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Measuring the Effects of Eliminating State Trading Enterprises on the World Wheat Sector

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Abstract

The objective of this paper is to present a comprehensive, multi-regional trade model which includes all types of state trading enterprises (STEs) as well as other domestic and trade policies. The model is applied to measure the effects of STEs on the world wheat sector, where exports and imports by STEs are dominant. The STE model is based on a trade and policy simulation model by Maeda, Suzuki, and Kaiser (MSK). The MSK model is a nonlinear imperfectly competitive spatial equilibrium model formulated as a mixed complementarity problem (MCP). The MSK model can be used to evaluate the following various trade and domestic support policies: specific duties, *ad valorem* tariffs, tariff-rate quotas, export subsidies, production subsidies, production quotas, consumption taxes and price floors, combined with various imperfectly competitive market structures. However, it does not explicitly incorporate STEs. We incorporate both Canadian and Australian types of exporting STEs into the model. Importing STEs, like the Japanese Food Agency, are treated as specific duties in the model since their mark-ups are imposed on imports within tariff-rate quotas. In addition, we introduce Chinese and Indian STEs (COFCO and FCI) which act as an exclusive importer and prohibit exports. The effects of relaxing the export prohibition due to China's entry to the WTO is one of the focal points to be analyzed. The main empirical findings are as follows. In the base case where all STEs are active with the committed 2000 levels remaining the same, Canada, the United States, the European Community, and Australia would be the largest net exporters. By explicitly incorporating the roles of the CWB and AWB into the world wheat trade model, Canadian and Australian net exports became larger than previous estimates. Hence, it is important to include STEs in trade simulation models. In the case where CWB is no longer a monopoly buyer of domestic wheat, compared to the base case, Canada would reduce exports, increase domestic sales, and therefore reduce imports. While the European Community, Australia, and Argentina would increase net exports, only the United States would decrease net exports because decreases in Canada's imports results in a decrease in the United States' exports to Canada. Under the scenario where the CWB and AWB are eliminated, Canada would reduce net exports. The largest gains of eliminating the CWB and AWB would go to the European Community in the form of increased exports, while other exporters would have only minor increases in net exports. Interestingly, there would be almost no changes in Australia's situation after eliminating AWB. This is partly because the AWB was already deregulated in 1997 and it is no longer a monopoly buyer of domestic wheat. Also, there would be only small differences in Canada's situation between a case assuming the CWB with no monopoly buying right and a complete elimination of the CWB. These results imply that being a monopoly buyer is more important for the exporting STE than only being a monopoly exporter. The simulation results also revealed that export prohibition by COFCO and FCI would have almost no effects on world wheat trade.

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Measuring the Effects of Eliminating State Trading Enterprises on the World Wheat Sector

One of the most controversial issues in the new World Trade Organization (WTO) agricultural concerns state trading enterprises (STEs).[1] There are two types of STEs: exporting and importing STEs. Examples of exporting STEs include the Canadian Dairy Commission (CDC), Canadian Wheat Board (CWB), Australian Dairy Corporation (ADC), Australian Wheat Board (AWB), and the New Zealand Dairy Board (NZDB). The most important role of these enterprises is the implementation of price discrimination between domestic and export markets to maximize the total sales values for the country's producers. When there are higher domestic prices, lower export prices, and pooled revenues distributed to farmers, the system is equivalent to an export subsidy.[2] Another type of price discrimination practice by exporting STEs is to export the same quality goods at different prices between countries in the world market in order to maximize pooled total revenues from export markets. Although private export firms' price discrimination of this kind is not prohibited, the practice certainly decreases world economic welfare if the discriminated price gap is larger than the difference explained by transportation costs. STEs with the monopoly right for buying and selling domestic products, e.g., Canadian STEs, can exercise both of the above price discrimination practices with pooling schemes. However, exporting STEs such as the AWB can exercise only the practices between export markets because Australian STEs are no longer monopoly buyers in the domestic market. Since deregulation occurred in 1997, Australian producers can sell their products to domestic buyers

[1] The state-owned or private enterprises exporting or importing by the single desk are referred to as STEs in this paper. The term, single desk, means the authorized exclusive right for monopoly trading.

[2] Indeed, the CDC's "special" milk class system, which creates substantially lower prices for milk used for exporting products, was already judged to be equivalent to an export subsidy by the WTO court. Legal questions still remain as to whether other exporting STEs such as the CWB, ADC, AWB, and NZDB are exempted from rules for reducing export subsidy schemes under the WTO agreements.

other than STEs. Opponents of exporting STEs argue the above price discrimination practices are "hidden" export subsidies and should be included in the "yellow box" supports, which must be reduced according to the WTO agreements.

Importing STEs are designed to restrict imports into a country. Examples of importing STEs include the Japanese Food Agency, the China National Cereals, Oils & Foodstuffs Import & Export Corporation (COFCO), and the Indian Food Corporation (FCI). Some importing STEs impose mark-ups on imports within tariff-rate quotas. The WTO has ruled that the mark-ups imposed by importing STEs are equivalent to tariffs, which are already regulated under the agreements.

To examine the impacts of various options to regulate STEs in the WTO agreements, a comprehensive world trade policy simulation model is necessary for measuring the alternative policy impacts. Several models have been used to measure the effects of STEs on world agricultural trade (e.g., Alston and Gray, Brooks and Schmitz, Carter, Loyns and Berwald, Fulton, Larue and Veeman, McCorriston and MacLaren, Schmitz and Gray, and Suzuki and Kaiser). However, some of these models incorporate only price discrimination between domestic and export sales, while some incorporate only price discrimination between different export markets. Some models incorporate Canadian-type STEs, but not Australian-type, and none of them incorporate importing STEs. Moreover, most models have only two regions: one country and the rest of world. The previous models have not incorporated a comprehensive set of domestic and trade policies, or transportation costs. There have been no comprehensive, multi-regional policy simulation models that can simultaneously analyze various STE types.

The objective of this paper is to present a comprehensive, multi-regional trade model which includes all types of STEs as well as other domestic and trade policies. The model is applied to measure the effects of STEs on the world wheat sector where exports and imports by STEs are dominant. The STE model is based on a trade and policy simulation model by Maeda, Suzuki, and Kaiser (MSK). The MSK model is a nonlinear imperfectly competitive spatial equilibrium model formulated as a mixed complementarity problem (MCP). The MSK model can be used to evaluate the following various trade and domestic support policies: specific duties, *ad valorem* tariffs, tariff-rate quotas, export subsidies, production subsidies, production quotas, consumption taxes and price floors, combined with various imperfectly competitive market structures. However, it does not explicitly incorporate STEs. We incorporate both Canadian and Australian types of exporting STEs into the model. Importing STEs, like the Japanese Food Agency, are treated as specific duties in the model since their mark-ups are imposed on imports within tariff-rate quotas. In addition, we introduce Chinese and Indian STEs (COFCO and FCI) which act as an exclusive importer and prohibit exports. The effects of relaxing the export prohibition due to China's entry to the WTO is one of the focal points to be analyzed.

The STE model

Assumptions

Consider international trade among n ($n \geq 2$) countries. In each country, there are three administratively different markets: (1) a domestic market with no tariffs, (2) an in-quota import market with lower tariffs, i.e., the so-called minimum or current access market, and (3) an over-quota import market with higher tariffs. Products in the three markets are not differentiated by consumers, i.e., there is only one demand function in each country. Consumers in each country are assumed to behave as price-takers.

STEs are classified into three types: Australian, Canadian, and Chinese. The Australian-type STE is a Cournot player acting as a consignment seller of the commodity in both the domestic and export markets. The STE pools all returns and distributes them back to perfectly competitive producers. The Cournot player maximizes profits with the expectation that his rivals will not change their supply in response to changes in his supply. While the Australian-type STE is an exclusive exporter, it is not an exclusive buyer because producers are allowed to sell to other buyers in the market. Similar to the Australian STE, the Canadian-type STE is also is a Cournot player acting as a consignment seller of the commodity in both the domestic and export markets. However, unlike the Australian-type STE, the Canadian-type STE is an exclusive buyer of domestic products as well as an exclusive exporter. The Chinese-type STE is an exclusive importer, but has no market power over import and domestic prices. It does not export any products and prohibits producers' exports. Because the mark-ups imposed by the Japanese STE is equivalent to specific duties on in-quota imports, no special category of STE is considered here.

Producers in countries without STEs are classified into two types: (1) price-taking producers, and (2) producers behaving as Cournot players. All demand and cost functions are assumed to be continuously differentiable. It is also assumed that unit transportation costs are constant regardless of quantity shipped, and there is no forwarding transportation between countries.

