The Export-Side International Trade Model and Trade Liberalization in the World Corn Market

C.S. Kim
Economic Research Service, USDA

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Trade liberalization has become a major issue facing agricultural policy makers. Discussions of government intervention for the GATT negotiations, however, have focused heavily in recent years on the measurement of the producer subsidy equivalents (PSE) and consumer subsidy equivalents (CSE) as a common basis for multilateral trade negotiations. Accordingly, all tariff and nontariff trade barriers and domestic agricultural policies for major grain trading countries were quantified in monetary terms by the Organization for Economic Cooperation and Development (OECD) and by the Economic Research Service (ERS).

Even though PSE's and CSE's provide a common basis for determining the degree of trade protection, they may be insufficient as the basis for successful trade negotiation. To reach an agreement in multilateral trade negotiations, governments must be convinced that many of their present trade barriers and domestic farm policies generate little benefit at enormous costs (Hillman) and that the payoff on trade liberalization could be significant. The objective of this paper is to estimate the economic gains from trade liberalization in the world corn market; thus, providing a basis for trade negotiations.

A primary issue for international trade economists is to quantify the effects of policy change on trade patterns. The Armington model and a spatial equilibrium model have been widely used in international trade to quantify the effects of policy change. These models adopt the Marshallian concept by connecting spatially separated import and export markets through a price

mechanism. Researchers who have used these models in empirical study recognize the difficulty associated with data collection, especially price from all importing countries, and transfer costs connecting all export and importing countries. While we do not have reliable transfer costs and price information from importing countries, except for a few, we do have reliable information on quantities traded among all importing and exporting countries. Therefore, by adopting the Walrasian concept, this paper develops the Export-Side International Trade (ESIT) model, which connects spatially separated import and export markets through a quantity mechanism, and therefore it requires limited price information from importing countries and no transfer costs. The model is then used to measure the effect of removing PSE's and CSE's on trade patterns for major corn trading countries including the U.S., EC, Canada, and Japan.

The Export-Side International Trade Model

The ESIT model is based on a two-step procedure. The first step links domestic commodity markets with an international commodity market. The second step links the international commodity market with export markets. The linkage between domestic commodity markets and the international commodity market can be illustrated with Figure 1. Suppose that an importing country removes an implicit tax on consumers (i.e., a negative CSE) equivalent to AB in Figure 1. The domestic commodity demand curve D shifts to the right toward D' by the horizontal distance CE. The excess demand curve ED then shifts to the right toward ED' by the horizontal distance FG, where CE equals FG. That is, the horizontal shift in the importing country's domestic commodity demand, and/or supply curve is equivalent to the horizontal shift in the excess demand curve in the international commodity market.

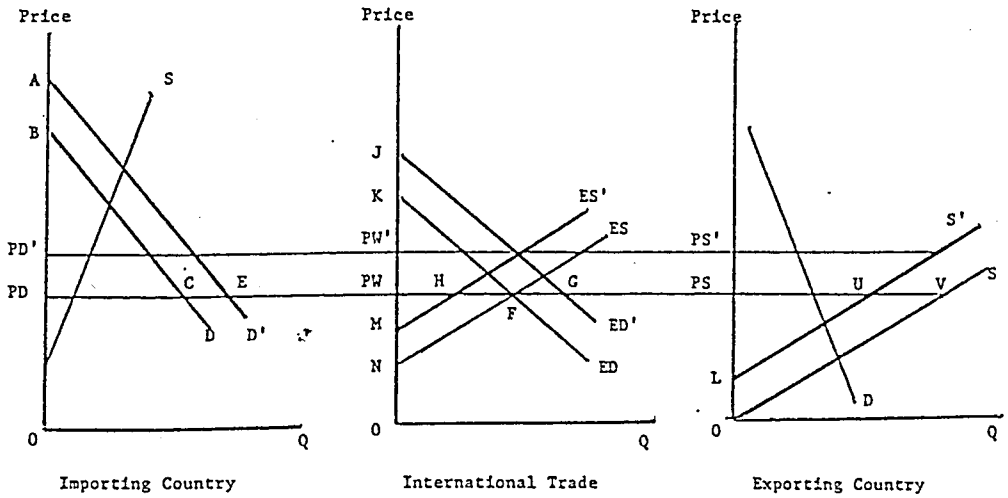

Figure 1. Linkage between domestic commodity market and international commodity market.

