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Targeting of U.S. Agricultural Export Subsidies

A Theoretical Analysis

Stephen L. Haley

TARGETING OF U.S. AGRICULTURAL EXPORT SUBSIDIES: A THEORETICAL ANALYSIS. By Stephen L. Haley, Agriculture and Trade Analysis Division, Economic Research Service, U.S. Department of Agriculture. ERS Staff Report No. AGES880203.

ABSTRACT

The United States has proposed that all direct and most indirect agricultural export subsidies be eliminated by the year 2000. Prospects for success depend on major agricultural exporters reaching a consensus that elimination of the subsidies would be mutually beneficial. This report illustrates a methodology that can be refined to show whether the United States has the power to influence other exporters, especially the European Community (EC). It is assumed that the United States seeks a consensus based on U.S. capacity to threaten to use targeted export subsidies to disrupt world wheat and corn markets to its own benefit. Preliminary results indicate that there are potentially large gains to a targeted subsidy program for wheat but probably not for corn. The marginal gain to a program involving more than $2.5 billion is likely to be small. If the EC decides to target its wheat subsidies in response to the U.S. program, it can more than offset the losses due to the U.S. program.

Keywords: Export subsidies, spatial equilibrium model, agricultural trade, wheat, corn.

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INTRODUCTION

The United States actively uses export subsidies to promote sales of a variety of agricultural crops. Programs include PL-480 food aid, export credits (GSM 100), export credit guarantees (GSM 102 and 103), and the Export Enhancement Program. Under the latter program, policymakers have directed that sales be targeted to countries where the United States has lost market share because of export subsidies of competitors, especially the European Community (EC). At the same time, the United States has proposed that all agricultural export subsidies be eliminated by the year 2000.

A study completed at the U.S. Department of Agriculture's (USDA) Economic Research Service (ERS) has indicated substantial gains to U.S. and world welfare when major agricultural trading nations remove barriers to trade (4).1/ Work continues at ERS on strategies for obtaining agreement among these nations on how to relax the numerous barriers to liberalized agricultural trade. Part of this effort includes an assessment of U.S. ability to influence outcomes in various world commodity markets. The premise: negotiating from a position of market strength enhances the prospects of directing an agreement favorable to U.S. interests. U.S. policymakers have identified these interests with a more liberalized world trading environment.

The purpose of this report is to assess the U.S. ability to influence world wheat and corn markets through an actively supported targeted export subsidy program. The underlying question is whether the United States can influence agreement among other agricultural exporters regarding trade liberalization based on its market power in these commodity markets. Although this question cannot be answered directly, this research intends to provide the U.S. policymaker with greater perspective on the strength of the U.S. negotiating position in these two markets. This report first reviews the theory of targeted export subsidies, and then applies the theory to an examination of world wheat and corn markets.

THE THEORY OF TARGETED EXPORT SUBSIDIES

Targeted export subsidies have received increased attention from economists. Sharples has applied the price discrimination model from microeconomics to a

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1/ Underlined numbers in parentheses cite sources listed in the References section at the end of the report.

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concise analysis of the underlying theory of targeted export subsidies ($\underline{6}$).
The logic is that by subsidizing relatively elastic markets, a nation can tax
those countries with relatively less elastic excess demand schedules. The
world price of a subsidized good increases, and the return to the subsidizing
country may outweigh the costs of that subsidy. Abbott, Paarlberg, and
Sharples have extended this analysis to both a general equilibrium framework,
and to a multicountry spatial equilibrium framework ($\underline{1}$). I have revised the
Abbott and others' framework to include other commodities ($\underline{3}$).

I present an outline of the model used in the succeeding empirical analysis
for two commodities, wheat and corn. A set of n1 countries exports wheat, and
a set of m1 countries imports wheat. A second set of countries, n2, exports
corn, and a set of m2 countries imports corn. The union of sets n1 and m1 is
identical to the union of sets n2 and m2. In what follows, superscripts refer
to commodities, and subscripts refer to the countries. Country 1 is the
subsidizing country, and it exports both commodities.

Country 1 gives export subsidies to maximize an objective function $F(p_1^w, p_1^c)$,
where p is price. (In addition, let S, Z, and M represent export subsidies,
export levels, and import levels, respectively). The function F can define a
wide range of objectives, including export revenue, producers' surplus, and
economic surplus. To determine optimal subsidies, the problem is written as a
LaGrangian:

$$\text{MAX } L = F(p_1^w, p_1^c) - \sum_{g=1}^{m1} S_{1g}^w Z_{1g}^w - \sum_{i=1}^{m2} S_{1i}^c Z_{1i}^c \tag{1a}$$

$$- \sum_{h=1}^{n1} e_h^w \left(\sum_{g=1}^{m1} Z_{hg}^w - Z_h^w (p_h^w, p_h^c) \right) \tag{1b}$$

$$- \sum_{j=1}^{n2} e_j^c \left(\sum_{i=1}^{m2} Z_{ji}^c - Z_j^c (p_j^w, p_j^c) \right) \tag{1c}$$

$$- \sum_{g=1}^{m1} m_g^w \left(M_g^w (p_g^w, p_g^c) - \sum_{h=1}^{n1} Z_{hg}^w \right) \tag{1d}$$

$$- \sum_{i=1}^{m2} m_i^c \left(M_i^c (p_i^w, p_i^c) - \sum_{j=1}^{n2} Z_{ji}^c \right) \tag{1e}$$

$$- \sum_{h=1}^{n1} \sum_{g=1}^{m1} q_{hg}^w (p_g^w - p_h^w - T_{hg}^w + S_{hg}^w) \tag{1f}$$

$$- \sum_{j=1}^{n2} \sum_{i=1}^{m2} q_{ji}^c (p_i^c - p_j^c - T_{ji}^c + S_{ji}^c) \tag{1g}$$

$$- \sum_{h=1}^{n1} \sum_{g=1}^{m1} r_{hg}^w Z_{hg}^w (p_g^{w*} - p_h^w - T_{hg}^w + S_{hg}^w) \tag{1h}$$

$$- \sum_{j=1}^{n2} \sum_{i=1}^{m2} r_{ji}^c Z_{ji}^c (p_i^{c*} - p_j^c - T_{ji}^c + S_{ji}^c) \tag{1i}$$

Condition 1a shows the objective of the exercise: maximization of F less the
costs of the subsidies. Conditions 1b and 1c say that total exports by a
country are the sum of shipments to the individual importing countries.
The cost or benefit (if negative) resulting from a unit increase in exports by
a country is e. Conditions 1d and 1e say that the total level of imports by a
country is the sum received from the n1 or n2 exporting countries. The cost
arising from the importation of an additional unit of k is m. Conditions 1f
and 1g say that border prices between exporter and importer are linked by
transport costs T and subsidies S. The increased cost from a unit increase in
transportation costs or reduction in the subsidy is captured by q. Conditions

1h and 1i are complementary slackness conditions for a competitive equilibrium. The cost associated with suboptimal trade flows is r.

One can derive expressions for optimal subsidies by manipulating the first order conditions. The first order conditions are a result of differentiating equation 1 with respect to export prices, import prices, trade flows, and subsidy levels. Because $r > 0$ only when $Z = 0$, the subsidy to country g or i on wheat or corn is determined:

$$S_{1g}^w = -e_1^w + m_g^w \quad \text{and} \quad S_{1i}^c = -e_1^c + m_i^c \quad (2)$$

Solving for e_1^k yields:

$$
\begin{vmatrix} e_1^w \\ \\ e_1^c \end{vmatrix}
=
\begin{vmatrix} \dfrac{\delta Z_1^w}{\delta p_1^w} & \dfrac{\delta Z_1^c}{\delta p_1^w} \\ \\ \dfrac{\delta Z_1^w}{\delta p_1^c} & \dfrac{\delta Z_1^c}{\delta p_1^c} \end{vmatrix}^{-1}
\begin{vmatrix} Z_1^w - \dfrac{\delta F}{\delta p_1^w} \\ \\ Z_1^c - \dfrac{\delta F}{\delta p_1^c} \end{vmatrix}
\quad (3)
$$

To simplify the evaluation of the m, assume the following. There are two exporters and two importers. Exporter 1 ships wheat to importers 3 and 4, while shipping corn only to importer 3. Exporter 2 ships corn to both importers, while shipping wheat only to importer 4:
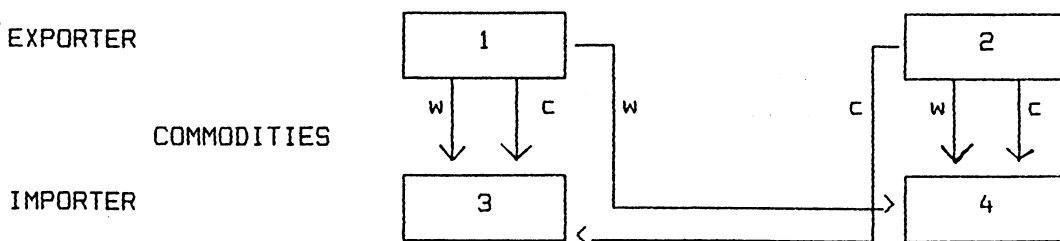
This simplification illustrates three cases: an unshared market, a market shared with a competitor who has no other customers, and a market shared with a competitor who has at least one other customer. Solving for the m, which is relevant for determining exporter 1's subsidies produces:

$$
\begin{vmatrix} m_3^w \\ \\ m_4^w \\ \\ m_3^c \end{vmatrix}
=
\begin{vmatrix} -\dfrac{\delta M_3^w}{\delta p_3^w} & 0 & -\dfrac{\delta M_3^c}{\delta p_3^w} \\ \\ 0 & \left(\dfrac{\delta Z_2^w}{\delta p_2^w} - \dfrac{\delta M_4^w}{\delta p_4^w}\right) & \left(\dfrac{\delta Z_2^c}{\delta p_2^w} - \dfrac{\delta M_4^c}{\delta p_4^w}\right) \\ \\ -\dfrac{\delta M_3^w}{\delta p_3^c} & \left(\dfrac{\delta Z_2^w}{\delta p_2^c} - \dfrac{\delta M_2^w}{\delta p_4^c}\right) & \left(\dfrac{\delta Z_2^c}{\delta p_2^c} - \left(\dfrac{\delta M_4^c}{\delta p_4^c} + \dfrac{\delta M_3^c}{\delta p_3^c}\right)\right) \end{vmatrix}^{-1}
\begin{vmatrix} -Z_{13}^w \\ \\ -Z_{14}^w \\ \\ -Z_{13}^c \end{vmatrix}
\quad (4)
$$