Notations

Notations used in this paper are as follows:

Y : quantity produced;

X^{fd} : quantity supplied from producers to domestic market in a country with STE;

X^{fg} : quantity supplied from producers to STE;

X^{d} : quantity supplied from STE or producers to domestic market;

X^{p} : quantity exported to in-quota market;

X^{s} : quantity exported to over-quota market;

X^{ep} : quantity exported with export subsidy to in-quota market;

X^{es} : quantity exported with export subsidy to over-quota market;

X^{m} : quantity imported by STE;

P : market price;

PP : STE's pooled price;

W : STE's import price;

$C = C(Y)$: cost function;

$D = D(P)$: demand function;

ST^{p} : in-quota specific duty rate;

ST^{s} : over-quota specific duty rate;

AT^{p} : in-quota *ad valorem* tariff rate;

AT^{s} : over-quota *ad valorem* tariff rate;

$\overline{X^{p}}$: tariff-rate quota;

ES : specific export subsidy;

$\overline{X^{e}}$: upper limit of subsidized quantity exported;

PS : (specific) producer subsidy;

$\overline{Y}$: production quota;

$\underline{P}$: price floor;

CT : (*ad valorem*) consumption tax rate;

TC : unit transportation cost between countries;

TC^d : unit transportation cost inside the country;

where $ST^p < ST^s$ and $AT^p < AT^s$. Subscripts, *h, i, j* and *k* are put on the above notations. Subscripts *h* and *j* indicate producing and consuming areas in countries with exporting STEs, respectively. Both producing and consuming areas in countries with importing STEs are indicated by *k*. Subscripts *i* and *j* indicate producing and consuming areas in countries with no STEs, respectively. Subscript *i* in X_{ij} means "from *i* " and *j* in X_{ij} means "to *j*." Subscripts, *h, i, j* and *k* are natural numbers.

Necessary Conditions for Profit Maximization of the Australian-Type STE and Producers with the STE

Using the above notation, the constrained optimization problem for the Australian-type STE's in country *h* can be expressed as:

(1)
$$\begin{aligned}
\max_{\substack{X_{hj}^d, X_{hj}^p, X_{hj}^s, X_{hj}^{ep}, X_{hj}^{es},\\ X_{hk}^p, X_{hk}^s, X_{hk}^{ep}, X_{hk}^{es}}} \quad \pi_h &= \sum_j P_j\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right) - \sum_j TC_{hj}^d X_{hj}^d - \sum_j TC_{hj}\left(X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right) \\
&- \sum_j ST_j^p\left(X_{hj}^p + X_{hj}^{ep}\right) - \sum_j AT_j^p P_j\left(X_{hj}^p + X_{hj}^{ep}\right) - \sum_j ST_j^s\left(X_{hj}^s + X_{hj}^{es}\right) - \sum_j AT_j^s P_j\left(X_{hj}^s + X_{hj}^{es}\right) \\
&+ \sum_k W_k\left(X_{hk}^p + X_{hk}^s + X_{hk}^{ep} + X_{hk}^{es}\right) - \sum_k TC_{hk}\left(X_{hk}^p + X_{hk}^s + X_{hk}^{ep} + X_{hk}^{es}\right) \\
&- \sum_k ST_k^p\left(X_{hk}^p + X_{hk}^{ep}\right) - \sum_k AT_k^p W_k\left(X_{hk}^p + X_{hk}^{ep}\right) - \sum_k ST_k^s\left(X_{hk}^s + X_{hk}^{es}\right) - \sum_k AT_k^s W_k\left(X_{hk}^s + X_{hk}^{es}\right) \\
&+ ES_h\left\{\sum_j\left(X_{hj}^{ep} + X_{hj}^{es}\right) + \sum_k\left(X_{hk}^{ep} + X_{hk}^{es}\right)\right\}
\end{aligned}$$

$$s.t. \quad \sum_j\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right) + \sum_k\left(X_{hk}^p + X_{hk}^s + X_{hk}^{ep} + X_{hk}^{es}\right) \le X_h^{fg}$$

$$\sum_h\left(X_{hj}^p + X_{hj}^{ep}\right) + \sum_i\left(X_{ij}^p + X_{ij}^{ep}\right) \le \overline{X_j^p}$$

$$\sum_h \left(X_{hk}^p + X_{hk}^{ep}\right) + \sum_i \left(X_{ik}^p + X_{ik}^{ep}\right) \le \overline{X_k^p}$$

$$\sum_j \left(X_{hj}^{ep} + X_{hj}^{es}\right) + \sum_k \left(X_{hk}^{ep} + X_{hk}^{es}\right) \le \overline{X_h^e}$$

where $X_{hj}^d, X_{hj}^p, X_{hj}^s, X_{hj}^{ep}, X_{hj}^{es}, X_{hk}^p, X_{hk}^s, X_{hk}^{ep}$, and X_{hk}^{es} are non-negative variables. Values for $TC_{hj}^d\ (h \ne j)$ and TC_{hh} are set at extremely large numbers in order that $X_{hj}^d\ (h \ne j), X_{hh}^p, X_{hh}^s, X_{hh}^{ep}$, and X_{hh}^{es} be zero. In the case where countries *j* and *k* do not have the tariff-rate quota system, values for ST^p, AT^p, and $\overline{X^p}$ are zero, and over-quota tariff rates, ST^s and AT^s, are applied to all imports to the country.

The Kuhn-Tucker optimality conditions for the above maximization problem can be expressed as follows:

(2) $$P_j + \frac{dP_j}{dD_j}\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right) \le TC_{hj}^d + \alpha_h, \quad X_{hj}^d \ge 0,$$

$$X_{hj}^d\left[TC_{hj}^d + \alpha_h - P_j - \frac{dP_j}{dD_j}\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right)\right] = 0$$

(3) $$P_j + \frac{dP_j}{dD_j}\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right) \le TC_{hj} + ST_j^p + AT_j^p\left\{P_j + \frac{dP_j}{dD_j}\left(X_{hj}^p + X_{hj}^{ep}\right)\right\} + \alpha_h + \beta_{hj}, \quad X_{hj}^p \ge 0,$$

$$X_{hj}^p\left[TC_{hj} + ST_j^p + AT_j^p\left\{P_j + \frac{dP_j}{dD_j}\left(X_{hj}^p + X_{hj}^{ep}\right)\right\} + \alpha_h + \beta_{hj} - P_j - \frac{dP_j}{dD_j}\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right)\right] = 0$$

(4) $$P_j + \frac{dP_j}{dD_j}\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right) \le TC_{hj} + ST_j^s + AT_j^s\left\{P_j + \frac{dP_j}{dD_j}\left(X_{hj}^s + X_{hj}^{es}\right)\right\} + \alpha_h, \quad X_{hj}^s \ge 0,$$

$$X_{hj}^s\left[TC_{hj} + ST_j^s + AT_j^s\left\{P_j + \frac{dP_j}{dD_j}\left(X_{hj}^s + X_{hj}^{es}\right)\right\} + \alpha_h - P_j - \frac{dP_j}{dD_j}\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right)\right] = 0$$

(5) $$P_j + \frac{dP_j}{dD_j}\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right) + ES_h \le TC_{hj} + ST_j^p + AT_j^p\left\{P_j + \frac{dP_j}{dD_j}\left(X_{hj}^p + X_{hj}^{ep}\right)\right\} + \alpha_h + \beta_{hj} + \gamma_h, \quad X_{hj}^{ep} \ge 0,$$

$$X_{hj}^{ep}\left[TC_{hj}+ST_j^p+AT_j^p\left\{P_j+\frac{dP_j}{dD_j}\left(X_{hj}^p+X_{hj}^{ep}\right)\right\}+\alpha_h+\beta_{hj}+\gamma_h-P_j-\frac{dP_j}{dD_j}\left(X_{hj}^d+X_{hj}^p+X_{hj}^s+X_{hj}^{ep}+X_{hj}^{es}\right)-ES_h\right]=0$$

(6) $$P_j+\frac{dP_j}{dD_j}\left(X_{hj}^d+X_{hj}^p+X_{hj}^s+X_{hj}^{ep}+X_{hj}^{es}\right)+ES_h\le TC_{hj}+ST_j^s+AT_j^s\left\{P_j+\frac{dP_j}{dD_j}\left(X_{hj}^s+X_{hj}^{es}\right)\right\}+\alpha_h+\gamma_h,\ X_{hj}^{es}\ge 0,$$

$$X_{hj}^{es}\left[TC_{hj}+ST_j^s+AT_j^s\left\{P_j+\frac{dP_j}{dD_j}\left(X_{hj}^s+X_{hj}^{es}\right)\right\}+\alpha_h+\gamma_h-P_j-\frac{dP_j}{dD_j}\left(X_{hj}^d+X_{hj}^p+X_{hj}^s+X_{hj}^{ep}+X_{hj}^{es}\right)-ES_h\right]=0$$

(7) $$W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)\le TC_{hk}+ST_k^p+AT_k^p\left\{W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^{ep}\right)\right\}+\alpha_h+\beta_{hk},\ X_{hk}^p\ge 0,$$

$$X_{hk}^p\left[TC_{hk}+ST_k^p+AT_k^p\left\{W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^{ep}\right)\right\}+\alpha_h+\beta_{hk}-W_k-\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)\right]=0$$