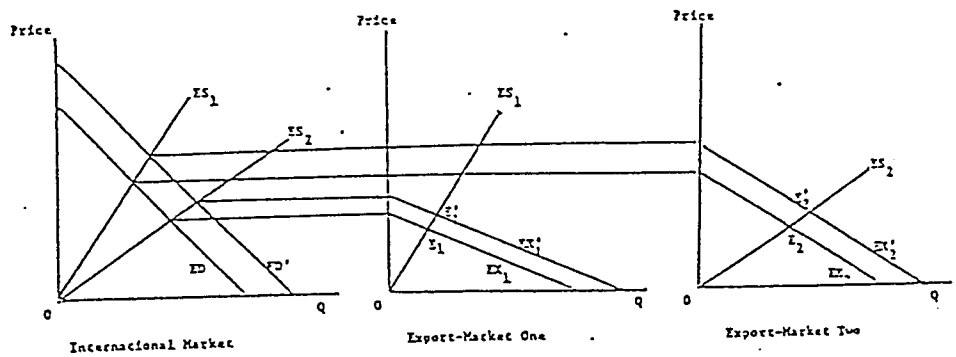

Figure 2. The ESIT model with the excess demand shift.

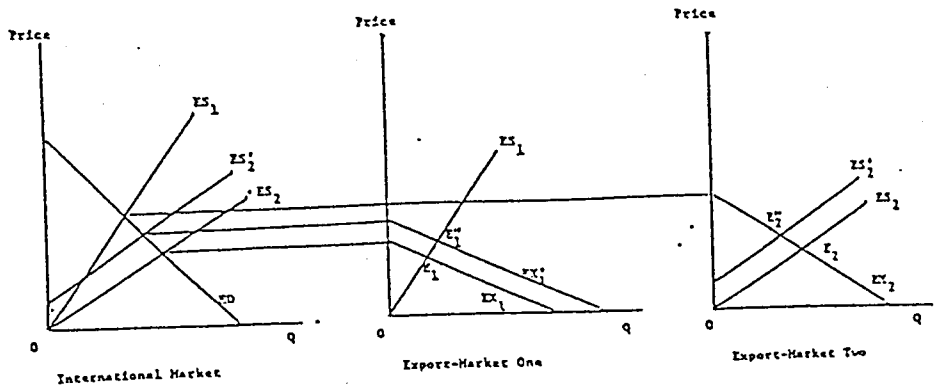

Figure 3. The ESIT model with an excess supply shift.

Similarily, if the exporting country removes government subsidies to domestic producers equivalent to LO in Figure 1, the domestic supply curve S shifts to the left toward S' by the horizontal distance UV. The excess supply curve ES in the international market then shifts to the left toward ES' by the horizontal distance HF; where UV equals HF. That is, the horizontal shift in the exporting country's domestic supply curve to the left, shifts the excess supply curve in the international commodity market to the left by an equivalent magnitude.

The second step of the ESIT model links the international commodity market with export markets. The linkage between the international commodity market and export markets can be illustrated with Figure 2. Assume for simplicity that there is one importing country and two exporting countries. The export demand of the first exporting country EX_1 is derived by subtracting the second exporting country's excess supply ES_2 from the excess demand curve ED. Similarily, the export demand of the second exporting country EX_2 is derived by subtracting the excess supply of the first exporting country ES_1 from the excess demand ED. A market clearing equilibrium is attained where the excess supply curve intersects the export demand curve for each exporting country. In Figure 2, the first exporting country attains equilibrium at E_1, where $ES_1 = EX_1$, and the second exporting country attains its equilibrium at E_2, where $ES_2 = EX_2$.

The effect of trade liberalization in the importing country on trade patterns also can be illustrated with Figure 2. When the importing country removes trade barriers, the excess demand curve ED shifts to the right, toward ED' in Figure 2. The horizontal shift in the excess demand curve shifts the export demand curves EX_1 and EX_2 toward EX_1' and EX_2', respectively. The export demand curves EX_1' and EX_2' are estimated by $EX_1' = ED' - ES_2$

and $EX_2' = ED' - ES_1$. As a result of trade liberalization in the importing country, a new equilibrium price and quantity are attained at E_1' for the first exporting country and at E_2' for the second exporting country.