The solution can be fairly complex even in this simple example. Compare to the single commodity case where exporter 1 is the sole supplier to a first import market:

$$m^w_3 = \frac{M^w_3}{\left(\dfrac{\delta M^w_3}{\delta p^w_3}\right)} \qquad \text{since } z^w_{13} = M^w_3 \qquad (5)$$

and to the case of a shared market:

$$m^w_4 = \frac{z^w_{14}}{\left(\dfrac{\delta M^w_4}{\delta p^w_4} - \dfrac{\delta z^w_2}{\delta p^w_4}\right)} \qquad \text{and} \qquad m^c_3 = \frac{z^c_{13}}{\left(\left(\dfrac{\delta M^c_4}{\delta p^c_4} + \dfrac{\delta M^c_3}{\delta p^c_3}\right) - \dfrac{\delta z^c_2}{\delta p^c_2}\right)} \qquad (6)$$

These terms are found on the main diagonal of the matrix to be inverted in equation 4.

The rationale behind targeting is the same as in the single commodity case, in spite of the added complexity. For the unshared import market, the subsidy should go to the country with the high import demand price elasticity.

Equation 5 says that the value of "m" varies inversely with the importer price response. If the import response is high (implying elastic excess demand), then the value of "m" is low. For a given value of "e," the probability of a welfare-enhancing subsidy increases (equation 2). For a shared market, the price elasticity of competing export suppliers helps determine the optimal export subsidy (equation 6). The excess supply response of the competing exporter accounts for the adjustment to a price change resulting from the withdrawal from the subsidized market of the competitor. When the competitor supplies another importer market, the other importer's demand response belongs in the denominator of an equation, as in equation 6. This response accounts for the competitor's ability to expand into that other market. Where cross price effects are important, they should be accounted for when determining the target and the level of the subsidy. These effects are picked up by the off-diagonal elements of the matrix in equation 4. It is best left as an empirical matter whether or not cross commodity effects substantially alter the results obtained in the single good setting.

Another avenue of gain, not readily apparent in the mathematics described above, is the exploitation of transport cost differentials between competitors. In a shared market, the subsidized price and the price of a competing exporter will differ by the transport cost differential. A small change in the subsidy changes the pre-existing relationship between the importer's and competitor's price. The subsidy forces the competitor out of that market and into a less advantageous trade relationship with another importer. In short, the subsidy allows the subsidizing country to raise its border price without the price of the competitor rising as well.

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U.S. TARGETED EXPORT SUBSIDIES FOR WHEAT AND CORN

This report outlines a method through which to evaluate U.S. market power in world wheat and corn markets. The market power concept relates to U.S. competitiveness in these markets. The means to evaluate U.S. market power are based on the potential for gain for the United States if this country were to choose to target export subsidies for wheat and corn. This potential depends on the export demand elasticities for wheat and corn facing the United States. Reliable estimates of relevant elasticities are hard to come by. Gardner and Dixit review a large number of studies which try to fix the own price export demand elasticity for various crops (2). Arriving at a consensus for individual country parameter values is difficult as well. For wheat, longrun elasticities vary between -0.23 and -6.72. For U.S. coarse grains, the values range between -0.41 and -10.18.

ERS researchers have compiled own and cross supply and demand elasticities for 22 commodities covering 36 world regions. The base period is 1984. Individual country analysts in ERS country branches provided the elasticities, which are inputs to the USDA trade liberalization model.

Based on these parameter estimates, I have constructed linear excess supply and demand equations for 21 aggregated regions for wheat and corn. Tables 1 and 2 show excess supply and demand elasticities and schedules. I treat trade patterns among the 21 regions as a solution to a generalized transportation problem, using intercountry transport costs from Sharples and Dixit (6). These transport costs are shown in appendix tables 1 and 2 for wheat and corn, respectively.

The individual trade elasticities imply an aggregate U.S. export demand elasticity of -4.57 for wheat and -2.30 for corn. The cross price elasticity for wheat with respect to the price of corn is 0.14. The cross price elasticity for corn with respect to the price of wheat is 0.25. For the range of elasticity estimates, the wheat elasticity is toward the high end of the spectrum, while the corn elasticity is closer to the median. These elasticities imply _a priori_ that export subsidies are likely to yield high benefits, especially for wheat. The question, however, is whether the benefits exceed the costs and what affects other commodity exporters.

The partial, static, spatial equilibrium model, like all models, is a simplification of reality. The partial specification provides that no other markets affect the operations of the wheat or corn markets. All market influences are contained in the excess supply and demand equations. Results are likely to be sensitive to the elasticities used in the analysis. For realistic policy implications, a range of elasticities should probably be used for each of the trading nations. Although not a part of this preliminary report, sensitivity analysis should be an important part of any exercise on which specific policy recommendations are to be made.

The model is static, and it takes no account of adjustment costs in going from one equilibrium to another. The model assumes an adjustment period of 3 to 5 years. Subsidy costs incurred during the adjustment period are ignored. Given the long adjustment period, price transmission elasticities are implicitly set equal to one. I assume that targeted countries do not reship their commodity imports to other countries. The model assumes that wheat and corn are homogeneous commodities, not differentiated by variety or by country

of origin. This simplification allows the use of the spatial equilibrium model in determining equilibrium solutions. The spatial equilibrium framework, although powerful in its theoretical structure, has not proved useful in predicting actual trade patterns (7). Model results should be interpreted as tendencies rather than as predictions.

Tables 3 and 4 show the base solution for the model for wheat and corn, respectively. The free on board (f.o.b.) price of wheat is $146.11 per metric ton (mt), and the total quantity traded is nearly 92 million mt. The f.o.b. price of corn is $131.28 per mt, and the total quantity traded is just over 58 million mt. The U.S. price for both commodities is close to the world price. Figures 1 and 2 show the relative market shares for the major exporters of wheat and corn, respectively. The United States has a substantial world market share for both commodities: 0.40 for wheat and 0.75 for corn. Appendix tables 3 and 4 show the trade flows for wheat and corn, respectively.

Subsidy Scenarios

The subsidy scenarios show U.S. competitiveness in world wheat and corn markets. A scenario consists of the maximization of an objective function

Table 1--Wheat: Excess supply and demand schedules

Country or region	Elasticities		Intercept	Own price	Cross price
	Own	Cross			
				- - Dollars - -	
Exporters:					
United States	1.259	0	-9,971.52	317.88	0
Canada	.811	0	3,323.66	93.51	0
European Community	3.326	-0.273	-31,566.38	355.37	-30.91
Other Western Europe	4.619	-.398	-3,252.64	30.59	-2.96
Australia	1.137	0	-1,909.24	103.91	0
Eastern Europe	--	--	1,358.00	0	0
Argentina	1.101	-.359	2,427.20	67.93	-24.87
Importers:					
Japan	-.471	.114	7,238.56	-16.48	4.48
South Africa	--	--	8.00	0	0
Soviet Union	-1.132	.170	51,600.95	-195.24	32.92
China	-2.474	.881	19,189.00	-120.06	48.00
Mexico	--	--	486.00	0	0
Brazil	-.796	.147	7,732.99	-24.87	5.08
Other Latin America	-.506	.142	9,066.98	-22.06	6.95
Africa	-.720	.126	20,263.13	-60.02	11.79
Middle East	-.372	0	23,700.00	-42.14	0
India	--	--	599.00	0	0
Thailand	-.606	.001	303.23	-.75	0
East Asia	-1.605	.201	961.00	-4.21	.59
Other Asia	-.403	.024	16,573.26	-33.24	2.08
Rest of world	-.250	.050	3,054.21	-4.17	.94

-- = Not applicable.

subject to the constraints described in equation 1. Judgments regarding competitiveness are based on comparing scenario results with the base.

The choice of a specific objective function influences the level and targeting of the subsidies. In the following four scenarios, I have chosen export revenue maximization less subsidy costs as the objective to be maximized. Export revenue is an easily identifiable measure of competitiveness and is a close proxy for world market share.

Domestic farmers will benefit from export revenue maximization, while domestic consumers will be hurt. The effect on both groups is a byproduct of the export revenue objective. Export-oriented policies intended to benefit the domestic farm sector in a cost-effective way can be dealt with in the context of equation 1. The level of subsidization, however, would be less, and the effect on trading partners would be less as well. Policies meant to directly benefit farmers are not pursued in this report.

