD*

on-line.⁵ Prices were obtained from the FAO World Trade Yearbook. For importing countries, the 1996, 1997 and 1998 average CIF prices for soybean oil, soybean meal, and soybeans were obtained by dividing import values by the corresponding import quantities. For exporting countries, the 1996, 1997 and 1998 average FOB prices were obtained by dividing the export values by the export quantities. Tariffs were then applied to the CIF prices to obtain regional domestic prices.

Tariffs and duties data were gathered from several sources. The primary source was from the online database for Uruguay Round Agreement tariff schedules.⁶ Tariff rates for each country were calculated for 1997. The calculated bound rates are at best only approximations of the actual rates applied by these countries or regions. While actual rates cannot be higher than bound rates, countries usually set actual rates (or applied tariff rates) lower than bound rates in any particular year and increase or decrease the applied rates to synchronize with their domestic policies. For countries not available in the FAS Online database, actual rates were obtained from Agriculture and Agri-Food Canada (1998). Finally, approximations of tariff rates for ROW were obtained from Milke, Wensley and Cluff (2001). For trade between members of regional groupings, such as members of NAFTA, MERCOSUR or ANDEAN GROUP, tariffs were adjusted accordingly to reflect the preferential treatment member countries enjoy for being in the group.

Regional demand parameters were derived from elasticity estimates given in Sullivan, Roningen, Leetmaa and Gray (1992). For a region that consists of several countries, consumption weighted average elasticity was calculated. Data on crushing costs were not available. They were approximated by the regional crushing margin based on the assumption that markets are competitive and are independent of crushing volume. Specifically, the crushing cost of each region (cm_i) is approximated using the following equation.

$$cm_i = k_{PO} PO_i + k_M M_i - PB_i$$

Maritime transportation costs between all ports were estimated using the Ordinary Least Squares method. For the purpose of estimation, secondary data on shipping costs, volume of shipments, and ports of origin and destinations were obtained from "Chartering Annual, 1998". Data on distance between ports were obtained the United States National Imagery and Mapping Agency.

Specification for transportation cost equations is as follows:

$$RATE = \alpha + \beta_1 \cdot DIST + \beta_2 \cdot WGT + \gamma_2 \cdot DV_3 + \gamma_3 \cdot DV_3 + \gamma_4 \cdot DV_4 + e_i$$

where *RATE* is the transportation charge in dollars per hundred metric tons;

DIST is the distance between two ports in nautical miles;

WGT is average weight of shipment per voyage between two ports in hundreds of metric tons;

DV₁ is a dummy variable that equals 1 if the distance between two ports is greater than 5,000 nautical miles and 0 if otherwise;

DV₂ is a dummy variable that equals 1 if the shipment originated in Canada and 0 if otherwise;

DV₃ is a dummy variable that equals 1 if the shipment originated in South America and 0 if otherwise;

DV₄ is a dummy variable that equals 1 if the destination of the shipment is the European Union and 0 if otherwise; and

e_i is the disturbance term.

Estimation and Results

The spatial model was solved for prices, quantities, and regional trade quantities using average level data of 1996, 1997, and 1998.⁷ Validation of the model indicated that the base-case model predicted all variables reasonably accurate. In the next four sections, four alternative trade scenarios are simulated. Solutions from the base-case model served as a standard of comparison against the simulated results. In all of the simulations, tariff rates for importing regions within the Western Hemisphere were adjusted to their GATT's Uruguay Round Agreement bound rates to cater to imports from outside the FTAA. For regions and countries outside the Western Hemisphere, tariff rates were also adjusted to their GATT's Uruguay Round Agreement bound rates because these are the rates that will be applicable when FTAA is implemented. These rates are as presented in Table 2.

Several items in Table 2 should be noted. First, since the EU and Japan have immediately implemented their final bound rates upon signing of the trade agreement, their rates are not adjusted. Second, tariff rates for China are only adjusted to their committed WTO accession bound rates in scenario three and scenario four. Third, due to unavailability of data, tariff rates for the rest of the world were arbitrarily reduced by 10%.