The effect of trade liberalization in an exporting country on trade patterns can be illustrated with Figure 3. Assume that the second exporting country removes government subsidies to producers so that the domestic supply curve shifts to the left. The excess supply curve ES_2 then shifts to the left toward ES_2'. The horizontal shift in ES_2 toward ES_2' shifts the export demand curve EX_1 toward EX_1' for the first exporting country. The first exporting country attains its new equilibrium at $E_1"$, where $ES_1 = EX_1'$. Similarily, the second exporting country attains its new equilibrium at $E_2"$, where $ES_2' = EX_2$.

A distinctive characteristic of the ESIT model compared with other existing international trade models, such as the Armington model and the spatial equilibrium model formulated by Takayama and Judge, is that the market clearing equilibrium is attained at the point where the excess supply curve intersects the export demand curve in each export market. In the latter models, the market clearing equilibrium is attained, through a price mechanism in the international market, at the point where excess demand equals excess supply. Consequently, the ESIT model substantially reduces data requirements from importing countries, such as transfer costs and import and/or consumer prices.

A Mathematical Model

In order to formulate a workable model, the first step is to convert the vertical distances of domestic demand and supply shifts to horizontal distances of domestic demand and supply shifts. Let the domestic demand be given by $D = \alpha - \beta P$. When a government removes an implicit consumer tax (negative CSE), which is equivalent to AB in Figure 1, the demand curve D

shifts to the right toward D' by the horizontal distance CE. The horizontal distance CE is estimated by $-\beta*CSE$. Similarily, let the domestic supply curve be given by $S = \gamma + \delta P$. When a government removes its subsidy to producers, which is equivalent to LO, the domestic supply curve S shifts to the left toward S' by the horizontal distance UV. The horizontal distance UV is then estimated by $(-\delta*PSE)$.

The next step is to estimate the horizontal distance of the export demand shifts when an importing country and/or an exporting country removes the PSE and the CSE. Assuming for simplicity that the export demand and excess supply functions are linear, and only h importing countries remove their trade barriers and/or domestic farm policies, we have the following implicit function (Bredahl et.al, Johnson, and Tweeten):

$$(1)\quad F_k = (a_k - b_kP_k) + \sum_{i=k}^{m}\sum_{j}^{n}(es_i(P_i)*T_i/E_k)*(c_{ij} + d_{ij}P_i)$$

$$- \sum_{j}^{h}\sum_{i}^{m}(ed_j(P^j)*T^j/E_k)*f_{ij}(P^{ij})^{-zj}$$

$$- \sum_{g}^{n-h}\sum_{i}^{m}(ed_g(P^g)*T^j/E_k)*M_{ig}$$

$$= 0 \qquad \text{for } k = 1,2,\ldots,m.$$

where $(a_k - b_kP_k)$ is export demand equation of the kth exporting country, $(c_{ij} + d_{ij}P_i)$ is excess supply equation of the ith exporting country to the jth importing country, and $f_{ij}(P^{ij})^{-zj}$ is excess demand equation which is derived from the specification of the Armington's excess demand equation, es and ed are excess supply and excess demand elasticities, respectively, E_k is export demand elasticity of the kth exporting country, M is import, and T is the price transmission elasticity.

The horizontal distance of the export demand shifts resulting from the

horizontal shift of the excess demand and excess supply curves can be estimated by applying the implicit function theorem to the system of m-equations (1). Note that there are m endogenous variables of a_k ($k = 1,2,\ldots,m$) and $m(n+h)-n$ exogenous variables including c_{ij} ($i \neq k$) and f_{ij} for all i and j ($j = 1,2,\ldots h$). The horizontal distances of the export demand shifts resulting from removing the PSE and the CSE in the jth importing country are given by the following equation.

$$(2)\quad \Delta a_k^j = (ed_j(P^j)*T^j/E_k)*\sum_i^m \Delta f_{ij}*(P^{ij})^{-zj}$$
$$= (ed_j(P^j)*T^j/E_k)*(-\beta^j*CSE^j + \delta^j*PSE^j)$$

for $k = 1,2,\ldots,m$, where β and δ are the slope coefficients associated with the domestic commodity demand and supply functions, respectively. The price transmission elasticity T^j in equation (2) equals 1 when the importing country removes its trade barriers. Note that the horizontal distance of the excess demand shift in equation (2) is replaced with the horizontal distance of the domestic commodity demand and/or supply shift.