Given the effect of U.S. subsidies on the world wheat and corn markets, other exporters would not likely remain passive in the face of declining market

Table 2--Corn: Excess supply and demand schedules

Country or region	Elasticities		Intercept	Own price	Cross price
	Own	Cross			
				- - Dollars - -	
Exporters:					
United States	3.071	0	-97,946.48	1,069.36	0
Australia	3.895	-0.271	-302.71	3.30	-0.20
South Africa	--	--	206.00	0	0
Eastern Europe	--	--	1,358.00	0	0
China	4.052	-.701	-11,966.00	151.85	-23.40
Argentina	1.163	-.531	2,618.06	60.75	-24.75
India	--	--	6.00	0	0
Thailand	.658	-.037	1,204.43	15.41	-.77
Importers:					
Canada	--	--	42.00	0	0
European Community	-3.030	.681	26,698.00	-177.85	35.60
Other Western Europe	-6.726	1.227	2,403.80	-18.32	2.98
Japan	-.300	.050	17,442.57	-30.82	4.58
Soviet Union	-.589	.242	27,343.01	-88.03	32.22
Mexico	--	--	1,684.00	0	0
Brazil	--	--	1,044.00	0	0
Other Latin American	-1.965	.483	5,085.04	-29.64	6.49
Africa	-5.683	.600	3,048.00	0	0
Middle East	-1.343	0	9,515.53	-40.16	0
East Asia	-.702	.130	1,049.66	-3.45	.57
Other Asia	-1.700	.061	19,378.00	-91.91	2.94
Rest of world	-.301	.271	552.76	-1.19	.95

-- = Not applicable.

shares. For large market share changes, U.S. subsidies may violate the General Agreement on Tariffs and Trade (GATT) restriction on "inequitable" market shares.

The United States would be more vulnerable in the world wheat market because its world wheat market share is considerably less than its corn share. Although Canada and Australia could conceivably retaliate for the U.S. program, it is the EC, judged by its past behavior, that would be the likely candidate to take retaliatory action in the world wheat market.

In this report, I allow only the EC to retaliate against the U.S.-targeted subsidies. I make this restriction to limit the scope of this particular report. This report could be extended to include the probable reaction of other exporters. Also, one should be alert to retaliation in other markets besides the ones described in this report.

Table 3--Wheat: Base prices and trade volume

Country or region	Price	Volume	Market share	Revenue 1/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	146.10	36,470.25	0.397	5.328
Canada	146.84	17,054.52	.186	2.504
European Community	148.95	14,015.52	.153	2.088
Other Western Europe	148.95	879.59	.010	.131
Australia	146.59	13,322.76	.145	1.953
Eastern Europe	148.95	1,358.00	.015	.202
Argentina	138.72	8,787.39	.096	1.219
Total	146.11	91,888.03	1.000	13.425
Importers:				
Japan	165.34	5,192.84	.057	.859
South Africa	160.07	8.00	.000	.001
Soviet Union	160.76	25,211.34	.274	4.053
China	163.76	5,910.19	.064	.968
Mexico	154.07	486.00	.005	.075
Brazil	153.48	4,616.61	.050	.709
Other Latin America	158.10	6,582.62	.072	1.041
Africa	166.27	12,060.55	.131	2.005
Middle East	161.96	16,875.07	.184	2.733
India	163.32	599.00	.007	.098
Thailand	164.89	179.70	.002	.030
East Asia	164.89	357.22	.004	.059
Other Asia	168.24	11,296.73	.123	1.901
Rest of world	163.32	2,512.07	.027	.410
Total	162.59	91,888.04	1.000	14.940

1/ For importers, it is expenditures.

I choose four scenarios to evaluate the potential gain to a U.S.-targeted export subsidy program. Case 1 places no limit on funds available for the subsidies, and it does not allow for an EC response. Case 2 allows for the EC to retaliate against U.S. subsidies by targeting EC export subsidies for wheat, given the level and direction of the U.S. subsidies. The EC goal is the same as that of the United States: export revenue maximization. Case 3 is like case 1 except that an upper limit of $2.5 billion is placed on total subsidy costs. Case 4 is like case 2, but the pre-determined U.S. subsidies are from case 3 instead of case 1. Table 5 provides a summary of the cases.

In all four cases, the United States can subsidize its corn exports to the EC. However, the EC allows imports of corn to enter only at the threshold price, which is typically set higher than the world offer price. The difference between these prices constitutes the variable levy. Proceeds from the variable levy are used to subsidize the exports of EC wheat and other crops.

Table 4--Corn: Base prices and trade volume

Country or region	Price	Volume	Market share	Revenue 1/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	132.36	43,592.35	.750	5.769
Australia	133.49	107.90	.001	.014
South Africa	132.11	206.00	.003	.027
Eastern Europe	139.98	86.00	.001	.012
China	132.11	4,270.68	.073	.564
Argentina	123.16	6,666.65	.114	.821
India	139.98	6.00	.000	.000
Thailand	132.11	3,113.26	.053	.411
Total	131.28	58,048.84	1.000	7.620
Importers:				
Canada	137.36	42.00	.007	.005
European Community	141.41	6,851.07	.118	.968
Other Western Europe	143.28	222.81	.003	.031
Japan	151.60	13,527.56	.233	2.050
Soviet Union	151.79	19,160.70	.330	2.908
Mexico	140.33	1,684.00	.029	.236
Brazil	137.92	1,044.00	.017	.143
Other Latin America	144.36	1,832.31	.031	.264
Africa	150.71	3,048.00	.052	.459
Middle East	148.22	3,563.08	.061	.528
East Asia	151.79	619.97	.010	.094
Other Asia	147.76	5,921.24	.102	.874
Rest of world	149.35	532.08	.009	.079
Total	148.95	58,048.82	1.000	8.646

1/ For importers, it is expenditures.

Figure 1—World wheat exporters: Base
(Volume: 91,888,030 metric tons)

US(40%)

CAN(19%)—

—ARG(10%)

—EE(1%)

EC(15%)

OWE(1%)

AUS(14%)
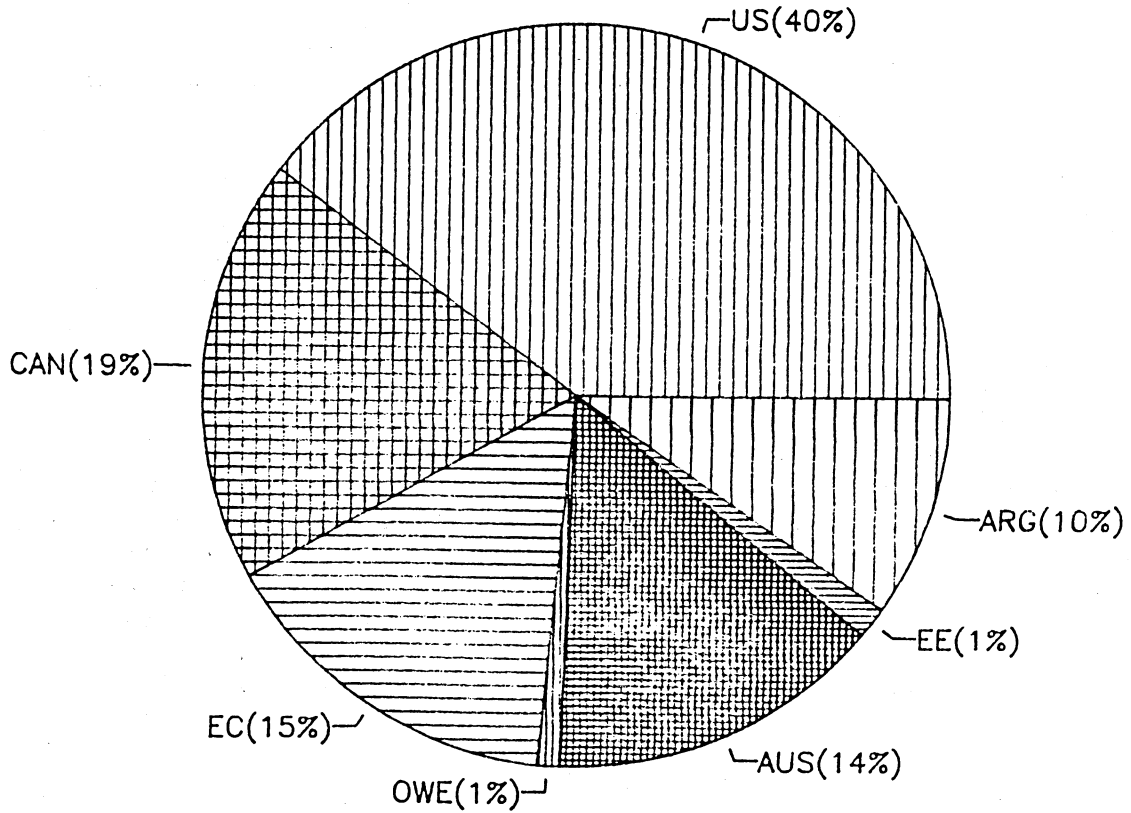
Figure 2—World corn exporters: Base
(Volume: 58,048,840 metric tons)

US(75%)

—THAI(5%)

—OTHER(1%)

ARG(11%)