Table 2
Ad Valorem Tariff Rates for Importing Countries or Regions
Used in Simulations*

Regions	Soybean Oil	Soybean Meal	Soybeans
CANADA	4.8%	0.0%	na [*]
MEXICO	45.0%	25.0%	33.0%
CARIBBEAN	116.0%	100.0%	100.0%
CENTAM	35.0%	40.0%	40.0%
CEV	75.0%	88.0%	121.0%
PECH	31.5%	31.5%	31.5%
GUSU	na	100.0%	na
EU	na	4.5%	0.0%
CHINA	121.6%	36.0%	114.0%
JAPAN	0.0%	4.2%	0.0%
MENA	20.0%	62.0%	17.0%
ROW	15.0%	5.0%	9.6%

* For imports from FTAA members to FTAA members, the applied rates depend on the applicable scenario.

** na implies not applicable.

Scenario I: Implementation of FTAA

The most likely liberalization scheme for soybean oil, soybean meal, and soybeans is 100% tariff removal upon FTAA implementation. It is the most likely because NAFTA members are already trading soybean oil, soybean meal, and soybeans at zero tariffs. It is most likely that the major economies in the Americas (namely Canada, the U.S., and Brazil) will be able to influence other participating members of the proposed FTAA to accept full liberalization of soybean oil, soybean meal, and soybeans upon signing. In the U.S., the call to full market access is also supported by the American Soybean Association, a powerful soybean lobby group.

Table 3 shows the percentage price change in soybean oil, soybean meal, and soybeans when trade in the Western Hemisphere is fully liberalized. In Table 3 (and all subsequent tables), the world price of a particular commodity refers to the consumption weighted average price of the commodity over all regions. Average exporter price of a particular commodity or average price of exporting countries is the consumption weighted average price of the commodity over all exporting regions. Similarly, average importer price is the consumption weighted average price of the commodity over all importing regions that consume the commodity.

Table 3
Regional Price Impacts following 100% Regional Tariff Removals

(Per cent change in prices relative to prices in the base model)						
	World	All exporters	All importers	U.S.	Argentina	Brazil
Soybean oil	-0.7%	1.4%	-2.2%	0.8%	0.3%	1.5%
Soybean meal	-1.8%	0.4%	-2.7%	-0.5%	6.7%	5.0%
Soybeans	4.4%	5.9%	1.5%	-1.3%	25.4%	12.8%

In general, the results show that price impacts are modest. World soybean oil price decreased only 0.7%, soybean meal price decreased by 1.8%, and soybean price increased by 4.4%. Prices of the three commodities in exporting countries increased while prices in importing countries decreased, except for soybeans. The simulation results also indicate that not all of the major producers and exporters enjoy price increases when trade barriers are fully removed. In particular, the U.S. experienced a marginal increase in soybean oil price while prices for soybean meal, and soybeans decreased. On the other hand, Brazil and Argentina attained price increases for all three commodities. Price increases in Brazil and Argentina are especially large for soybeans.

Changes in prices affect processing activities. Processing activities will expand when prices of soybean oil and soybean meal increase. On the other hand, the processing sector will contract with increasing soybean prices. This scenario indicate that there are no significant shift in processing activities in favor of FTAA member countries (Table 4). In regions out side the Western Hemisphere, impacts of FTAA on processing are also almost insignificant. The EU, China, Japan, and the rest of

the world only experienced changes in processing activities less the one-half of a percentage point.

Table 4
Per Cent Changes in Processing Activities

Exporting Regions	Per Cent Change	Importing Regions	Per Cent Change
CANADA	0.2%	MEXICO	1.6%
U.S.	0.3%	EU15	0.0%
ARGENTINA	-0.7%	CHINA	-0.1%
BRAZIL	1.2%	JAPAN	-0.2%
PARU	6.1%	MENA	0.3%
BOLIVIA	-29.1%	ROW	-0.1%

Table 5 shows the per cent changes in export volume of selected regions. The results indicate that, at the world level, only soybean oil has a significant increase in total export volume. Soybean meal and soybeans sustained only small changes. Consequently, the trade mix was not significantly altered.

Table 5
Changes in Export Volumes following Regional Tariff Removals

	Soybean Oil	Soybean Meal	Soybeans
World	6.6%	1.0%	-0.2%
U.S.	9.1%	-4.5%	-0.5%
Brazil	24.7%	6.5%	-4.4%
Argentina	-0.8%	-0.1%	217.4%

Scenario II: Shift in Acreage

Brazil is the largest soybean producer and exporter after the U.S. In the last decade, Brazil has consistently outpaced the U.S. in soybean acreage expansion. Between 1991 and 2000, Brazil's rate of acreage growth was about 3.7% while U.S. acreage growth was about 2.5%. To gauge the effects of Brazil's output expansion (at given prices), the base model was simulated under the assumption that FTAA would fully liberalize and that Brazil would increase its harvested area by 10%.