(8) $$W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)\le TC_{hk}+ST_k^s+AT_k^s\left\{W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^s+X_{hk}^{es}\right)\right\}+\alpha_h,\ X_{hk}^s\ge 0,$$

$$X_{hk}^s\left[TC_{hk}+ST_k^s+AT_k^s\left\{W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^s+X_{hk}^{es}\right)\right\}+\alpha_h-W_k-\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)\right]=0$$

(9) $$W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)+ES_h\le TC_{hk}+ST_k^p+AT_k^p\left\{W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^{ep}\right)\right\}+\alpha_h+\beta_{hk}+\gamma_h,\ X_{hk}^{ep}\ge 0,$$

$$X_{hk}^{ep}\left[TC_{hk}+ST_k^p+AT_k^p\left\{W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^{ep}\right)\right\}+\alpha_h+\beta_{hk}+\gamma_h-W_k-\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)-ES_h\right]=0$$

(10) $$W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)+ES_h\le TC_{hk}+ST_k^s+AT_k^s\left\{W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^s+X_{hk}^{es}\right)\right\}+\alpha_h+\gamma_h,\ X_{hk}^{es}\ge 0,$$

$$X_{hk}^{es}\left[TC_{hk}+ST_k^s+AT_k^s\left\{W_k+\frac{dW_k}{dX_k^m}\left(X_{hk}^s+X_{hk}^{es}\right)\right\}+\alpha_h+\gamma_h-W_k-\frac{dW_k}{dX_k^m}\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)-ES_h\right]=0$$

(11) $$\sum_j\left(X_{hj}^d+X_{hj}^p+X_{hj}^s+X_{hj}^{ep}+X_{hj}^{es}\right)+\sum_k\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)\le X_h^{fg},\ \alpha_h\ge 0,$$

$$\alpha_h\left[X_h^{fg}-\sum_j\left(X_{hj}^d+X_{hj}^p+X_{hj}^s+X_{hj}^{ep}+X_{hj}^{es}\right)-\sum_k\left(X_{hk}^p+X_{hk}^s+X_{hk}^{ep}+X_{hk}^{es}\right)\right]=0$$

(12) $\sum_h \left(X_{hj}^p + X_{hj}^{ep}\right) + \sum_i \left(X_{ij}^p + X_{ij}^{ep}\right) \le \overline{X_j^p}$, $\beta_{hj} \ge 0$, $\beta_{hj}\left[\overline{X_j^p} - \sum_h \left(X_{hj}^p + X_{hj}^{ep}\right) - \sum_i \left(X_{ij}^p + X_{ij}^{ep}\right)\right] = 0$

(13) $\sum_h \left(X_{hk}^p + X_{hk}^{ep}\right) + \sum_i \left(X_{ik}^p + X_{ik}^{ep}\right) \le \overline{X_k^p}$, $\beta_{hk} \ge 0$, $\beta_{hk}\left[\overline{X_k^p} - \sum_h \left(X_{hk}^p + X_{hk}^{ep}\right) - \sum_i \left(X_{ik}^p + X_{ik}^{ep}\right)\right] = 0$

(14) $\sum_j \left(X_{hj}^{ep} + X_{hj}^{es}\right) + \sum_k \left(X_{hk}^{ep} + X_{hk}^{es}\right) \le \overline{X_h^e}$, $\gamma_h \ge 0$, $\gamma_h\left[\overline{X_h^e} - \sum_j \left(X_{hj}^{ep} + X_{hj}^{es}\right) - \sum_k \left(X_{hk}^{ep} + X_{hk}^{es}\right)\right] = 0$

where $\left\{P_j + \frac{dP_j}{dD_j}\left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right)\right\}$ and $\left\{W_k + \frac{dW_k}{dX_k^m}\left(X_{hk}^p + X_{hk}^s + X_{hk}^{ep} + X_{hk}^{es}\right)\right\}$ indicate "perceived" marginal revenues by country *h*'s STE in country *j* and *k*'s markets, respectively. The relation $\left\{\frac{dW_k}{dX_k^m} = \frac{dP_k}{dD_k}\right\}$ holds because $\{W_k = P_k\}$ as shown later. α_h, β_{hj}, β_{hk}, and γ_h are the Lagrange multipliers for the above four constraints in the problem (1), respectively. For country *h*'s STE, β_{hj} and β_{hk} are the shadow prices for the right to export the in-quota markets in countries *j* and *k*, respectively. Assuming that the market for this right is perfectly competitive in countries *j* and *k*, producers in all countries should face the same shadow price for this right in countries *j* and *k*. Throughout this paper, the competitive shadow price in countries *j* and *k* is expressed as β_j and β_k, respectively. A relatively high shadow price means more expansion of tariff-rate quotas in countries *j* and *k* is demanded. The parameter γ_h is the shadow prices for the right for country *h*'s STE to export within the upper limit of subsidized quantity exported in country *h*, respectively.

Theoretically, introducing the conjectural variations concept into the above model can generalize the model to incorporate any degree of market structure from perfect competition to monopoly. However, conjectural variations in the generalized model cannot be estimated in the same manner as Suzuki, Lenz and Forker, in cases where X^p, X^s, X^{ep} and X^{es} are zero, and tariff-rate quotas and limits of subsidized quantity exported are effective. Therefore, we use the above model without introducing conjectural variations, and find plausible market structures by simulating a lot of combinations of producers' marketing behavior according to Kawaguchi, Suzuki and Kaiser.

Profits earned by the STE are returned to producers using the pooled price defined by the following equation:

(15) $$PP_h = \frac{\pi_h}{\sum_j \left(X_{hj}^d + X_{hj}^p + X_{hj}^s + X_{hj}^{ep} + X_{hj}^{es}\right) + \sum_k \left(X_{hk}^p + X_{hk}^s + X_{hk}^{ep} + X_{hk}^{es}\right)}$$

Producers sell their products to either the STE or the domestic market *j* with the pooled price and the domestic market price given. Profit maximization behavior of producers with Australian-type STE in country *h* can be expressed as the following constrained optimization problem:

(16) $$\underset{Y_h, X_h^{fg}, X_{hj}^{fd}}{Max} \quad \pi_h' = PP_h X_h^{fg} + \sum_j P_j X_{hj}^{fd} - C_h(Y_h) + PS_h Y_h - \sum_j TC_{hj}^d X_{hj}^{fd}$$

$$s.t. \quad X_h^{fg} + \sum_j X_{hj}^{fd} \leq Y_h$$

$$Y_h \leq \overline{Y_h}$$

where Y_h, X_h^{fg}, and X_{hj}^{fd} are non-negative variables. A value for TC_{hj}^d ($h \neq j$) is set at extremely large numbers in order that X_{hj}^{fd} ($h \neq j$) be zero. The Kuhn-Tucker optimality conditions for the above maximization problem can be expressed as follows:

(17) $$PP_h \leq \alpha_h^f, \; X_h^{fg} \geq 0, \; X_h^{fg}\left[\alpha_h^f - PP_h\right] = 0$$

(18) $$P_j \leq TC_{hj}^d + \alpha_h^f, \; X_{hj}^{fd} \geq 0, \; X_{hj}^{fd}\left[TC_{hj}^d + \alpha_h^f - P_j\right] = 0$$

(19) $$PS_h + \alpha_h^f \leq \frac{dC_h}{dY_h} + \delta_h, \; Y_h \geq 0, \; Y_h\left[\frac{dC_h}{dY_h} + \delta_h - PS_h - \alpha_h^f\right] = 0$$

(20) $X_h^{fg}+\sum_j X_{hj}^{fd}\le Y_h,\ \alpha_h^f\ge 0,\ \alpha_h^f\left[Y_h-X_h^{fg}-\sum_j X_{hj}^{fd}\right]=0$

(21) $Y_h\le\overline{Y}_h,\ \delta_h\ge 0,\ \delta_h\left[\overline{Y}_h-Y_h\right]=0$

where α_h^f and δ_h are the Lagrange multipliers for the above two constraints in the problem (16), respectively. Condition (19) shows that the relation $\left[\frac{dC_h}{dY_h}+\delta_h-PS_h=\alpha_h^f\right]$ holds if there is any production in country *h*. δ_h is the shadow prices for the right to produce within production quotas in country *h*.

Necessary Conditions for Profit Maximization of the Canadian-Type STE and Producers with the STE

The Canadian-type STE's profit maximizing behavior is the same as the Australian-type STE's. Therefore, necessary conditions for the Canadian-type STE's profit maximization are also expressed by conditions (2) to (14). However, unlike the Australian-type STE case, producers are not allowed to sell their products to any buyers other than the STE. Thus, necessary conditions for producers' profit maximization are modified from the Australian-type STE case, by eliminating condition (18) and all X_{hj}^{fd} terms from conditions (17) to (21).