CHINA(7%)
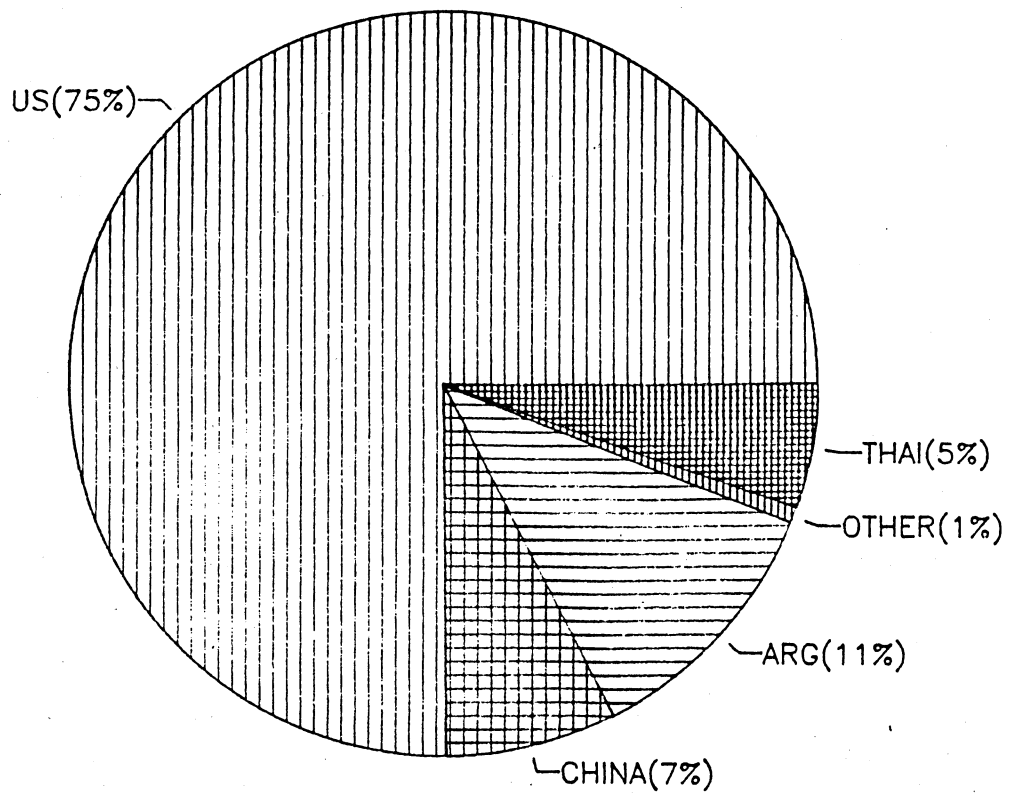
Table 5--Description of cases

Case	U.S. subsidy	EC response
Case 1	No limit	No response
Case 2	No limit	Targeted subsidies
Case 3	Limit = $2.5 billion	No response
Case 4	Limit = $2.5 billion	Targeted subsidies

A U.S. corn subsidy to the EC, therefore, causes the EC to be more competitive in the world wheat market. The model deals with this issue by making the variable levy endogenous. The threshold price is set initially equal to the EC border price, in effect making the variable levy equal to zero. The variable levy, adjusted due to the U.S. subsidies, is set equal to the difference between the base EC price for corn ($141.41) and the EC price after the subsidy. The variable levy acts like an increase in corn transport costs from all sources to the EC. I use the proceeds of the variable levy to uniformly subsidize EC wheat exports. This EC subsidization occurs in all four cases and does not influence the EC-targeted export subsidies in cases 2 and 4. Table 6 provides U.S. subsidy and target information for all four cases.

Case 1

The U.S. maximizes export revenue less subsidy costs. No upper limit exists on the subsidy cost, and the EC does not retaliate with a targeted subsidy program of its own. Tables 7 and 8 summarize the model results for wheat and corn, respectively. Appendix tables 5 and 6 show the direction of trade for wheat and corn, respectively.

The total subsidy cost is high, $4.2 billion. Of this amount, $3.5 billion is for wheat, and $748 million is for corn. Total wheat sales increase from $5.3 billion to $10.2 billion. Total corn sales increase from $5.8 billion to $6.6 billion. Net revenue increases from the base of $11.1 billion to $12.6 billion.

The United States increases its wheat exports dramatically. Because of a subsidy of $91.95 per mt, China increases its purchases to 10,640 tmt from 5,910 tmt. Japan, Other Latin America, and the Middle East also increase their wheat purchases. The U.S. subsidy to Other Asia not only increases purchases but also displaces Canada and Australia from that market. U.S. exports to Other Asia increase from 1,423 to 11,712 tmt.

Canadian trade to Other Asia is diverted to the USSR, where it reduces EC wheat exports from 14,016 to 9,632 tmt. This EC loss is partially offset by EC exports to Africa, where it reduces Argentine exports from 1,052 tmt to 132 tmt. Overall EC wheat exports fall from 14,016 tmt to 10,722 tmt. Figure 3 shows the new wheat market shares. The U.S. share increases from 0.40 to 0.52. The EC market share decreases from 0.15 to 0.11. U.S. corn exports rise but not nearly as much as wheat exports: from 43,592 tmt to 48,281 tmt. Because of a very elastic demand for corn, Other Western Europe responds to the U.S. subsidy by increasing corn imports from 223 tmt to 1,240 tmt. Sales

to Other Latin America and the Middle East increase by 30 and 25 percent, respectively. Increased U.S. sales to the EC displace Argentine sales, and increased U.S. sales to the USSR displace Thai sales. Figure 4 shows new corn world market shares. The U.S. share increases from 0.75 to 0.78.

The United States benefits from the targeted subsidy program. For each dollar spent on subsidies, the United States nets a 35 cent return. The return on the dollar wheat subsidy, 40 cents, is especially high. The dollar corn return is 11 cents.

Case 2

Given the U.S. subsidies from case 1, case 2 provides that the EC targets export subsidies for wheat, maximizing EC export revenue less the costs of the subsidies. Table 9 shows the EC subsidies for case 2 and for case 4 as well. Tables 10 and 11 summarize model results for wheat and corn, respectively.

Table 6--U. S. export subsidies

Item	Case 1/case 2	Case 3/case 4
Wheat target:		
Japan	61.75	50.34
South Africa	--	--
Soviet Union	--	--
China	91.95	49.06
Mexico	57.76	45.95
Brazil	--	--
Other Latin America	60.71	48.90
Africa	--	--
Middle East	57.49	45.68
India	--	--
Thailand	--	--
East Asia	--	--
Other Asia	62.24	50.43
Rest of world	--	50.92
Corn target:		
Canada	8.68	--
European Community	12.73	2.32
Other Western Europe	62.01	37.03
Japan	12.54	2.13
Soviet Union	12.73	2.32
Mexico	4.42	--
Brazil	--	--
Other Latin America	25.13	10.26
Africa	--	--
Middle East	26.20	2.06
East Asia	--	3.60
Other Asia	--	--
Rest of world	--	--

-- = Not applicable.

Appendix tables 7 and 8 show the direction of trade for wheat and corn, respectively.

Net EC revenue increases from $1.5 billion in case 1 to $2.6 billion. EC exports to the USSR and Africa increase by 73 and 144 percent from the case 1 levels. A comparison of table 10 with table 7 shows that the world corn market is little affected by the EC wheat subsidization program. The EC subsidies affect the direction and volume of U.S. wheat exports. U.S. wheat exports to China, Japan, and Other Latin America actually exceed their case 1 levels. U.S. exports to Other Asia are substantially below levels reported in case 1: 8,165 tmt instead of 11,712 tmt. Because of the EC subsidy to the USSR, Canada cannot shift their Other Asia wheat trade to the USSR.

Table 7—Case 1: Simulated wheat prices and trade volume 1/

Country or region	Price	Volume	Market share	Revenue 2/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	195.32	52,116.25	0.516	10.179
Canada	133.82	15,836.94	.156	2.119
European Community	138.74	10,721.60	.106	1.487
Other Western Europe	135.93	651.85	.006	.088
Australia	134.45	12,061.20	.119	1.621
Eastern Europe	135.93	1,358.00	.013	.184
Argentina	126.58	8,170.24	.080	1.034
Total	165.63	100,916.08	1.000	16.715
Importers:				
Japan	152.81	5,362.91	0.053	.819
South Africa	147.93	8.00	.000	.001
Soviet Union	147.74	27,478.78	.272	4.059
China	120.69	10,639.62	.105	1.284
Mexico	145.53	486.00	.004	.070
Brazil	141.34	4,876.15	.048	.689
Other Latin America	146.61	6,691.15	.066	.981
Africa	154.13	12,690.84	.125	1.956
Middle East	153.69	17,223.61	.170	2.647
India	151.18	599.00	.005	.090
Thailand	152.75	188.79	.001	.028
East Asia	152.75	403.41	.003	.061
Other Asia	155.22	11,712.19	.116	1.817
Rest of world	151.18	2,554.85	.025	.386
Total	147.59	100,916.10	1.000	14.893

1/ No limit on U.S. subsidy, and no EC retaliation.
2/ For importers, it is expenditures.

The EC subsidy to the USSR also causes East European exports to be diverted to the Middle East, causing U.S. wheat exports to the Middle East to fall from 17,224 tmt in case 1 to 16,925 tmt. U.S. wheat export volume declines from 52,116 tmt in case 1 to 49,554 tmt.

The United States, hurt by the EC retaliation, is still better off than in the base case. Wheat sales decrease from the case 1 level, from $10.2 to $9.3 billion. Corn sales and total subsidy costs decrease slightly to leave net export revenue at $11.8 billion, an amount $720 million greater than the base.

The subsidy dollar nets an 18-cent return. The wheat subsidy dollar return falls from 40 cents to 19 cents. Figure 5 shows that the U.S. world market share decreases to 0.47, which is still higher than the base of 0.40. The EC market share is 0.19, which is higher than the base of 0.15. Figure 6 shows

Table 8--Case 1:   Simulated corn prices and trade volume 1/

Country or region	Price	Volume	Market share	Revenue 2/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	136.74	48,281.26	0.777	6.601
Australia	125.14	82.83	.001	.010
South Africa	123.76	206.00	.003	.025
Eastern Europe	131.63	86.00	.001	.011
China	123.76	4,003.14	.064	.495
Argentina	114.81	6,460.10	.103	.741
India	131.63	6.00	.000	.000
Thailand	123.76	2,993.99	.048	.370
Total	132.93	62,119.32	1.000	8.257
Importers:				
Canada	133.06	42.00	0	.005
European Community	137.24	7,229.79	.116	.992
Other Western Europe	85.65	1,239.72	.019	.106
Japan	143.44	13,721.54	.220	1.968
Soviet Union	143.44	19,475.90	.313	2.793
Mexico	140.29	1,684.00	.027	.236
Brazil	129.57	1,044.00	.016	.135
Other Latin America	123.61	2,372.64	.038	.293
Africa	142.36	3,048.00	.049	.433
Middle East	126.40	4,439.30	.071	.561
East Asia	143.44	641.85	.010	.092
Other Asia	143.44	6,650.11	.107	.953
Rest of world	139.41	530.48	.008	.073
Total	139.18	62,119.33	1.000	8.645

1/ No limit on U.S. subsidy, and no EC retaliation.
2/ For importers, it is expenditures.