Table 6 presents results of simulation on prices. As expected, the implementation of FTAA and Brazil expanding output have the impact of decreasing overall world prices of soybean oil, soybean meal, and soybeans. At the world level, soybean oil price decreased slightly more than 2%, soybean meal price decreased by almost 5%, and soybean price decreased by almost 10%.

Table 6
Per Cent Change in Prices following FTAA Liberalization
and Production Increase in Brazil

(Per cent change in prices relative to prices in the base model)						
	World	Exporters	Importers	U.S.	Argentina	Brazil
Soybean Oil	-2.3%	0.2%	-4.0%	-0.5%	0.7%	0.5%
Soybean Meal	-4.9%	-4.9%	-4.9%	-4.7%	-4.7%	-4.8%
Soybeans	-9.5%	-12.1%	-4.2%	-18.0%	4.1%	-7.2%

For exporters, soybean oil price was almost unchanged, but soybean meal and soybean prices decreased. The drop in soybean price was quite substantial. For importers, prices decreased in the range of 4% to 5% for all three commodities. For the three major exporters, soybean oil price changes are within 1% while soybean meal prices decreased by almost 5%. In the soybean sector, the U.S. soybean price declined substantially while Brazil only had a 7% reduction.

The impacts of regional free trade and higher member output were greater trade volumes of soybean oil and soybeans. Soybean oil and soybean trade expanded but trade volumes of soybean meal decreased. Table 7 and Table 8 show the changes in export volume and processing activities in selected regions. In this scenario, the results indicate that the U.S. would have smaller soybean oil, soybean meal and soybean export volume. However, its crushing activities expanded, generating more value-added into the economy. On the other hand, higher soybean production in Brazil resulted in it exporting more soybean oil and soybeans. For Argentina, its trade mix leans toward more soybean export and less toward soybean products, resulting in lower level of processing activities.

It should be noted that as the world price of soybean oil, soybean meal and soybeans are lower, it now becomes cheaper for importing countries to import the final products needed rather than domestically crushing soybeans to produce soybean oil and meal. As a result, less efficient crushers are forced out of the industry. The removal of less effi-

cient crushers in these countries may cause objections to the idea of joining the FTAA. However, in the long-run the gain in efficiency would benefit all sectors in the industry in those countries.

Table 7
Changes in Export Volume following FTAA Liberalization and
Production Increase in Brazil

	Soybean Oil	Soybean Meal	Soybeans
U.S.	-63.1%	-5.5%	-7.9%
Brazil	8.7%	-0.7%	29.7%
Argentina	-7.2%	-6.8%	196.3%

Table 8
Per Cent Change in Crushing Activities following FTAA
Liberalization and Production Increase in Brazil

Exporting Regions	Per Cent Change	Importing Change	Per Cent Regions
CANADA	1.2%	MEXICO	3.0%
U.S.	4.9%	EU	7.8%
ARGENTINA	-6.4%	CHINA	-0.7%
BRAZIL	1.0%	JAPAN	-5.4%
PARU	-1.3%	MENA	2.4%
BOLIVIA	-28.5%	ROW	0.8%

Scenario III: China's Tariff Liberalization

To investigate the impacts of FTAA implementation with a more liberalized China, the base-model was simulated with the assumptions that the FTAA is fully liberalized in soybean and soybean products trade and China's tariffs on soybean oil, soybean meal, and soybeans are reduced to 9%, 5%, and 3%, respectively.⁸ Results of the simulation are presented below.

Implementation of FTAA with China having a more open market results in lower world prices of soybean oil and soybean meal but a higher world price of soybeans (Table 9). For exporters, prices for all three commodities increased with soybeans experiencing the largest rise. For importers, prices of soybean oil, soybean meal, and soybeans

decreased substantially. For the three major exporters, all countries enjoyed price increases with the largest increase in the soybean sector (except for Argentina's soybean oil price).