Necessary Conditions for Profit Maximization of the Chinese-Type STE and Producers with the STE

The Chinese-type STE is an exclusive importer, but has no market power over import and domestic prices. The Chinese-type STE's profit maximizing behavior in country *k* can be expressed as:

(22) $\underset{X_k^d,X_k^m}{Max}\quad \pi_k=P_kX_k^d-W_kX_k^m-TC_{kk}^dX_k^d$

$$s.t.\ \ X_k^d \le X_k^m$$

where X_k^d and X_k^m are non-negative variables. The Kuhn-Tucker optimality conditions for the above maximization problem (22) can be expressed as follows:

(23) $P_k \le TC_{kk}^d + \alpha_k,\ X_k^d \ge 0,\ X_k^d\left[TC_{kk}^d + \alpha_k - P_k\right] = 0$

(24) $\alpha_k \le W_k,\ X_k^m \ge 0,\ X_k^m\left[W_k - \alpha_k\right] = 0$

(25) $X_k^d \le X_k^m,\ \alpha_k \ge 0,\ \alpha_k\left[X_k^m - X_k^d\right] = 0$

From conditions (23) to (24), it is clear that the market price is equal to the import price whenever the STE is active (i.e., $X_k^d > 0$ and $X_k^m > 0$) since TC_{kk}^d must be zero. The Lagrange multiplier α_k is equal to the market and import prices. When these prices are positive, X_k^d is equal to X_k^m.

Producers are not allowed to export any products in a country with the Chinese-type STE. Profit maximization behavior of producers with Chinese-type STE in country *k* can be expressed as:

(26) $\underset{Y_k, X_k^{fd}}{Max}\ \ \pi_k' = P_k X_k^{fd} - C_k(Y_k) + PS_k Y_k - TC_{kk}^d X_k^{fd}$

$$s.t.\ \ X_k^{fd} \le Y_k$$

$$Y_k \le \overline{Y_k}$$

where Y_k and X_k^{fd} are non-negative variables. The Kuhn-Tucker optimality conditions for the above maximization problem (26) can be expressed as follows:

(27) $P_k \le TC_{kk}^d + \alpha_k^f,\ X_k^{fd} \ge 0,\ X_k^{fd}\left[TC_{kk}^d + \alpha_k^f - P_k\right] = 0$

(28) $PS_k + \alpha_k^f \le \dfrac{dC_k}{dY_k} + \delta_k,\ Y_k \ge 0,\ Y_k\left[\dfrac{dC_k}{dY_k} + \delta_k - PS_k - \alpha_k^f\right] = 0$

(29) $X_k^{fd} \leq Y_k$, $\alpha_k^f \geq 0$, $\alpha_k^f\left[Y_k - X_k^{fd}\right] = 0$

(30) $Y_k \leq \overline{Y}_k$, $\delta_k \geq 0$, $\delta_k\left[\overline{Y}_k - Y_k\right] = 0$

where α_k^f and δ_k are the Lagrange multipliers for the above two constraints in the problem (26), respectively, with the same meanings as the Australian-type STE case.

Necessary Conditions for Profit Maximization of Producers with no STEs

Profit maximizing behavior of producers in country *i* with no STE is expressed in the same fashion as Maeda, Suzuki, and Kaiser. Because production and marketing are made by producer themselves, the term $\{-C_i(Y_i) + PS_i Y_i\}$ is included in the objective function in the maximization problem (1). The right-hand side of the first constraint is replaced with Y_i. The new fifth constraint, $\{Y_i \leq \overline{Y}_i\}$, is added at the problem (1). Each subscript *h* is replaced with subscript *i*, except for the second and third constraints.

Accordingly, necessary conditions (2) to (14) are changed as follows:

First, the following two conditions are added.

(31) $PS_i + \alpha_i \leq \dfrac{dC_i}{dY_i} + \delta_i$, $Y_i \geq 0$, $Y_i\left[\dfrac{dC_i}{dY_i} + \delta_i - PS_i - \alpha_i\right] = 0$

(32) $Y_i \leq \overline{Y}_i$, $\delta_i \geq 0$, $\delta_i\left[\overline{Y}_i - Y_i\right] = 0$

Next, each X_h^{fg} is replaced with Y_i in condition (11). Each subscript *h* is replaced with *i*, except for conditions (12) and (13). The meanings of the Lagrange multipliers are the same as those already mentioned.

Market Equilibrium Conditions

The market equilibrium condition in country *j* can be expressed as follows:

(33) $D_j\{P_j(1+CT_j)\} = \sum_h \left(X_{hj}^{fd} + X_{hj}^{d} + X_{hj}^{p} + X_{hj}^{s} + X_{hj}^{ep} + X_{hj}^{es}\right) + \sum_i \left(X_{ij}^{d} + X_{ij}^{p} + X_{ij}^{s} + X_{ij}^{ep} + X_{ij}^{es}\right),\ P_j \ge \underline{P_j}$, or

(34) $D_j\{P_j(1+CT_j)\} < \sum_h \left(X_{hj}^{fd} + X_{hj}^{p} + X_{hj}^{s} + X_{hj}^{ep} + X_{hj}^{es}\right) + \sum_i \left(X_{ij}^{d} + X_{ij}^{p} + X_{ij}^{s} + X_{ij}^{ep} + X_{ij}^{es}\right),\ P_j = \underline{P_j}$

Similarly, the market equilibrium condition in country *k* with the Chinese-type STE can be expressed as follows:

(35) $D_k\{P_k(1+CT_k)\} \le X_k^d + X_k^{fd},\ P_k \ge 0,\ P_k\left[X_k^d + X_k^{fd} - D_k\{P_k(1+CT_k)\}\right] = 0$

The Chinese-type STE's import price in country *k* is determined at the level that its import demand is equalized to total supply from abroad. That is,

(36) $X_k^m \le \sum_h \left(X_{hk}^p + X_{hk}^s + X_{hk}^{ep} + X_{hk}^{es}\right) + \sum_i \left(X_{ik}^p + X_{ik}^s + X_{ik}^{ep} + X_{ik}^{es}\right)$, $W_k \ge 0$,

$$W_k\left[\sum_h \left(X_{hk}^p + X_{hk}^s + X_{hk}^{ep} + X_{hk}^{es}\right) + \sum_i \left(X_{ik}^p + X_{ik}^s + X_{ik}^{ep} + X_{ik}^{es}\right) - X_k^m\right] = 0$$

The spatial equilibrium model consists of the above conditions formulated as the MCP.[3] The Nash equilibrium solution for these conditions is the spatial equilibrium solution. The solution is found by the pathsearch damped Newton method (Ralph; Dirkse and Ferris; Anstreicher, Lee and Rutherford).

An Application

Data

The model is applied to a policy simulation of international wheat sector, where STEs play a dominant role in influencing exports and imports. Indeed, existing international wheat trade barriers is one of the most controversial areas of WTO agricultural negotiations. Most of the data comes from Maeda, Suzuki, and Kaiser. Additional data on the mark-ups imposed by the

[3] Harker and Pang, Ferris and Pang, and Ferris and Kanzow present excellent surveys on complementarity problems including MCP and their applications.

Japanese Food Agency on in-quota imports are also incorporated. Five major exporting countries and areas (United States, Canada, European Union, Australia and Argentina) sharing about 85 percent of total exports in the international wheat market are included in the model. In addition, nine other countries and areas (China, Egypt, India, Japan, South Korea, Mexico, New Zealand, Nigeria and the former Soviet Union) are included. The following STEs are included: AWB (as the Australian-type STE), CWB (as the Canadian-type STE), COFCO and FCI (as the Chinese-type STEs). Recall that the Japanese STE's mark-up is included as an additional specific duty on the in-quota market.

Table 1 shows trade and domestic support policies for wheat in each country and area. Tariff rates and tariff quotas represent levels in 2000 committed by each country under the WTO agreement. It is assumed that specific export subsidies in 2000, calculated by dividing the committed value limit by the committed volume limit, can be used within the committed volume limit even though WTO agreements require countries to reduce the volume and value of subsidized export. China's trade and domestic support policies represent levels applied in 1998 because it is currently a non-WTO member. Likewise, Russia' s figures in 1998 are used for the former USSR. Specific duty rates and export subsidies are converted into U.S. dollars by using exchange rates at the end of 1998. Instead of the total Aggregate Measure of Support (AMS) in the WTO agreements, we use the unit PSE (converted into U.S. dollars) for wheat as (specific) production subsidies because we are focusing only on wheat trade. Although price floors are set at producer prices, this model sets the price floor at the border price in each country and area by using the relationship that the border price is equal to the producer price minus unit MPS (or Market Price Support). See Maeda, Suzuki, and Kaiser for more explanation on data.

This study uses demand and inverse marginal cost functions in each country and area estimated by Maeda, Suzuki, and Kaiser. Long-run price elasticities are used for the estimation. They are shown in table 2 and specified as follows:

(37) $D = DD \cdot N = (a + bP)N$

(38) $Y = YY \cdot A = YY(cPF^{d})$

where *DD* and *N* are quantity demanded and population, respectively; *YY*, *A*, and *PF* are yield, cultivated area and marginal cost, respectively; and *a, b, c,* and *d* are parameters. This study also uses the transportation costs between major ports estimated by Maeda, Suzuki, and Kaiser. They are shown in table 3.