Figure 3--Case 1: World wheat exporters
(Volume: 100,916,080 metric tons)

US(52%)

ARG(8%)

EE(1%)

AUS(12%)

CAN(16%)

EC(11%)   OWE(1%)
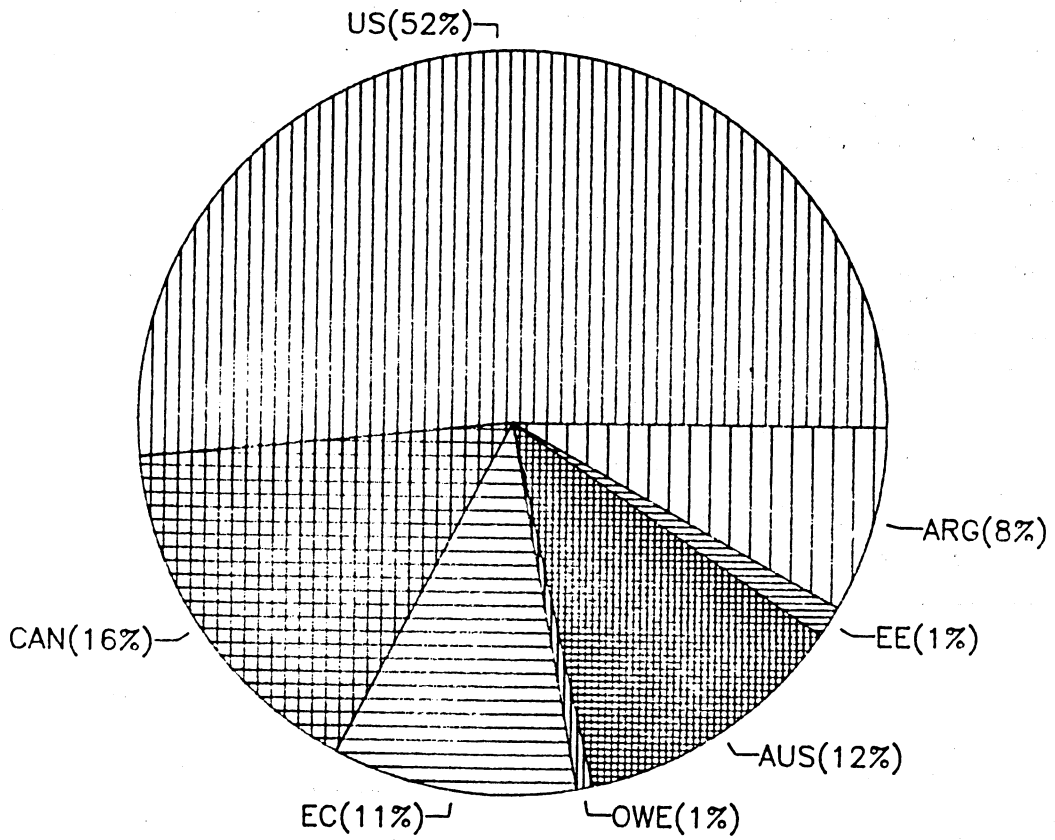
Figure 4--Case 1: World corn exporters
(Volume: 62,119,320 metric tons)

US(78%)

THAI(5%)

OTHER(1%)

ARG(10%)

CHINA(6%)
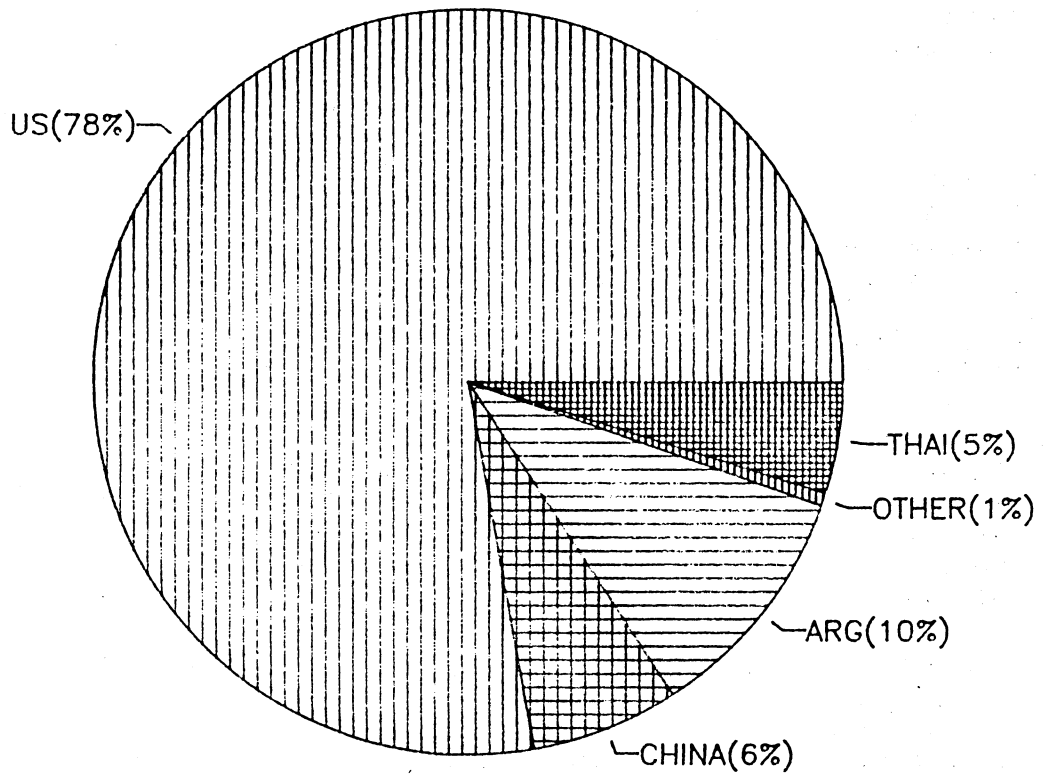
Table 9--EC subsidies

Target	Case 2	Case 4
	Dollars per mt	
Soviet Union	35.82	32.35
Africa	36.30	--

-- = Not applicable.

Table 10-- Case 2: Simulated wheat prices and trade volume 1/

Country or region	Price	Volume	Market share	Revenue 2/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	187.26	49,553.89	0.471	9.279
Canada	125.76	15,083.24	.143	1.897
European Community	166.50	20,028.00	.190	3.335
Other Western Europe	127.87	405.01	.004	.052
Australia	125.91	11,173.81	.106	1.407
Eastern Europe	127.87	1,358.00	.013	.174
Argentina	118.04	7,587.71	.072	.896
Total	162.98	105,189.66	1.000	17.039
Importers:				
Japan	144.75	5,496.18	.052	.796
South Africa	139.39	8.00	.000	.001
Soviet Union	139.68	29,055.61	.276	4.058
China	112.63	11,612.16	.110	1.308
Mexico	137.47	486.00	.005	.067
Brazil	132.80	5,089.03	.048	.676
Other Latin America	138.55	6,870.40	.065	.952
Africa	145.59	13,204.56	.126	1.922
Middle East	145.63	17,563.26	.167	2.558
India	142.64	599.00	.006	.085
Thailand	144.21	195.20	.002	.028
East Asia	144.21	439.42	.004	.063
Other Asia	147.16	11,980.31	.114	1.763
Rest of world	142.64	2,590.55	.025	.370
Total	139.25	105,189.68	1.000	14.647

1/ No limit on U.S. subsidy, and EC retaliation.
2/ For importers, it is expenditures.

that the U.S. export price for case 2 is still substantially higher than the base. In case 2, the United States benefits greatly from its subsidy program, even if the EC decides to retaliate.

<p align="center">Case 3</p>

Case 3 is like case 1 except that the United States places an upper limit of $2.5 billion on the subsidies. Tables 12 and 13 report the model results for wheat and corn, respectively. Appendix tables 9 and 10 report the direction of trade for wheat and corn, respectively.

Like case 1, U.S. wheat exports increase above the base for China (19.3 percent), Japan (3.5 percent), Other Latin America (2.3 percent), and the Middle East (1.7 percent). The United States replaces Australia and Canada

<p align="center">Table 11--Case 2: Simulated corn prices and trade volume 1/</p>

Country or region	Price	Volume	Market share	Revenue 2/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	136.84	48,383.31	0.772	6.620
Australia	125.24	84.89	.001	.010
South Africa	123.86	206.00	.003	.025
Eastern Europe	131.73	86.00	.001	.011
China	123.86	4,206.45	.067	.521
Argentina	114.91	6,677.33	.106	.767
India	131.73	6.00	.000	.000
Thailand	123.86	3,002.05	.047	.371
Total	132.94	62,652.03	1.000	8.3291
Importers:				
Canada	133.16	42.00	0	.005
European Community	137.33	8,201.51	.130	1.126
Other Western Europe	85.75	1,213.93	.019	.104
Japan	143.54	13,681.65	.218	1.963
Soviet Union	143.54	19,207.70	.306	2.757
Mexico	140.39	1,684.00	.026	.236
Brazil	129.67	1,044.00	.016	.135
Other Latin America	123.71	2,317.45	.036	.286
Africa	142.46	3,048.00	.048	.434
Middle East	126.50	4,435.34	.070	.561
East Asia	143.54	636.65	.010	.091
Other Asia	143.54	6,617.56	.105	.949
Rest of world	139.51	522.25	.008	.072
Total	139.25	62,652.04	1.000	8.724

1/ No limit on U.S. subsidy, and EC retaliation.
2/ For importers, it is expenditures.