The market clearing condition is given by the following equation.

$$(3)\quad (a_k + \Delta a_k^j) - b_k P_k = \sum_j^n (c_{kj} + d_{kj}P_k) \qquad \text{for } k = 1,2,\ldots,m.$$

The export price of the kth exporting country is obtained from equation (3) and given by

$$(4)\quad P_k = (a_k + \Delta a_k^j - \sum_j^n c_{kj})/(b_k + \sum_j^n d_{kj}) \quad \text{for all k and j.}$$

By substituting P_k from equation (4) into the export demand equation of the kth exporting country, exports by the kth country to the jth importing country are given by equation (5).

$$(5)\quad X_{kj} = c_{kj} + d_{kj}(a_k + \Delta a_k^j - \sum_j^n c_{kj})/(b_k + \sum_j^n d_{kj}) \quad \text{for all k and j.}$$

The horizontal distances of the export demand shifts resulting from

removing the PSE and the CSE in the ith exporting country, Δa_k^i, are given by:

$$(6) \quad \Delta a_k^i = -(es_i(P_i)*T_i/E_k)*(\delta_i*PSE_i - \beta_i*CSE_i)$$

for $k = 1,2,\ldots,m$ and $k \neq i$, where δ_i and β_i are the slope coefficients associated with the ith exporting country's domestic supply and demand functions, respectively. The price transmission elasticity T_i in equation (6) also equals one when the ith exporting country removes both the PSE and CSE. Market clearing conditions are given by the follwing equations.

$$(7a) \quad (a_k + \Delta a_k^i) - b_k P_k = \sum_j^n (c_{kj} + d_{kj} P_k) \quad \text{for } k = 1,2,\ldots,m \text{ and } k \neq i;$$

and

$$(7b) \quad (a_i - b_i P_i) = \sum_j^n (c_{ij} + \Delta c_{ij} + d_{ij} P_i) \qquad \text{for } k = i.$$

Export prices are then estimated from equations (7) and given as follows.

$$(8a) \quad P_k = (a_k + \Delta a_k^i - \sum_j^n c_{kj})/(b_k + \sum_j^n d_{kj}) \quad \text{for } k = 1,2,\ldots,m \text{ and } k \neq i,$$

and

$$(8b) \quad P_i = (a_i - \sum_j^n (c_{ij} + \Delta c_{ij}))/(b_i + \sum_j^n d_{ij}) \qquad \text{for } k = i.$$

Substituting P_k from equation (8a) into the kth export demand equation, exports by the kth country to the jth importing country are estimated using equation (9).

$$(9) \quad X_{kj} = c_{kj} + d_{kj}(a_k + \Delta a_k^i - \sum_j^n c_{kj})/(b_k + \sum_j^n d_{kj}) \quad \text{for all } k,j \text{ and } k \neq i.$$

Exports by the ith country to the jth importing country are given by equation (10).

$$(10) \quad X_{ij} = c_{ij} + \Delta c_{ij} + d_{ij}(a_i - \sum_j^n (c_{ij} + \Delta c_{ij}))/(b_i + \sum_j^n d_{ij})$$

for all j and $i = k$.

The new excess supply resulting from trade liberalization, X_{ij}, is endogenously determined in the ESIT model as shown in equations (9) and (10). Therefore, an equilibrium import price P^{ij} after trade liberalization can be estimated from the jth excess demand equation by substituting X_{ij} for M_{ij}.

Trade Pattern Effects of Trade Liberalization in the World Corn Market

In this section, we estimate the world trade pattern effects of removing PSE's and CSE's for corn in the U.S., EC, Canada, and Japan. Data for the simulation are given in Tables 1 and 2. Production data are from the FAO Production Year Book for 1984, and net trade flow data are obtained from Mackie et al. Data for domestic consumption are obtained by simply subtractiing the amount of net trade from domestic corn production. Export prices for the U.S. and Argentina are obtained from ERS, USDA, while those for other exporting countries are obtained by simply dividing total export values with the quantity of export for each country. The elasticities of domestic demand and supply are from the USDA study in Embargoes, Surplus Disposal, and U.S. Agriculture. Since there are no reliable domestic price information from both importing and exporting countries, the domestic corn price is simply assumed to be identical with import or export price.