Scenarios

Five scenarios are simulated to measure the effects of STEs on the world wheat trade. Scenario 1 is the base scenario, where all STEs are active under the committed 2000 levels of trade and domestic support policies according to the current WTO agricultural agreements shown in table 1. Trade and domestic policies in China and the former USSR shown in table 1 are also assumed to remain unchanged. Among countries with no STEs, the three major exporting countries and areas (United States, European Union, and Argentina) are assumed to behave as Cournot players, and other seven countries and areas (Egypt, Japan, South Korea, Mexico, New Zealand, Nigeria and the former Soviet Union) are assumed to behave as price takers in simulation. This scenario is indicative of long-term effects of maintaining the current wheat world market situation. For simplification, only specific duties are imposed on over-quota imports in Mexico and the United States. All levels of other domestic support policies, population, yield and unit transportation costs shown in tables 1 to 3 are assumed to remain unchanged. Population, yield and unit transportation costs are the same in all scenarios.

In addition to the baseline, there are four scenarios reflecting various options for STEs. Under Scenario 2, it is assumed that the Canadian STE (CWB) is deregulated to the same level as the Australian STE (AWB) and all other trade and domestic support policies are the same as scenario 1. Canadian producers are allowed to sell their wheat to any buyers other than CWB. In Scenarios 3, it is assumed that the CWB and AWB are eliminated and all other trade and domestic support policies are the same as Scenario 1. Canadian and Australian producers are assumed to become price takers. Under Scenario 4, it is assumed that COFCO and FCI are eliminated and all other trade and domestic support policies are the same as Scenario 1. That is, the effects of eliminating export prohibition in China and India are simulated in this scenario. Scenario 5 is the most extreme one, where it is assumed that all STEs (CWB, AWB, COFCO and FCI) are eliminated and all other trade and domestic support policies are the same as Scenario 1. Because we focus on estimating the effects of STEs on world wheat trade in this study, all trade and domestic support policies other than STEs are kept unchanged for all scenarios.

The Results

Table 4 shows the spatial equilibrium solution for Scenario 1. First, Scenario 1 was solved assuming three different market structures: (1) a case where producers in all countries and areas behave as a price taker, (2) a case where producers form a coalition to monopolize the international markets, and (3) a case where producers behave as a Cournot players. Although solutions in the above three cases are not shown, they were not realistic solutions. For example, the first and second cases resulted in highly simplistic world trade structures. The second and third cases resulted in extremely high market prices. As shown in table 4, the solution that was the closest to the actual world wheat trade structure was the case where producers in Argentina, European Community and the United States are Cournot players, and producers in the other seven countries and areas (Egypt, Japan, South Korea, Mexico, New Zealand, Nigeria and the former Soviet Union) are price takers, except the four countries with STEs (Australia, Canada, China, and India). Therefore, we used the fourth case as the basic market structure for simulating all four scenarios.

The results for the base scenario, where all STEs are active with the committed 2000 levels remaining the same, are displayed in table 4. In this situation, Canada, the United States, the European Community, and Australia are the largest net exporters (net exports of 22.3, 13.8, 13.7, and 12.4 million metric tons, respectively). Total world trade is almost 122 million metric tons. Compared to the simulation results of the base scenario by Maeda, Suzuki, and Kaiser's model with no STEs, Canadian and Australian net exports are larger and net exports of the United States and the European Community are smaller.[4] The fact that some of the discrepancy in results between the base scenarios of this study and Maeda, Suzuki, and Kaiser's study are relatively large suggests that it is important to incorporate the roles of CWB and AWB in the world wheat trade model. There is a high degree of price discrimination in Canada where the differences between domestic and pooled prices are large ($185 and $93). Although the European Community has no STE, it is still the world's third largest net exporter of wheat due mainly to a high degree of domestic market protection as shown by Maeda, Suzuki, and Kaiser. On the other hand, the United States has a relatively low degree of protection for its wheat market. Second only to Canada in terms of net exports, the United States has one of the lowest wheat market prices among all the exporters (almost one-half the market price of Canada and the European Community).

The simulation results for Scenario 2 are reported in table 5, where the CWB is no longer a monopoly buyer of domestic wheat. Compared to the base scenario, Canada would reduce exports by 4.9 million metric tons, increase domestic sales by 4.6 million metric tons, and therefore reduce imports by 3.3 million metric tons. Total world trade volume would decrease from 122 to116 million metric tons. The European Community, Australia, and Argentina would increase net exports, but only the United States would decrease net exports because decreases in Canada's imports results in a decrease in the United States' exports to Canada. On the other hand, importing countries would reduce net imports.

The simulation results for Scenario 3 are reported in table 6, where the CWB and AWB are eliminated. Compared to the base scenario, Canada would reduce exports by 5.2 million metric tons, increase domestic sales by 4.6 million metric tons, and reduce imports by 3.3 million metric tons. Total world trade volume would decrease from 122 to112 million metric tons. The largest gains from eliminating the CWB and AWB would go to the European Community, where net exports increase by 2.7 million metric tons. Other exporters, such as the United States, Australia, and Argentina would only have a marginal increase in net exports relative to the base scenario levels. Interestingly, there would be almost no changes in Australia's situation after eliminating the AWB since it was already deregulated in 1997 and it is no longer a monopoly buyer of domestic wheat. Also, there would only be small differences in Canada's situation between Scenarios 2 and 3. These results imply that being a monopoly wheat buyer is more important for the exporting STE than being only a monopoly exporter.

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[4] In their base scenario that did not include STEs, Maeda, Suzuki, and Kaiser estimated net exports for Canada and Australia to be 19.6 and 7.5 million metric tons, respectively, and net exports for the United States and European

The simulation results for Scenario 4 are reported in table 7, where COFCO and FCI are eliminated. This scenario results in almost no changes from the base scenario, except that China would become an exporter to Japan (2.1 million metric tons) since export prohibition by the COFCO is eliminated. Interestingly, the simulation results for Scenario 5 (elimination of all STEs, or CWB, AWB, COFCO, and FCI) are the same as Scenario 3 results (elimination of CWB and AWB). These results imply that export prohibition by COFCO and FCI have almost no effect on world wheat trade.

Conclusions

In this paper, a comprehensive multi-regional model with various types of STEs and domestic and trade policies was developed. The model was applied to measure the effects of STEs on the world wheat sector, where trade is significantly influenced by STEs. The STE model was based on a trade and policy simulation model by Maeda, Suzuki, and Kaiser, and is a nonlinear imperfectly competitive spatial equilibrium model formulated as a mixed complementarity problem (MCP). Both Canadian (CWB) and Australian (AWB) types of exporting STEs were included, as were the Chinese and Indian STEs (COFCO and FCI) that act as exclusive importers and prohibit exports. The mark-ups imposed by the Japanese STE on imports within tariff-rate quotas were treated as specific duties in the model. Finally, the model incorporated the following trade and domestic support policies: specific duties, *ad valorem* tariffs, tariff-rate quotas, export subsidies, production subsidies, production quotas, consumption taxes and price floors.

The main empirical findings are as follows. In the base case where all STEs are active with the committed 2000 levels remaining the same, Canada, the United States, the European

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Community to be 17.6 and 18.3 million metric tons, respectively.

Community, and Australia would be the largest net exporters. By explicitly incorporating the roles of the CWB and AWB into the world wheat trade model, Canadian and Australian net exports became larger than previous estimates. Hence, it is important to include STEs in trade simulation models. In the case where CWB is no longer a monopoly buyer of domestic wheat, compared to the base case, Canada would reduce exports, increase domestic sales, and therefore reduce imports. While the European Community, Australia, and Argentina would increase net exports, only the United States would decrease net exports because decreases in Canada's imports results in a decrease in the United States' exports to Canada. Under the scenario where the CWB and AWB are eliminated, Canada would reduce net exports. The largest gains of eliminating the CWB and AWB would go to the European Community in the form of increased exports, while other exporters would have only minor increases in net exports. Interestingly, there would be almost no changes in Australia's situation after eliminating AWB. This is partly because the AWB was already deregulated in 1997 and it is no longer a monopoly buyer of domestic wheat. Also, there would be only small differences in Canada's situation between a case assuming the CWB with no monopoly buying right and a complete elimination of the CWB. These results imply that being a monopoly buyer is more important for the exporting STE than only being a monopoly exporter. The simulation results also revealed that export prohibition by COFCO and FCI would have almost no effects on world wheat trade.