Figure 5--Case 2:   World wheat exporters
(Volume: 105,189,660 metric tons)
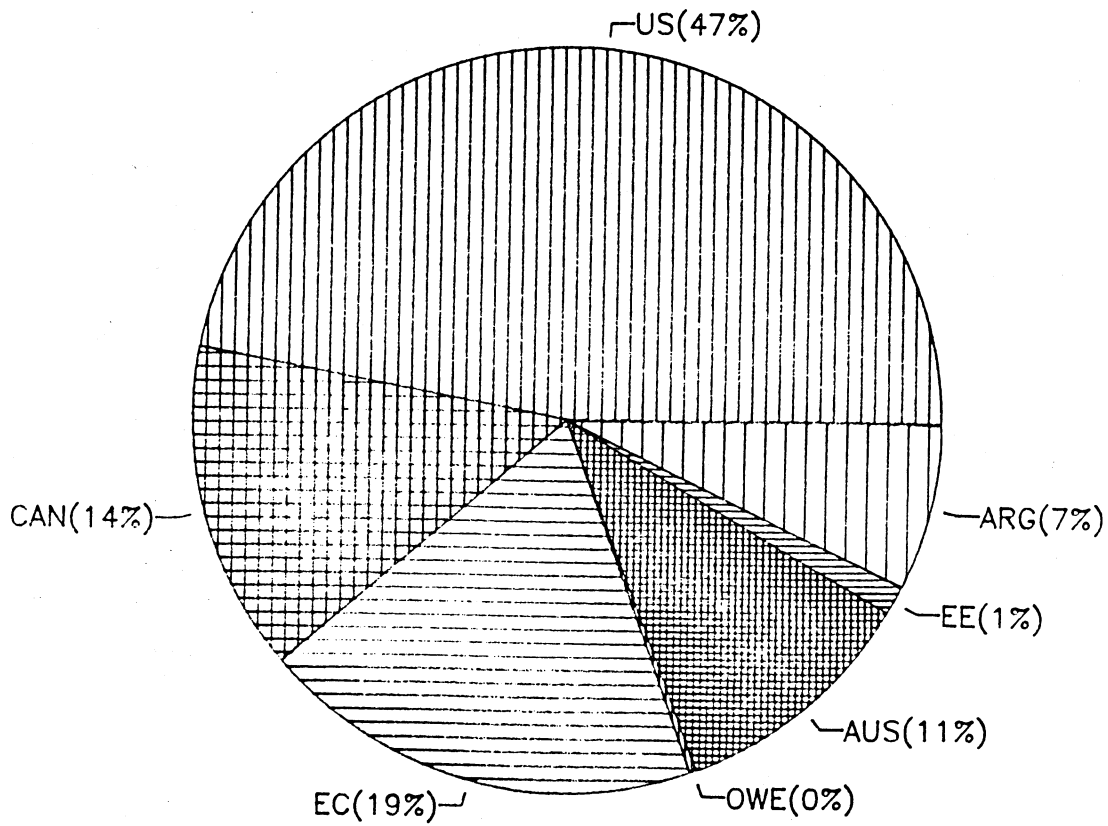

Figure 6--U.S. wheat prices: Base , case 1, and case 2
(Unlimited U.S. subsidy)
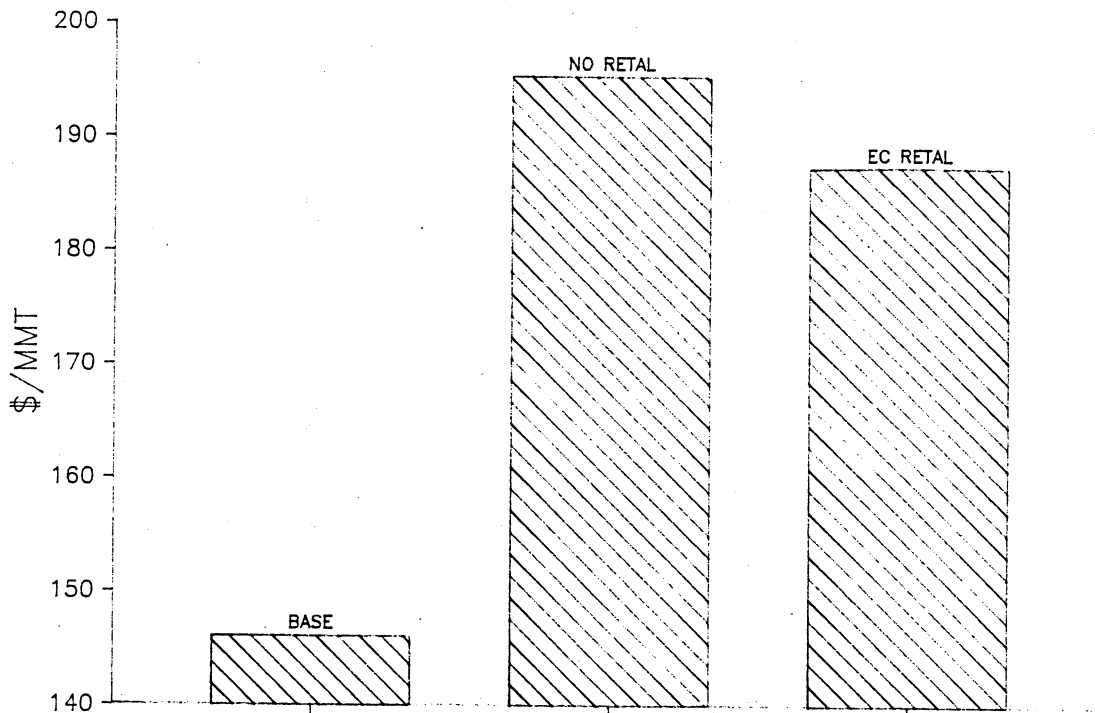
from the Other Asia market. Other Asia imports 10,779 tmt of U.S. wheat. Canada redirects their trade to the USSR, replacing EC exports, which fall to 10,353 tmt from 14,016 tmt. U.S. corn export patterns are similar to case 1's except for the EC. The U.S. corn subsidy to the EC falls from $12.73/mt to $2.32/mt. U.S. corn exports to the EC fall from the base volume of 6,313 tmt to 4,398 tmt.

Of the total subsidy of $2.5 billion, $2.4 billion (94 percent) is used to subsidize wheat sales. Wheat sales are $9.3 billion (compared with the base of $5.3 billion), and corn sales are $5.9 billion (compared with the base of $5.8 billion). Total net export revenue is $12.4 billion (compared with the base: $11.1 billion). The case 3 total is $185 million less than the case 1 total of $12.6 billion. The dollar return to the subsidy program is 52 cents. The dollar return to the wheat portion of the program is 57 cents. The change

Table 12--Case 3: Simulated wheat prices and trade volume 1/

Country or region	Price	Volume	Market share	Revenue 2/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	184.93	48,815.52	0.501	9.027
Canada	135.24	15,970.04	.164	2.159
EC	137.94	10,353.25	.106	1.428
Other Western Europe	137.35	633.02	.006	.086
Australia	134.99	12,117.67	.124	1.635
Eastern Europe	137.35	1,358.00	.013	.186
Argentina	127.12	8,045.08	.082	1.022
Total	159.80	97,293.08	1.000	15.547
Importers:				
Japan	153.83	5,375.15	.005	.826
South Africa	148.47	8.00	.000	.001
Soviet Union	149.16	27,414.74	.281	4.089
China	153.16	7,049.31	.072	1.079
Mexico	146.95	486.00	.004	.071
Brazil	141.88	4,895.64	.050	.694
Other Latin America	148.03	6,736.70	.069	.997
Africa	154.67	12,734.82	.130	1.969
Middle East	155.11	17,163.62	.174	2.662
India	151.72	599.00	.006	.090
Thailand	153.29	188.39	.001	.028
East Asia	153.29	404.64	.004	.062
Other Asia	156.64	11,678.39	.120	1.829
Rest of world	151.72	2,558.69	.026	.388
Total	152.03	97,293.09	1.000	14.791

1/ U.S. subsidy limit of $2.5 billion, no EC retaliation.
2/ For importers, it is expenditures.

in the marginal return goes from a total subsidy of $2.5 billion (case 3) to $4.2 billion (case 1), a 4-cent rise. Therefore, the marginal return to targeted subsidies above $2.5 billion is low. Figure 7 illustrates the small effect of the reduced wheat subsidy on U.S. wheat prices. Figure 8 shows the effect on the U.S. corn price. The corn price is only slightly higher than the base. This effect is not surprising because only $142 million is allocated to the corn subsidy. The return to the wheat subsidy far exceeds that for corn.

Figures 9 and 10 show the world market shares for wheat and corn, respectively. Figure 9 for wheat is very similar to figure 3, corresponding to case 1. Figure 10 for corn is very similar to figure 2, corresponding to the base.