The estimated domestic supply equations for corn are given as follows: U.S.: $Q = 97,464 + 854.95P$; Argentina: $Q = 2,850 + 64.56P$; China: $Q = 58,728 + 125.49P$; Thailand: $Q = 2,535.6 + 16.57P$; ROW: $Q = 9,703.4 + 33.0P$; EC: $Q = 10,168.5 + 63.43P$; Japan: $Q = 1.0 + 0.0065P$; and Canada: $Q = 5,619.2 + 10.26P$. The estimated domestic demand equations are given as follows: U.S.: $Q = 197,650.7 - 400.10P$; Argentina: $Q = 3,820.6 - 10.60P$;

China: Q = 75,641.5 - 58.77P; Thailand: Q = 3,736.8 - 16.28P; ROW: Q = 13,236.0 - 35.02P; EC: Q = 34,384.5 - 55.61P; Japan: Q = 21,340.5 - 46.12P; and Canada: Q = 11,033.1 - 25.0P.

The per unit PSE's and CSE's are also from the USDA study in Estimates of Producer and Consumer Subsidy Equivalents: Government Intervention in Agriculture, 1982-86. The vertical distances of domestic demand and supply shifts associated with the removal of PSE's and CSE's are converted into the horizontal distances of escess demand and supply shifts (Table 3).

The elasticities of excess supply are estimated to be as follows: U.S.: 3.3560; Argentina: 1.1433; China: 4.6412; Thailand: 1.5587; and ROW: 1.7012. The excess supply equations associated with the estimated elasticities of excess supply are given as follows: U.S.: Q = -100,186.69 + 1,255.05P; Argentina: Q = -970.6 + 75.16P; Thailand: Q = -1,201.20 + 32.85P; ROW: -3,532.60 + 68.02P; and China: -16,913.4 + 184.26P. The excess supply equations for each exporting country to all importing countries are estimated and given in Appendix I. The elasticities of excess demand are also estimated for the EC, Canada, and Japan and the results are: EC: -3.7177; Canada: -8.2544; and Japan: -0.5001.

The estimated export demand elasticities are -2.1661 for the U.S., -29.7033 for Argentina, -15.4775 for China, -71.5639 for Thailand, and -41.5470 for the ROW. The estimated export demand equations are as follows: U.S.: Q = 135,790.86 - 814.93P; Argentina: 207,892.04 - 1,952.63P; China: 76,537.99 - 614.47P; Thailand: 156,012.39 - 1,508.45P; ROW: 214,351.79 - 1,661.22P.

Table 4 presents estimated trade patterns and export prices under a limited trade liberalization in the world corn market. Results indicate

that the volume of world corn trade can be expected to decline by 11 percent to 54.825 million MT from 61.493 million MT, if the industrialized major trading countries remove all PSE's and CSE's. U.S. exports would decline substantially, by nearly 8 million MT from 42.889 million MT to 34.892 milliom MT, while China's exports would increase substantially by 25 percent from 4.645 million MT to 5.785 million MT. Corn exports from all other exporting countries would increase slightly.

Export prices from all exporting countries are expected to rise. The U.S. export price would rise sharply from $114/MT to $125.28/MT, and China's export price would rise to $123.19/MT from $117/MT. Export prices from other exporting countries are expected to rise slightly as their exports increase slightly.

The results also indicate that imports for most importing countries would decline, while South Korea and Other Asian countries would increase their imports slightly by 7,000 MT and 196,000 MT, respectively. Japannese corn imports would decline from 14.225 million MT to 12.822 million MT. EC's imports would also decline from 5.133 million MT to 4.748 million MT.

In summary, U.S. corn exports would suffer the most, declining by nearly 8 million MT, even though the export price is expected to rise by more than $11/MT. In contrast, China's corn exports would gain the most by increasing its exports by more than one million MT at a higher price of $123.19/MT.

Gains from Trade Liberalization in the World Corn Market

Trade liberalization does not only affect trade patterns, but also the social welfare for all countries. Therefore, changes in consumers' surplus (CS) and producers' surpluses (PS) are estimated using equations (14) and

(15), respectively.

$$(14) \quad \Delta CS = \int_0^{Qc'} (\alpha'/\beta - q/\beta)dq - \int_0^{Qc} (\alpha/\beta - q/\beta)dq - (P'Qc' - PcQc)$$

and

$$(15) \quad \Delta PS = \int_0^{Qs'} (-\gamma'/\delta + q/\delta)dq - \int_0^{Qs} (-\gamma/\delta + q/\delta)dq + (P'Qs' - PsQs),$$

where α and α' are intercept terms for the domestic demand curve before and after trade liberalization, respectively, β is the slope coefficient of the domestic demand curve, γ and γ' are intercept terms for the domestic supply curve before and after trade liberalization, respectively, δ is the slope coefficient of the domestic supply curve, Qc and Qc' are domestic consumer demand before and after trade liberalization, Qs and Qs' are domestic supply before and after trade liberalization, respectively, Pc, and Ps are consumer and producer prices before trade liberalization, and P' is domestic market price after trade liberalization.