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Table 1. Trade and Domestic Support Policies in Each Country and Area

(Unit: U.S. dollars per metric ton, million metric tons and percents)

Country or Area	Trade Policies							Domestic Support Policies			
	In-Quota Import Market			Over-Quota Import Market		Specific Export Subsidy	Upper Limit of Subsidized Quantity Exported	(Specific) Production Subsidy	Production Quota	Consumption Tax for Food	Price Floor
	Specific Duty	*Ad Valorem* Tariff	Tariff-Rate Quota	Specific Duty	*Ad Valorem* Tariff						
Argentina	n.a.	n.a.	n.a.	0.000	0.000	0.000	0.000	0.440	n.a.	21.000	n.a.
Australia	n.a.	n.a.	n.a.	0.000	0.000	0.000	0.000	10.374	n.a.	10.000	n.a.
Canada	1.241	0.000	0.227	0.000	76.500	14.693	8.851	9.275	n.a.	0.000	n.a.
China	n.a.	n.a.	n.a.	0.000	114.000	0.000	0.000	-36.000	n.a.	17.000	n.a.
Egypt	n.a.	n.a.	n.a.	0.000	5.000	0.000	0.000	48.000	n.a.	10.000	n.a.
EU	0.000	0.000	0.300	113.596	0.000	101.544	13.436	149.588	96.888	9.800	142.294
India	n.a.	n.a.	n.a.	0.000	100.000	0.000	0.000	-66.000	n.a.	0.000	n.a.
Japan	391.003	0.000	5.740	475.779	0.000	0.000	0.000	1275.087	n.a.	5.000	n.a.
South Korea	n.a.	n.a.	n.a.	0.000	1.800	0.000	0.000	454.900	n.a.	10.000	n.a.
Mexico	0.000	50.000	0.605	90.000	67.000	24.183	0.312	47.552	n.a.	0.000	143.500
New Zealand	n.a.	n.a.	n.a.	0.000	0.000	0.000	0.000	0.000	n.a.	12.500	n.a.
Nigeria	n.a.	n.a.	n.a.	0.000	150.000	0.000	0.000	349.000	n.a.	5.000	n.a.
U.S.	n.a.	n.a.	n.a.	3.500	2.800	25.065	14.522	61.200	n.a.	8.250	94.800
The Former USSR	n.a.	n.a.	n.a.	0.000	5.000	0.000	0.000	39.000	n.a.	0.000	n.a.

Source: Mark-up (specific duty in in-quota market in Japan) from the Japanese Food Agency. All others from Maeda, Suzuki, and Kaiser.

Note: The tariff rates in countiries and areas with no tariff-rate quotas are shown in columns of over-quota import market.
Mexico and the U.S. can select the higher of specific duty or *ad valorem* tariff in their over-quota import markets.
The specific duty rate in the in-quota market in Japan is the upper limit of the mark-up in 2000.

Table 2. Demand and Inverse Marginal Cost Functions in Each Country and Area

(Unit: million people and metric tons per ha)

Country or Area	Demand Function			Inverse Marginal Cost Function		
	Per Capita Demand Function	Price Elasticity	Population	Response Function of Cultivated Area	Price Elasticity	Yield
Argentina	d=0.16845-0.00055P	-0.32	36.577	$L= 0.31628P^{0.60}$	0.60	2.553
Australia	d=0.34949-0.00068P	-0.24	18.701	$L= 0.16427P^{0.90}$	0.90	2.016
Canada	d=0.29091-0.00044P	-0.20	30.857	$L= 1.08847P^{0.50}$	0.50	2.591
China	d=0.10074-0.00006P	-0.10	1274.107	$L=14.91401P^{0.15}$	0.15	3.947
Egypt	d=0.21283-0.00030P	-0.20	67.226	$L= 0.18256P^{0.30}$	0.30	6.550
EU	d=0.28258-0.00057P	-0.27	375.049	$L= 1.69804P^{0.50}$	0.50	5.693
India	d=0.07862-0.00009P	-0.30	998.056	$L= 2.66081P^{0.45}$	0.45	2.583
Japan	d=0.05419-0.00003P	-0.10	126.505	$L= 0.00454P^{0.52}$	0.52	3.450
South Korea	d=0.11786-0.00038P	-0.40	46.48	$L= 0.00007P^{0.45}$	0.45	5.000
Mexico	d=0.07169-0.00014P	-0.30	97.365	$L= 0.05606P^{0.55}$	0.55	4.429
New Zealand	d=0.16803-0.00024P	-0.22	3.828	$L= 0.00114P^{0.80}$	0.80	5.000
Nigeria	d=0.00820-0.00002P	-0.93	108.945	$L= 0.01421P^{0.20}$	0.20	1.286
U.S.	d=0.16994-0.00042P	-0.35	276.218	$L= 1.55619P^{0.60}$	0.60	2.873
The Former USSR	d=0.47948-0.00055P	-0.25	291.587	$L=13.69191P^{0.23}$	0.23	1.575

Source: Maeda, Suzuki,and Kaiser.

Table 3. Unit Transportation Cost of Grains among Countries and Areas (Unit: U.S. dollars per metric ton)

From \ To	Argentina (Buenos Aires)	Australia (Sydney)	Canada (Montreal)	China (Shanghai)	Egypt (Port Said)	EU (Rotterdam)	India (Mumbai)	Japan (Tokyo)	South Korea (Pusan)	Mexico (Tampico)	New Zealand (Wellington)	Nigeria (Lagos)	U.S. (New Orleans)	The Former USSR (Sankt Petersburg)
Argentina (Buenos Aires)	0.000	17.580	15.781	27.355	17.648	15.539	20.236	26.137	26.943	15.730	14.617	10.547	15.249	18.710
Australia (Sydney)	17.580	0.000	26.715	11.351	20.329	28.352	14.745	10.643	10.439	22.508	3.029	22.442	22.336	31.773
Canada (Montreal)	15.781	26.715	0.000	28.916	12.480	8.062	19.945	26.779	27.833	8.219	23.821	12.571	7.521	9.633
China (Shanghai)	27.355	11.351	28.916	0.000	17.759	25.782	11.439	2.568	1.171	24.708	13.130	25.127	24.537	28.923
Egypt (Port Said)	17.648	20.329	12.480	17.759	0.000	8.023	7.464	19.393	18.509	16.590	22.545	12.270	15.887	10.907
EU (Rotterdam)	15.539	28.352	8.062	25.782	8.023	0.000	15.487	27.416	26.622	12.600	27.769	10.221	11.895	2.963
India (Mumbai)	20.236	14.745	19.945	11.439	7.464	15.487	0.000	13.073	12.098	24.054	16.960	17.531	23.351	18.589
Japan (Tokyo)	26.137	10.643	26.779	2.568	19.393	27.416	13.073	0.000	1.676	22.572	12.353	26.755	22.400	30.715
South Korea (Pusan)	26.943	10.439	27.833	1.171	18.509	26.622	12.098	1.676	0.000	23.603	13.005	25.826	23.400	29.663
Mexico (Tampico)	15.730	22.508	8.219	24.708	16.590	12.600	24.054	22.572	23.603	0.000	19.614	14.747	1.796	18.491
New Zealand (Wellington)	14.617	3.029	23.821	13.130	22.545	27.769	16.960	12.353	13.005	19.614	0.000	23.892	19.442	30.923
Nigeria (Lagos)	10.547	22.442	12.571	25.127	12.270	10.221	17.531	26.755	25.826	14.747	23.892	0.000	14.100	13.110
U.S. (New Orleans)	15.249	22.336	7.521	24.537	15.887	11.895	23.351	22.400	23.400	1.796	19.442	14.100	0.000	14.424
The Former USSR (Sankt Petersburg)	18.710	31.773	9.633	28.923	10.907	2.963	18.589	30.715	29.663	18.491	30.923	13.110	14.424	0.000

Source: Maeda, Suzuki, and Kaiser.

Note: Selected ports in parentheses.

Table 4. Spatial Equilibrium Solution for Scenario 1 (Unit: million metric tons and U.S. dollars per metric ton)