Table 9
Per Cent Change in Prices following FTAA Implementation
and China Tariff Liberalization

(Per cent change in prices relative to prices in the base model)						
	World	Exporters	Importers	U.S.	Argentina	Brazil
Soybean Oil	-8.4%	5.8%	-18.4%	7.1%	-2.3%	1.4%
Soybean Meal	-21.2%	3.1%	-31.4%	2.4%	4.1%	7.4%
Soybeans	12.5%	28.0%	-18.7%	19.1%	53.8%	35.6%

With higher soybean world price, but lower soybean product prices, it could be expected that the processing sectors of net importing countries that do not have a large soybean base will generally have lower processing activities. Consequently, if consumption does not decrease, it could be expected that import of soybean products would increase. The simulated results show all importing regions, except Mexico and the EU, would have lower processing activities relative to the base-case (Table 10). Relative to the base-model solutions, export volumes of soybean oil, soybean meal, and soybeans expanded. Relative to Scenario I, the magnitudes of trade expansion are larger for soybean oil and meal, but smaller for soybeans.

Table 10
Per Cent Changes in Processing Activities

Exporting Regions	Per Cent Change	Importing Regions	Per Cent Change
CANADA	0.3%	MEXICO	0.2%
U.S.	-1.5%	EU15	7.4%
ARGENTINA	0.2%	CHINA	-3.8%
BRAZIL	2.8%	JAPAN	-0.6%
PARU	7.7%	MENA	-0.3%
BOLIVIA	-30.5%	ROW	-3.2%

Table 11 shows the changes in export volume attained by major export regions following China's tariff reduction and 100% elimination of tariffs in the FTAA. In this trade scenario, the U.S. is able to expand ex-

port volumes of all three commodities. Its soybean oil export increased by almost 30%, soybean meal export by almost 56%, and soybeans export by more than 2%. Brazil is shown to be able to have larger export volumes of soybean oil and soybean meal. In these sectors, Brazil's soybean oil export increased by 52% while soybean meal export increased by 18%. In the soybean sector, its soybean export decreased by more than 10%. Argentina on the other hand, suffered significant reduction in soybean export.

Table 11

Changes in Export Volume and Export Market Share following FTAA Liberalization and China's WTO accession

	Soybean Oil	Soybean Meal	Soybeans
U.S.	29.7%	55.6%	2.4%
Brazil	51.9%	17.9%	-10.4%
Argentina	0.6%	1.4%	-63.0%

China's tariff reduction results in changes in the trade mix. Results generated by the simulation show that China would import more soybean products and less of soybeans. The simulated results also indicate that China's higher consumption of soybean oil comes from higher imports of soybean oil from the EU and Brazil, but lesser quantities from the U.S. Soybean oil imports from Brazil and the EU increased by 78% and 82% respectively, but soybean oil import from the U.S. decreased by more than 34%.

Scenario IV: Liberalizations and Acreage Expansion

In this final scenario, all previous assumptions are combined. Specifically, the base model is altered to incorporate the assumptions of (i) elimination of import tariffs on soybean oil, soybean meal and soybean trade within the FTAA, (ii) A 10% expansion of soybean harvested area by Brazil, and (iii) reduction of Chinese import tariffs on soybean oil to 9%, soybean meal to 5%, and soybeans to just 3%. Simulation results are presented below.

Table 12 presents results of the simulation on prices. As might be expected, area expansion along with FTAA and China tariff liberalization result in aggregate price changes that are similar to Scenario II. Overall, the impacts on prices are lower world prices of soybean oil, soybean meal, and soybeans, with soybean oil price experiencing the largest percentage price decrease (9.3%). As in previous scenarios, liberalizations and a production increase have the effects of increasing

trade. In this scenario, the simulation results also indicated that total export markets for soybean oil, soybean meal, and soybeans expanded by 21.3%, 3.3% and 1.1%, respectively.

Table 12

Per Cent Change in Prices following FTAA and China Liberalization, and Production Increase in Brazil

(Per cent change in prices relative to prices in the base model)						
	World	Exporters	Importers	U.S.	Argentina	Brazil
Soybean Oil	-9.3%	3.9%	-18.5%	4.0%	0.5%	1.6%
Soybean Meal	-4.8%	-2.3%	-5.8%	-1.6%	0.2%	-4.9%
Soybeans	-4.0%	-5.6%	-0.8%	-12.7%	11.9%	1.4%

Table 13 shows the changes in export volumes following FTAA and China's liberalization, and expansion in production. In this scenario, the results indicate that the U.S. would be able to increase its soybean oil and soybean meal export. However, soybean export volume would decrease. For Brazil, simulation results indicate that it would have lower soybean meal and soybeans export, but would have higher export volume in soybean oil. Argentina is also expected to have lower soybean oil and meal export volume.