For Argentina, changes in consumers' and producers' benefits resulting from trade liberalization in the world corn market are estimated to be -$3.5 million and $12.1 million, respectively (Table 5). As a result of price increases from $103/MT to $104.27/MT, consumer demand would decline slightly from 2.729 million MT to 2.716 million MT, while domestic production would rise slightly from 9.5 million MT to 9.58 million MT.

In Thailand, domestic consumption would decline by 11,000 MT from 2,076 million MT to 2.065 million MT, while producers would increase their corn production by 12,000 MT to 4.238 million MT from 4.226 million MT. Consumers' and producers' benefits resulting from trade liberalization are

estimated to be -$1.435 million and $2.934 million, respectively. For the rest of world (ROW), domestic consumption would be expected to decline slightly from 8.824 million MT to 8.787 million MT, while domestic production would rise by only 35,000 MT, from 13.862 million MT to 13.897 million MT. Changes in consumers' and producers' benefits for the ROW are estimated to be -$9.372 million and $14.773 million, respectively.

As a result of trade liberalization in the world corn market, China is expected to gain the most. While the export price is expected to rise by $6.19/MT from $117/MT to $123.19/MT, domestic consumers would reduce their corn consumption slightly from 68.765 million MT to 68.401 million MT, and producers would increase their production from 73.41 million MT to 74.186 million MT. Changes in China's consumers' and producers' surpluses resulting from trade liberalization are estimated to be -$424 million and $457 million, respectively.

U.S. consumers would reduce their corn consumption to 147.5 million MT from 152 million MT, and producers would reduce their production substantially from 194.9 million MT to 182.4 million MT. Changes in the U.S. consumers' and producers' surpluses are estimated to be -$1,689 million and -$523 million, respectively.

The results indicate that consumer demand in the EC will decline from 25.47 million MT to 25.024 million MT, while producers reduce their corn production slightly from 20.34 million MT to 20.276 million MT. Changes in consumers' and producers' benefits are estimated to be -$202.397 million and $348.972 million, respectively.

The results indicate that losses to Canadian consumers and gains to producers would be -$42 million and $25 million, respectively. Results also

indicate that Canadian consumers would reduce their corn consumption from 7.609 million MT to 7.469 million MT, while producers reduce their corn production to 6.981 million MT from 7.024 million MT.

When the Japanese government removes its implicit domestic taxes on consumers, producers' surplus increases by $73,000 due to the negligible size of corn production in Japan. Even though the domestic demand curve shifts to the right, consumer demands for corn are expected to decline from 14.227 million MT to 12.824 million MT due to the sharply rising corn price, from $154.24/MT to $188.66/MT. The estimated changes in consumers' and producers' surpluses are -411 million and $0.073 million, respectively.

The effectiveness ratio of government intervention in the corn market is estimated for the U.S., Canada, the EC, and Japan. Results of this ratio are presented in Table 5. The estimated effectiveness ratio is 0.36 for the U.S., 0.25 for Canada, -9.85 for the EC, and -7.2 for Japan. The results indicate, for example, that when a government spends one dollar to subsidize corn producers and/or consumers, social welfare increases by 36 cents for the U.S. and 25 cents for Canada, while social welfare declines by $9.85 for the EC and $7.2 for Japan.

Limitations and Conclusions

This research develops an export-side international trade model to estimate the effect on trade patterns of removing PSE's and CSE's for major wheat and corn trading countries, and then estimates economic gains from trade liberalization in the world corn market. The results indicate that U.S. corn exports only would suffer, while China's corn exports would gain the most. China's corn exports would increase by one million MT, and its

export price would rise by more than $5/MT.

The estimated economic gains resulting from trade liberalization in the world corn market are substantial, which ranging from $3.93 billion for the U.S. to -$468 million for Japan.

The estimated effectiveness ratio of government expenditures in the corn market are 0.36 for the U.S., 0.25 for Canada, -9.85 for the EC, and -7.2 for Japan. These results indicate that government subsidies to producers and consumers do not generate an adequate level of social welfare. Because members of GATT are currently negotiating for trade liberalization, this study offers the timely advice that trade barriers are unlikely to be beneficial to all exporting countries.