		From \ To	Argentina	Australia	Canada	China	Egypt	EU	India	Japan	South Korea	Mexico	New Zealand	Nigeria	U.S.	The Former USSR
Volume of Trade	In-Quota Import Market	Argentina	n.a.	n.a.	0.056	n.a.	n.a.		n.a.	0.216	n.a.		n.a.	n.a.	n.a.	n.a.
		Australia	n.a.	n.a.	0.170	n.a.	n.a.	0.204	n.a.	0.378	n.a.		n.a.	n.a.	n.a.	n.a.
		Canada	n.a.	n.a.	n.a.	n.a.	n.a.	0.019	n.a.	0.323	n.a.		n.a.	n.a.	n.a.	n.a.
		China	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		Egypt	n.a.	n.a.		n.a.	n.a.		n.a.	1.626	n.a.		n.a.	n.a.	n.a.	n.a.
		EU	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	0.465	n.a.		n.a.	n.a.	n.a.	n.a.
		India	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		Japan	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.
		South Korea	n.a.	n.a.		n.a.	n.a.		n.a.	0.006	n.a.		n.a.	n.a.	n.a.	n.a.
		Mexico	n.a.	n.a.		n.a.	n.a.		n.a.	0.032	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		New Zealand	n.a.	n.a.		n.a.	n.a.		n.a.	0.124	n.a.		n.a.	n.a.	n.a.	n.a.
		Nigeria	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		U.S.	n.a.	n.a.		n.a.	n.a.	0.077	n.a.	0.489	n.a.	0.605	n.a.	n.a.	n.a.	n.a.
		The Former USSR	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
	Over-Quota Import Market	Argentina	n.a.	0.010			0.626				0.064		0.048		2.568	5.010
		Australia	0.446	n.a.			0.970	0.782			0.770		0.080		4.095	6.084
		Canada	0.580	0.210	n.a.		1.219	6.685			0.511		0.063		6.441	10.489
		China				n.a.										
		Egypt					n.a.									
		EU	1.283	0.619	2.012		1.955	n.a.			1.152	0.304	0.091		9.780	16.861
		India							n.a.							
		Japan								n.a.						
		South Korea									n.a.					
		Mexico										n.a.				
		New Zealand											n.a.			
		Nigeria												n.a.		
		U.S.	1.290	0.702	2.043		1.794	13.073			1.215		0.100	0.341	n.a.	14.948
		The Former USSR														n.a.
Import			3.599	1.541	4.281	0.000	6.564	20.840	0.000	3.659	3.712	0.909	0.382	0.341	22.884	53.392
Demand for Domestic Product			0.404	3.857	2.050	111.332	3.822	42.408	53.786	0.770	0.000	4.198	0.132	0.064	11.677	68.102
Total Demand			4.003	5.398	6.331	111.332	10.386	63.248	53.786	4.429	3.712	5.107	0.514	0.405	34.510	121.494
Market Price			73.404	73.493	185.026	105.994	108.859	181.899	162.746	519.256	86.960	125.725	115.900	157.306	94.800	109.378
Shadow Price[a] (Tariff Quota)			n.a.	n.a.	108.577	n.a.	n.a.	113.600	n.a.	0.000	n.a.	38.047	n.a.	n.a.	n.a.	n.a.

Country	Argentina	Australia	Canada	China	Egypt	EU	India	Japan	South Korea	Mexico	New Zealand	Nigeria	U.S.	The Former USSR
Domestic Supply by producer	0.404	3.339	n.a.	111.332	3.822	42.408	53.786	0.770	0.000	4.198	0.132	0.064	11.677	68.102
Domestic Supply by Exporting STE	n.a.	0.518	2.050	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Export	8.598	13.979	26.540	0.000	1.626	34.522	0.000	0.000	0.006	0.032	0.124	0.000	36.677	0.000
Next Export	4.999	12.438	22.259	0.000	-4.938	13.682	0.000	-3.659	-3.706	-0.877	-0.258	-0.341	13.793	-53.392
Total Supply	9.002	17.836	28.590	111.332	5.448	76.930	53.786	0.770	0.006	4.230	0.256	0.064	48.354	68.102
Production	9.002	17.836	28.590	111.332	5.448	96.888	53.786	0.770	0.006	4.230	0.256	0.064	52.777	68.102
Pooled Price by Exporting STE	n.a.	73.493	93.476	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Shadow Price[b] (Subsidied Export)	n.a.	n.a.	14.693	n.a.	n.a.	101.544	n.a.	n.a.	n.a.	4.135	n.a.	n.a.	25.065	n.a.
Shadow Price[c] (Production Quota)	n.a.	n.a.	n.a.	n.a.	n.a.	49.135	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Note: Blank spaces indicate zero.

a. Shadow price for the right to export to the in-quota marakit.

b. Shadow price for the right to export within the upper limit of subsidied quontity exported.

c. Shadow price for the right to produce within the production quota.

Table 5. Spatial Equilibrium Solution for Scenario 2 (Unit: million metric tons and U.S. dollars per metric ton)

		From \ To	Argentina	Australia	Canada	China	Egypt	EU	India	Japan	South Korea	Mexico	New Zealand	Nigeria	U.S.	The Former USSR
Volume of Trade	In-Quota Import Market	Argentina	n.a.	n.a.		n.a.	n.a.		n.a.	0.220	n.a.		n.a.	n.a.	n.a.	n.a.
		Australia	n.a.	n.a.		n.a.	n.a.	0.248	n.a.	0.380	n.a.		n.a.	n.a.	n.a.	n.a.
		Canada	n.a.	n.a.	n.a.	n.a.	n.a.	0.027	n.a.	0.286	n.a.		n.a.	n.a.	n.a.	n.a.
		China	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		Egypt	n.a.	n.a.		n.a.	n.a.		n.a.	1.626	n.a.		n.a.	n.a.	n.a.	n.a.
		EU	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	0.476	n.a.		n.a.	n.a.	n.a.	n.a.
		India	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		Japan	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.
		South Korea	n.a.	n.a.		n.a.	n.a.		n.a.	0.006	n.a.		n.a.	n.a.	n.a.	n.a.
		Mexico	n.a.	n.a.		n.a.	n.a.		n.a.	0.032	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		New Zealand	n.a.	n.a.		n.a.	n.a.		n.a.	0.128	n.a.		n.a.	n.a.	n.a.	n.a.
		Nigeria	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		U.S.	n.a.	n.a.	0.227	n.a.	n.a.	0.025	n.a.	0.499	n.a.	0.605	n.a.	n.a.	n.a.	n.a.
		The Former USSR	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
	Over-Quota Import Market	Argentina	n.a.	0.004			0.638				0.078		0.048		2.650	5.094
		Australia	0.458	n.a.			0.978	0.892			0.780		0.080		4.150	6.132
		Canada	0.401	0.084	n.a.		1.050	4.839			0.354		0.054		5.444	9.110
		China				n.a.										
		Egypt					n.a.									
		EU	1.333	0.634	0.758		1.997	n.a.			1.197	0.304	0.093		10.050	17.202
		India							n.a.							
		Japan								n.a.						
		South Korea									n.a.					
		Mexico										n.a.				
		New Zealand											n.a.			
		Nigeria												n.a.		
		U.S.	1.340	0.717			1.836	13.685			1.260		0.102		n.a.	15.288
		The Former USSR														n.a.
Import			3.532	1.439	0.985	0.000	6.499	19.716	0.000	3.653	3.669	0.909	0.377	0.000	22.294	52.826
Demand for Domestic Product			0.420	3.945	6.602	111.332	3.846	42.969	53.786	0.770	0.000	4.198	0.132	0.068	11.946	68.327
Total Demand			3.952	5.384	7.587	111.332	10.345	62.685	53.786	4.423	3.669	5.107	0.509	0.068	34.240	121.153
Market Price			75.664	74.574	91.070	105.994	111.034	184.305	162.746	521.430	89.262	125.725	118.074	340.613	96.992	111.521
Shadow Price[a] (Tariff Quota)			n.a.	n.a.	65.308	n.a.	n.a.	113.600	n.a.	0.000	n.a.	38.047	n.a.	n.a.	n.a.	n.a.

Country	Argentina	Australia	Canada	China	Egypt	EU	India	Japan	South Korea	Mexico	New Zealand	Nigeria	U.S.	The Former USSR
Domestic Supply by producer	0.420	3.436	5.944	111.332	3.846	42.969	53.786	0.770	0.000	4.198	0.132	0.068	11.946	68.327
Domestic Supply by Exporting STE	n.a.	0.509	0.658	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Export	8.732	14.098	21.649	0.000	1.626	34.044	0.000	0.000	0.006	0.032	0.128	0.000	35.584	0.000
Next Export	5.200	12.659	20.664	0.000	-4.873	14.328	0.000	-3.653	-3.663	-0.877	-0.249	0.000	13.290	-52.826
Total Supply	9.152	18.043	28.251	111.332	5.472	77.013	53.786	0.770	0.006	4.230	0.260	0.068	47.530	68.327
Production	9.152	18.043	28.251	111.332	5.472	96.888	53.786	0.770	0.006	4.230	0.260	0.068	52.777	68.327
Pooled Price by Exporting STE	n.a.	74.574	91.070	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Shadow Price[b] (Subsidied Export)	n.a.	n.a.	14.693	n.a.	n.a.	101.544	n.a.	n.a.	n.a.	6.312	n.a.	n.a.	25.065	n.a.
Shadow Price[c] (Production Quota)	n.a.	n.a.	n.a.	n.a.	n.a.	49.135	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Note: Blank spaces indicate zero.

a. Shadow price for the right to export to the in-quota maraket.

b. Shadow price for the right to export within the upper limit of subsidied quontity exported.

c. Shadow price for the right to produce within the production quota.