Table 13--Case 3: Simulated corn prices and trade volume 1/

Country or region	Price	Volume	Market share	Revenue 2/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	132.83	44,096.80	0.751	5.857
Australia	131.10	102.38	.001	.013
South Africa	130.26	206.00	.003	.026
Eastern Europe	138.13	86.00	.001	.011
China	130.26	4,229.11	.072	.550
Argentina	121.31	6,841.32	.116	.829
India	138.13	6.00	.000	.000
Thailand	130.26	3,093.68	.052	.402
Total	131.16	58,661.29	1.000	7.694
Importers:				
Canada	137.83	42.00	.000	.005
European Community	140.48	6,623.64	.112	.930
Other Western Europe	106.72	857.92	.014	.091
Japan	149.94	13,526.01	.230	2.028
Soviet Union	149.94	18,949.87	.323	2.841
Mexico	140.80	1,684.00	.028	.237
Brazil	136.07	1,044.00	.017	.142
Other Latin America	134.57	2,056.99	.035	.276
Africa	148.86	3,048.00	.051	.453
Middle East	146.63	3,626.79	.061	.531
East Asia	149.40	621.61	.010	.092
Other Asia	149.94	6,057.19	.103	.908
Rest of world	145.91	523.26	.008	.076
Total	146.8805	58,661.28	1.000	8.616

1/ U.S. subsidy limit of $2.5 billion, no EC retaliation.
2/ For importers, it is expenditures.

Figure 7--U.S. wheat prices: Base, case 1, and case 2
(Unlimited versus limited U.S. subsidy)
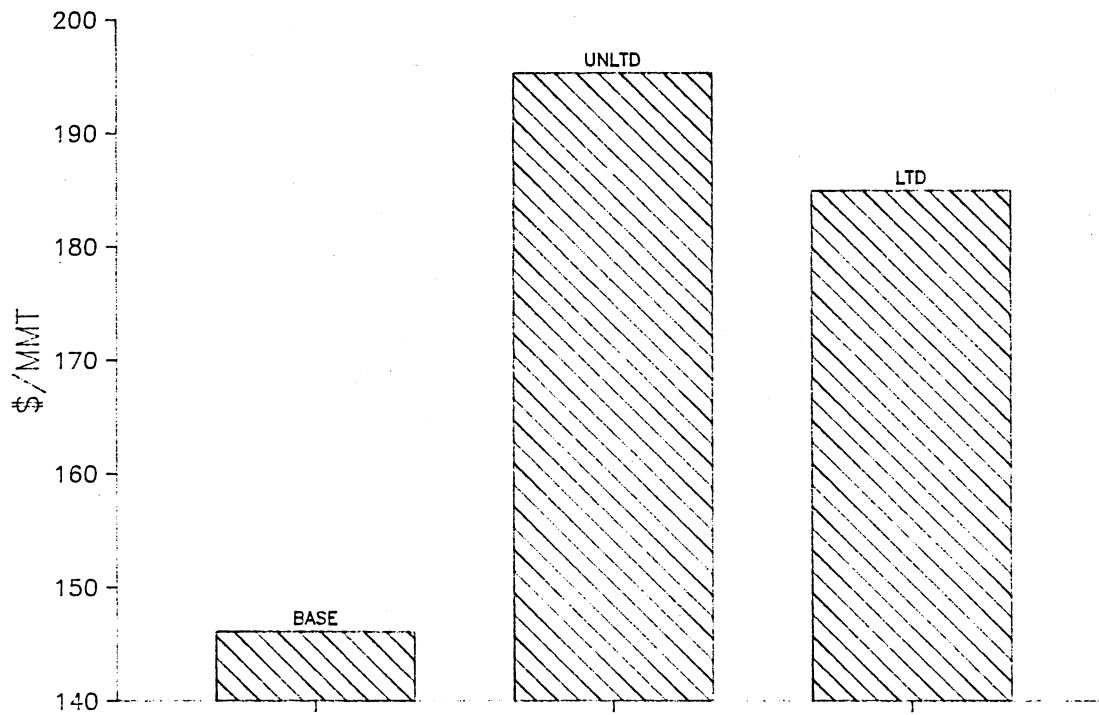
Figure 8--U.S. corn prices: Base, case 1, and case 2
(Unlimited versus limited U.S. subsidy)
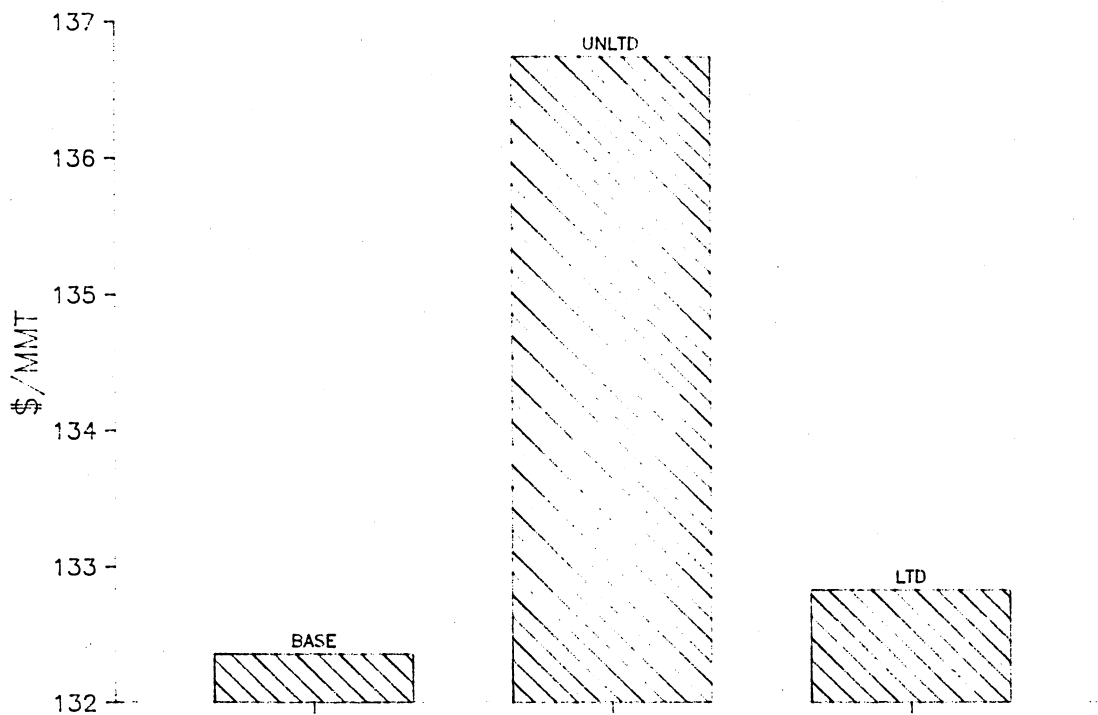
Figure 9--Case 3:   -World wheat exporters
(Volume: 97,293,080 metric tons)

┌US(50%)

ARG(8%)

CAN(16%)─

─EE(1%)

─AUS(12%)

EC(11%)─┘

└OWE(1%)
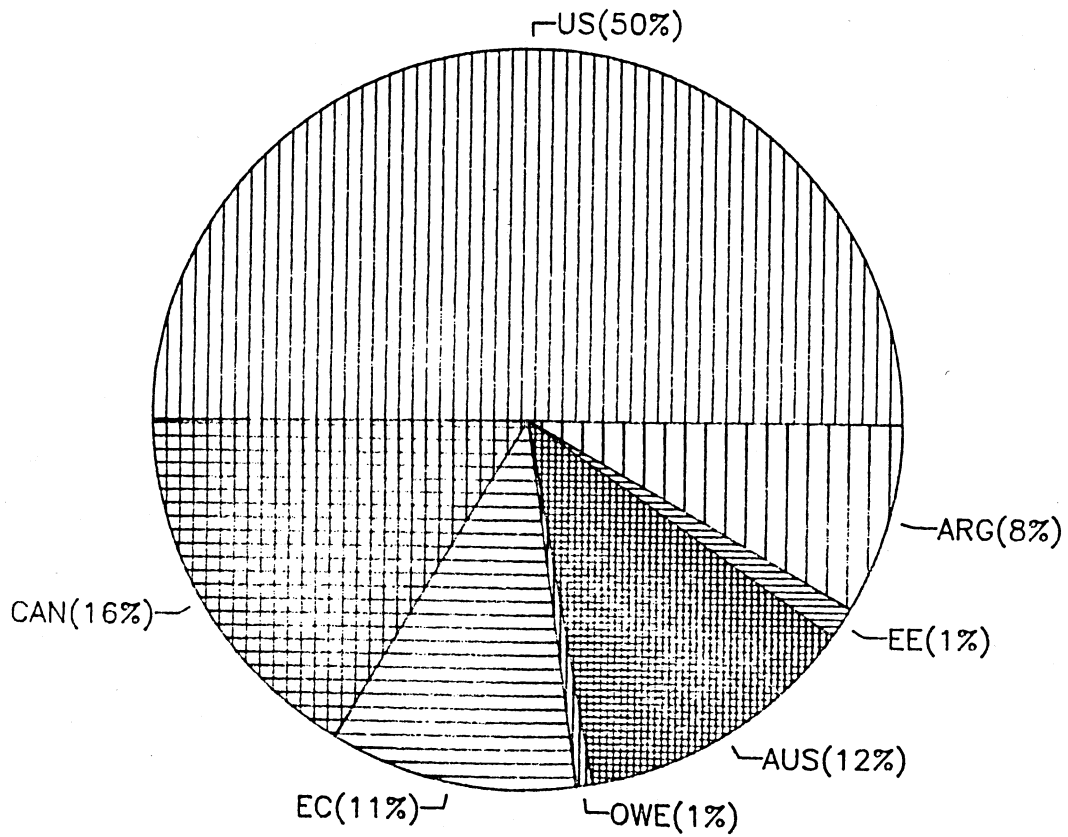
Figure 10--Case 3: World corn exporters
(Volume: 58,661,290 metric tons)