Price elasticities of domestic demand and supply affect the magnitude of welfare effects of trade liberalization. Domestic demand and supply equations, however, are synthesized by using secondary data in a crude manner. Further econometric study is necessary for confirmation of elasticities used in this paper. Also, the foregoing analysis ignored the long-run effect on domestic supply of trade liberalization in the world wheat and corn markets. Producers are expected to react to changing prices and to increased uncertainty associated with market prices.

Table 1. Base Data for Simulation (1984/85): Corn.

Country	Production	Consumption	Net Trade	e[1]	n[1]	T[2]
		(1,000MT)				
U.S.	194,928	152,039	42,889	.50	-.30	1.00
Argentina	9,500	2,729	6,771	.70	-.40	1.00
China	73,410	68,765	4,645	.20	-.10	0.
Thailand	4,226	2,076	2,150	.40	-.80	.50
ROW	13,862	8,824	5,038	.30	-.50	0.
Canada	7,024	7,609	-585	.20	-.45	1.00
EC	20,337	25,470	-5,133	.50	-.35	.10
WE	4,718	10,406	-5,688	.70	-.60	.70
EE	22,389	23,785	-1,396	.30	-.30	.35
USSR	13,600	28,784	-15,184	.30	-.40	.38
M.E.	226	3,122	-2,896	.90	-.70	.90
N.Africa	3,440	6,301	-2,861	.90	-.70	.90
Other Africa	18,438	19,516	-1,078	.40	-.50	.30
Japan	2	14,227	-14,225	.50	-.50	1.00
Korea	133	3,540	-3,407	.20	-.50	.60
Taiwan	190	3,207	-3,017	.50	-.70	.60
Other Asia	24,819	26,924	-2,105	.40	-.50	.50
C.Am.	15,753	18,526	-2,773	.60	-.50	.30
S.Am.	25,758	26,903	-1,145	.20	-.50	.50

1/. Source: USDA.
2/. Source: Embargoes, Surplus Disposal, and U.S. Agriculture, USDA.

Table 2. Trade Data for Base Year, 1984/85: Corn[1].

	U.S.	Argentina	China	Thailand	ROW	Subtotal
			(1,000MT)			
Canada	527	28	0	0	30	585
EC	2,279	862	0	21	1,971	5,133
WE	4,102	1,097	0	0	489	5,688
EE	923	42	0	0	431	1,396
USSR	2,044	2,039	0	35	1,066	15,184
M.E.	1,313	824	0	589	170	2,896
N.Africa	2,227	544	0	0	90	2,861
Other Africa	702	99	14	33	230	1,078
Japan	10,970	466	2,578	20	191	14,225
Korea	1,675	0	1,280	362	90	3,407
Taiwan	2,997	0	0	20	0	3,017
Other Asia	46	21	773	1,070	195	2,105
C.Am.	2,142	546	0	0	85	2,773
S.Am.	942	203	0	0	0	1,145
Subtotal	42,889	6,771	4,645	2,150	5,038	61,493
Price ($/MT)	114	103	117	102	126	

1/. See Mackie et al. for regional groupings.

Table 3. Average PSE and CSE during the Period 1982-86: Corn

Country	Price	PSE	CSE	Horizontal Distance PSE	Horizontal Distance CSE
		(US $/MT)		(1,000MT)	
U.S.	114.00	31.51	0	-22,149.39[1/]	0
EC	160.31	41.66	-32.68	-2,642.50	1,817.27
Canada	136.96	9.80	0	-100.52	0
Japan	154.24	0	-4.0	0	184.48

1/. Acreage allcoated for corn production and for the acreage reduction program (APR) are 80.5 million acres and 3.9 million acres, respectively, in 1984. Production foregone from set-aside acreage was based on 50 percent of production slippage. When the U.S. removes its producer subsidies, the domestic supply curve initially shifts to the left by 26,939.39 million MT, but it shifts back to the right by 4.79 million MT due to a relaxed ARP.