Table 6. Spatial Equilibrium Solution for Scenario 3 and 5 (Unit: million metric tons and U.S. dollars per metric ton)

		From \ To	Argentina	Australia	Canada	China	Egypt	EU	India	Japan	South Korea	Mexico	New Zealand	Nigeria	U.S.	The Former USSR
Volume of Trade	In-Quota Import Market	Argentina	n.a.	n.a.		n.a.	n.a.	0.182	n.a.	0.008	n.a.		n.a.	n.a.	n.a.	n.a.
		Australia	n.a.	n.a.		n.a.	n.a.		n.a.	3.306	n.a.		n.a.	n.a.	n.a.	n.a.
		Canada	n.a.	n.a.	n.a.	n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		China	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		Egypt	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		EU	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	0.265	n.a.		n.a.	n.a.	n.a.	n.a.
		India	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		Japan	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.
		South Korea	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		Mexico	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		New Zealand	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		Nigeria	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
		U.S.	n.a.	n.a.	0.227	n.a.	n.a.	0.119	n.a.	0.289	n.a.	0.605	n.a.	n.a.	n.a.	n.a.
		The Former USSR	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
	Over-Quota Import Market	Argentina	n.a.				0.412	1.020			0.018		0.006		3.018	3.868
		Australia		n.a.			1.414				1.358		0.250		7.616	
		Canada			n.a.										0.444	20.878
		China				n.a.										
		Egypt					n.a.									
		EU	1.549	0.631	0.732		1.775	n.a.			1.140	0.293	0.052		10.439	16.000
		India							n.a.							
		Japan								n.a.						
		South Korea									n.a.					
		Mexico										n.a.				
		New Zealand											n.a.			
		Nigeria												n.a.		
		U.S.	1.556	0.713			1.614	15.194			1.203		0.060		n.a.	14.086
		The Former USSR														n.a.
Import			3.105	1.344	0.959	0.000	5.215	16.515	0.000	3.868	3.719	0.898	0.368	0.000	21.517	54.832
Demand for Domestic Product			0.632	4.043	6.654	111.332	5.350	44.571	53.786	0.760	0.006	4.219	0.185	0.068	12.335	67.521
Total Demand			3.737	5.387	7.613	111.332	10.565	61.086	53.786	4.628	3.725	5.117	0.553	0.068	33.852	122.353
Market Price			85.386	74.306	89.122	105.994	99.616	191.175	162.746	475.952	86.299	124.928	77.335	340.613	100.143	103.952
Shadow Price[a] (Tariff Quota)			n.a.	n.a.	63.360	n.a.	n.a.	113.600	n.a.	0.000	n.a.	37.649	n.a.	n.a.	n.a.	n.a.

Country	Argentina	Australia	Canada	China	Egypt	EU	India	Japan	South Korea	Mexico	New Zealand	Nigeria	U.S.	The Former USSR
Domestic Supply by producer	0.632	4.043	6.654	111.332	5.350	44.571	53.786	0.760	0.006	4.219	0.185	0.068	12.335	67.521
Domestic Supply by Exporting STE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Export	8.532	13.944	21.322	0.000	0.000	32.876	0.000	0.000	0.000	0.000	0.000	0.000	35.666	0.000
Next Export	5.427	12.600	20.363	0.000	-5.215	16.361	0.000	-3.868	-3.719	-0.898	-0.368	0.000	14.149	-54.832
Total Supply	9.164	17.987	27.976	111.332	5.350	77.447	53.786	0.760	0.006	4.219	0.185	0.068	48.001	67.521
Production	9.164	17.987	27.976	111.332	5.350	96.888	53.786	0.760	0.006	4.219	0.185	0.068	52.777	67.521
Pooled Price by Exporting STE	n.a.			n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Shadow Price[b] (Subsidied Export)	n.a.	n.a.	14.693	n.a.	n.a.	101.544	n.a.	n.a.	n.a.	0.000	n.a.	n.a.	25.065	n.a.
Shadow Price[c] (Production Quota)	n.a.	n.a.	n.a.	n.a.	n.a.	49.135	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Note: Blank spaces indicate zero.

a. Shadow price for the right to export to the in-quota maraket.

b. Shadow price for the right to export within the upper limit of subsidied quontity exported.

c. Shadow price for the right to produce within the production quota.

Table 7. Spatial Equilibrium Solution for Scenario 4 (Unit: million metric tons and U.S. dollars per metric ton)

	From \ To	Argentina	Australia	Canada	China	Egypt	EU	India	Japan	South Korea	Mexico	New Zealand	Nigeria	U.S.	The Former USSR
Volume of Trade: In-Quota Import Market	Argentina	n.a.	n.a.	0.062	n.a.	n.a.		n.a.	0.160	n.a.		n.a.	n.a.	n.a.	n.a.
	Australia	n.a.	n.a.	0.166	n.a.	n.a.	0.192	n.a.	0.318	n.a.		n.a.	n.a.	n.a.	n.a.
	Canada	n.a.	n.a.	n.a.	n.a.	n.a.	0.077	n.a.	0.266	n.a.		n.a.	n.a.	n.a.	n.a.
	China	n.a.	n.a.		n.a.	n.a.		n.a.	2.104	n.a.		n.a.	n.a.	n.a.	n.a.
	Egypt	n.a.	n.a.		n.a.	n.a.		n.a.	0.010	n.a.		n.a.	n.a.	n.a.	n.a.
	EU	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	0.406	n.a.		n.a.	n.a.	n.a.	n.a.
	India	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
	Japan	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.
	South Korea	n.a.	n.a.		n.a.	n.a.		n.a.	0.006	n.a.		n.a.	n.a.	n.a.	n.a.
	Mexico	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	New Zealand	n.a.	n.a.		n.a.	n.a.		n.a.	0.022	n.a.		n.a.	n.a.	n.a.	n.a.
	Nigeria	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
	U.S.	n.a.	n.a.		n.a.	n.a.	0.030	n.a.	0.430	n.a.	0.605	n.a.	n.a.	n.a.	n.a.
	The Former USSR	n.a.	n.a.		n.a.	n.a.		n.a.		n.a.		n.a.	n.a.	n.a.	n.a.
Volume of Trade: Over-Quota Import Market	Argentina	n.a.				0.392				0.076		0.036		2.668	5.112
	Australia	0.440	n.a.			0.720	0.768			0.764		0.066		4.095	6.048
	Canada	0.587	0.196	n.a.		0.978	6.728			0.517		0.050		6.508	10.546
	China				n.a.										
	Egypt					n.a.									
	EU	1.278	0.597	2.011		1.704	n.a.			1.148	0.294	0.077		9.781	16.828
	India							n.a.							
	Japan								n.a.						
	South Korea									n.a.					
	Mexico										n.a.				
	New Zealand											n.a.			
	Nigeria												n.a.		
	U.S.	1.285	0.680	2.041		1.543	13.094			1.211		0.087		n.a.	14.913
	The Former USSR														n.a.
Import		3.590	1.473	4.280	0.000	5.337	20.889	0.000	3.722	3.716	0.899	0.316	0.000	23.052	53.447
Demand for Domestic Product		0.417	3.948	2.056	110.785	5.301	42.383	53.786	0.767	0.000	4.219	0.210	0.068	11.677	68.079
Total Demand		4.007	5.421	6.336	110.785	10.638	63.272	53.786	4.489	3.716	5.118	0.526	0.068	34.510	121.526
Market Price		73.177	71.885	184.890	112.784	95.959	181.790	162.746	506.356	86.729	124.928	103.000	340.613	94.800	109.163
Shadow Price[a] (Tariff Quota)		n.a.	n.a.	108.848	n.a.	n.a.	113.600	n.a.	0.000	n.a.	37.649	n.a.	n.a.	n.a.	n.a.

Country	Argentina	Australia	Canada	China	Egypt	EU	India	Japan	South Korea	Mexico	New Zealand	Nigeria	U.S.	The Former USSR
Domestic Supply by producer	0.417	3.452	n.a.	110.785	5.301	42.383	53.786	0.767	0.000	4.219	0.210	0.068	11.677	68.079
Domestic Supply by Exporting STE	n.a.	0.496	2.056	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Export	8.506	13.577	26.453	2.104	0.010	34.124	0.000	0.000	0.006	0.000	0.022	0.000	35.919	0.000
Next Export	4.916	12.104	22.173	2.104	-5.327	13.235	0.000	-3.722	-3.710	-0.899	-0.294	0.000	12.867	-53.447
Total Supply	8.923	17.525	28.509	112.889	5.311	76.507	53.786	0.767	0.006	4.219	0.232	0.068	47.596	68.079
Production	8.923	17.525	28.509	112.889	5.311	96.888	53.786	0.767	0.006	4.219	0.232	0.068	52.777	68.079
Pooled Price by Exporting STE	n.a.	71.885	92.905	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Shadow Price[b] (Subsidied Export)	n.a.	n.a.	14.693	n.a.	n.a.	101.544	n.a.	n.a.	n.a.	0.000	n.a.	n.a.	25.065	n.a.
Shadow Price[c] (Production Quota)	n.a.	n.a.	n.a.	n.a.	n.a.	49.135	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Note: Blank spaces indicate zero.

a. Shadow price for the right to export to the in-quota maraket.

b. Shadow price for the right to export within the upper limit of subsidied quontity exported.

c. Shadow price for the right to produce within the production quota.

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