Table 13

Per Cent Changes in Export Volume following FTAA and China Liberalization, and Production Increase in Brazil

	Soybean Oil	Soybean Meal	Soybeans
U.S.	119.3%	38.6%	-11.0%
Brazil	18.3%	-5.2%	-11.0%
Argentina	-4.1%	-3.9%	118.1%

As in Scenario II, China's tariff reduction resulted in changes in its import trade mix towards more soybean products and less of soybeans. Relative to the solutions in the base-case model, the import of soybean oil and meal increased by almost 63% and 70.4% respectively. On the other hand, soybeans import decreased by slightly more than 17%. The simulated results indicate that China's higher consumption of soybean oil comes from higher imports of soybean oil from the U.S. and EU, but lesser imports from Brazil. In soybean meal, China's import from the U.S. increased by 70.4%. In the soybean sector, China's

imports from the U.S. decreased by almost 15% and no imports were made from Canada.

CONCLUSION

The purpose of this paper was to analyze the effects of changes in several anticipated trade scenarios in the international trade of soybeans and soybean products. To analyze these changes, a static quadratic programming spatial equilibrium model was formulated. The model allowed for trades in soybean oil, soybean meal or soybeans to be connected through shipping activities.

The results indicate the following points. If liberalization were only within the FTAA, Brazil would benefit with higher soybean oil and soybean meal exports, as well as expansion of its crushing sector. The U.S. would only be able to increase its soybean oil export. However, when implementation of the FTAA is combined with China's trade liberalization (which is the more accurate future scenario), the U.S. would achieve higher exports in all three commodities, with much of the increase in soybean meal exports going to China. In this situation, Brazil would still gain with larger exports of soybean oil and soybean meal. Much of its increase in soybean oil exports would go to China. In addition, its processing sector would expand, creating more value-added to the economy.

If liberalization is only within the FTAA and Brazil expands soybean output, the U.S. would only be able to increase its soybean oil exports and achieve higher processing activities. Brazil on the other hand would be able to achieve higher soybean oil and soybean exports, as well as a slight expansion in the processing sector. However, in the more likely future scenario where the implementation of the FTAA is combined with China's liberalization and Brazil expanding soybean output, the U.S. would be able to greatly expand its soybean oil and soybean meal exports, with much of these increases in exports going to China. Additionally, the U.S. would also be able to expand its soybean-processing sector. Brazil, on the other hand, would have higher soybean oil and soybean exports only.

To further summarize the points above, two points should be noted about the implementation of FTAA. First, with greater market access into the Chinese market, the U.S. is not affected by liberalization of soybean and soybean product trade within the FTAA. Second, with

greater market access into the Chinese market, the U.S. is not affected by expansion of Brazil soybean output. As a whole, elimination of tariffs results in changes in relative prices of soybean oil, soybean meal, and soybeans. In turn, changes in prices alter trade composition either towards more of the final products or more of the primary commodities. Changes in relative prices also affect the processing sector of countries with processing capacities. Regions with lower crushing activities by processors, exporters or importers in countries where their activities are adversely affected. Specifically, it is likely that FTAA will be opposed by processors in the EU and in China. Within the Western Hemisphere itself, opposition may come from processors in Argentina and Bolivia, and processors in importing countries in the Western Hemisphere will have some processors leaving the industry with those that are less efficient exiting first. Regional changes in crushing activities will eventually result in regional reallocation of crushing capacity. Generally, in the process of reallocation, there will be pressure from different quarters of the economy to either participate or abandon the processes that lead to the changes. Depending on the scenario, it is likely that implementation of FTAA in the Western Hemisphere will be opposed.

NOTES

1. A brief history of various trade groupings in the Americas can be found in Frankel (1997).
2. This is one of the approaches to construct the objective function prescribed by Takayama and Judge (1971). The method is discussed in detail in Takayama and Judge (1971)
3. Endogenous variables of *TC* are as in equations (3), (4), and (5).
4. This is a simplifying assumption to reduce the complexity of the model. To some extent, this assumption compromises the accuracy of the model.
5. Web address for PSD on-line is <http://www.fas.usda.gov/psd>.
6. The site address is: http://www.fas.usda.gov/scripts/wtopdf/wtopdf_frm.asp.
7. Solutions were solved using Premium Solver Platform by Frontline Systems, Inc.

8. These levels are consistent with tariff rates committed by China in 2005 upon being a member of the WTO.

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