Table 5. Gains from Trade Liberalization in the World Corn Market

Country	Δ in Consumer Surplus	Δ in Producer Surplus	Net Changes in Surplus	Government Expenditure Eqiv. Saved	Tax-Payer Gains	Effectiveness Ratio
			(Million US $)			
U.S.	-1,688.903	-522.527	-2,211.430	6,142.000	3,930.570	.36
Argentina	-3.456	12.113	8.657	2.390[1/]	11.047	-3.622
China	-424.239	456.498	32.259		32.259	-
Thailand	-1.435	2.934	1.499		1.499	-
ROW	-9.372	14.773	5.401		5.401	-
Canada	-42.235	25.185	-17.050	68.835	51.785	.248
EC	-202.397	348.972	146.576	14.880	161.456	-9.851
Japan	-411.426	.073	-411.353	-56.908	-468.261	-7.228

1/. Export tax rate for 1985 was 0.283.

Table 4. Estimated Trade Patterns After Trade Liberalization in the World Corn Market.

	U.S.	Argentina	China	Thailand	ROW	Subtotal
			(1,000 MT)			
Canada	429	28	0	0	31	488
EC	1,854	874	0	21	1,999	4,748
WE	3,337	1,112	0	0	496	4,945
EE	751	43	0	0	437	1,231
USSR	9,798	2,068	0	36	1,081	12,983
M.E.	1,068	836	0	595	172	2,671
N.Africa	1,812	552	0	0	91	2,455
Other Africa	571	100	17	33	233	954
Japan	8,924	473	3,211	20	194	12,822
Korea	1,363	0	1,594	366	91	3,414
Taiwan	2,439	0	0	20	0	2,459
Other Asia	37	21	963	1,082	198	2,301
C. Am.	1,743	554	0	0	86	2,383
S. Am.	766	205	0	0	0	971
Subtotal	34,892	6,866	5,785	2,173	5,109	54,825
Price ($/MT)	125.28	104.27	123.19	102.69	127.06	

Appendix I

Excess Supply Equations for Corn

U.S.:
Aggregate excess supply; -100,186.69 + 1,255.05P;
Excess supply to; Canada -1,231.04 + 15.4215P; EC -5,323.63 + 66.6898P;
WE -9,582.07 + 120.0357P; EE -2,156.08 + 27.0095P; USSR -28,134.20
+ 352.4405P; M.E. -3,067.10 + 38.4220P; N. Africa -5,202.16 + 65.1681P;
Other Africa -1,639.83 + 20.5424P; Japan -3,912.72 + 49.0151P; Korea
-3,912.72 + 49.0151P; Taiwan -7,000.05 + 87.7004P; Other Asia -107.45
+ 1.3461P; C.Am. -5,003.61 + 62.6808P; S.Am. -2,200.46 + 27.5655P.

Argentina:
Aggregate excess supply; -970.595 + 75.1611P;
Excess supply to; Canada -4.01 + 0.3108P; EC -123.56 + 9.5686P; WE
-157.25 + 12.1772P; EE -6.02 + 0.4662P; USSR -292.28 + 22.6338P;
M.E. -118.12 + 9.1468P; N. Africa -77.98 + 6.04P; Other Africa
-14.19 + 1.10P; Japan -66.80 + 5.17P; Other Asia -3.01 + 0.23P;
C.Am. -78.27 + 6.06P; S.Am. -29.10 + 2.25P.

China:
Aggregate excess supply; -16,913.4 + 184.26P;
Excess supply to; Other Africa -50.98 + 0.5554P; Japan -9,387.08
+ 102.27P; Korea 4,660.77 + 50.7758P; Other Asia -2,814.66 + 30.6638P.

Thailand:
Aggregate excess supply; -1,260.86 + 33.4398P;
Excess supply to; EC -12.32 + 0.3266P; USSR -20.53 + 0.5444P;
M.E. -345.42 + 9.1610P; Other Africa -19.35 + 0.5133P; Japan -11.73
+ 0.3111P; Korea -11.73 + 5.6303P; Taiwan -11.73 + 0.3110P; Other Asia
-627.50 + 16.6421P.

The ROW:
Aggregate excess supply; -3,532.59 + 68.02P;
Excess supply to; Canada -21.04 + 0.4050P; EC -1,382.04 + 26.6115P;
WE -342.88 + 6.6022P; EE -302.21 + 5.8191P; USSR -747.47 + 14.3926P;
M.E. -119.20 + 2.2953P; N. Africa -63.11 + 1.2151P; Japan -133.93
+ 2.5788P; Korea -63.11 + 1.2151P; Other Asia -136.73 + 2.6328P;
C.Am. -59.60 + 1.1476P.

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