US(75%)─

─THAI(5%)

─OTHER(1%)

─ARG(12%)

└CHINA(7%)
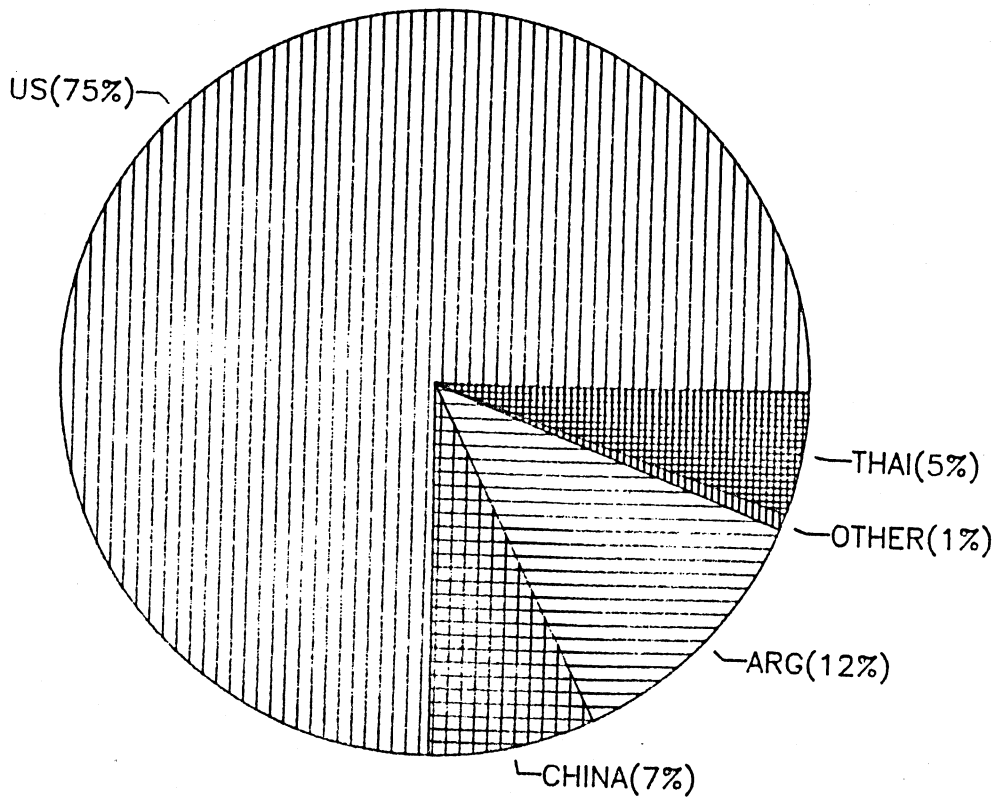
Case 4 differs from case 3 in that the EC retaliates by targeting its own wheat export subsidies, as in case 2. Tables 14 and 15 report model results for wheat and corn, respectively. Appendix tables 11 and 12 report the direction of trade for wheat and corn, respectively.

World corn trade is practically the same as in case 3. U.S. wheat exports fall from 48816 tmt in case 3 to 46,114 tmt. However, as in case 2, U.S. wheat exports to China, Japan, and Other Latin America are higher with the EC subsidies. This condition holds for U.S. wheat exports to the Middle East and the rest of the world as well. The large decrease in U.S. wheat exports comes from reduced exports to Other Asia. The United States exports only 4,112 tmt as compared with 10,779 tmt in case 3. As in case 2, this decrease occurs

Table 14--Case 4: Simulated wheat prices and trade volume 1/

Country or region	Price	Volume	Market share	Revenue 2/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	176.44	46,113.93	0.453	8.136
Canada	126.75	15,175.67	.149	1.923
European Community	166.80	20,028.00	.196	3.340
Other Western Europe	122.86	372.88	.003	.045
Australia	126.50	11,234.95	.110	1.421
Eastern Europe	128.86	1,358.00	.013	.174
Argentina	118.63	7,465.99	.073	.885
Total	156.54	101,749.40	1.000	15.928
Importers:				
Japan	145.34	5,515.60	.054	.801
South Africa	139.98	8.00	.000	.001
Soviet Union	140.67	29,076.65	.285	4.090
China	144.70	8,074.09	.079	1.168
Mexico	138.46	486.00	.004	.067
Brazil	133.39	5,107.43	.050	.681
Other Latin America	139.54	6,924.77	.068	.966
Africa	146.18	13,245.89	.130	1.936
Middle East	146.62	17,521.61	.172	2.569
India	143.23	599.00	.005	.085
Thailand	144.80	194.76	.001	.028
East Asia	144.80	440.43	.004	.063
Other Asia	148.15	11,960.97	.117	1.772
Rest of world	143.23	2,594.21	.025	.371
Total	143.52	101,749.40	1.000	14.602

1/ U.S. subsidy limit of $2.5 billion, and EC retaliation.
2/ For importers, it is expenditures.

because Canada cannot redirect Other Asia trade to the USSR because of the EC subsidy. Figure 11 shows world wheat market shares. The U.S. and EC shares are 0.45 and 0.20, respectively.

Total U.S. wheat export sales are $8.2 billion. Corn sales are about the same as in case 3, and U.S. subsidy costs are somewhat lower ($2.4 billion). Net export revenue is $11.6 billion, which is $540 million above the base. The dollar subsidy return is 23 cents. For wheat alone, the dollar subsidy return is 26 cents. A U.S. targeted subsidy program gains even when the EC retaliates. The gains come mainly from wheat sales. Corn sales do not respond nearly as much.

Table 15—Case 4: Simulated corn price and trade volume 1/

Country or region	Price	Volume	Market share	Revenue 2/
	Dollars/mt	1,000 mt	Percent	Billion dollars
Exporters:				
United States	132.93	44,203.47	0.746	5.875
Australia	131.20	104.44	.001	.013
South Africa	130.36	206.00	.003	.026
Eastern Europe	138.23	86.00	.001	.011
China	130.36	4,443.27	.075	.579
Argentina	121.41	7,057.72	.119	.856
India	138.23	6.00	.000	.000
Thailand	130.36	3,101.78	.052	.404
Total	131.23	59,208.68	1.000	7.770
Importers:				
Canada	137.93	42.00	0	0
European Community	140.59	7,632.19	.128	1.073
Other Western Europe	106.82	830.85	.014	.088
Japan	150.04	13,483.98	.227	2.023
Soviet Union	150.04	18,667.24	.315	2.800
Mexico	140.90	1,684.00	.028	.237
Brazil	136.17	1,044.00	.017	.142
Other Latin America	134.67	1,998.97	.033	.269
Africa	148.96	3,048.00	.051	.454
Middle East	146.73	3,622.86	.061	.531
East Asia	149.45	616.59	.010	.092
Other Asia	150.04	6,022.93	.101	.903
Rest of world	146.01	515.07	.008	.075
Total	146.88	59208.68	1.000	8.696

1/ U.S. subsidy limit of $2.5 billion, and EC retaliation.
2/ For importers, it is expenditures.

Figure 11--Case 4: World wheat exporters
(Volume: 101,749,400 metric tons)

US(45%)

CAN(15%)

ARG(7%)

EE(1%)

AUS(11%)

EC(20%)

OWE(0%)
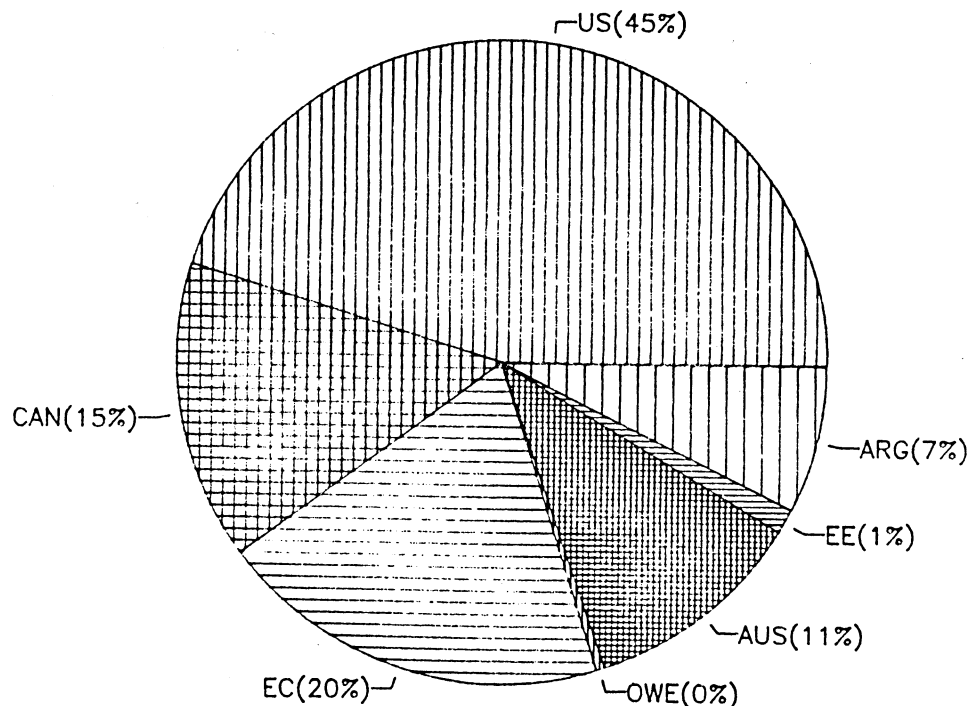
Effects of Policies on Welfare

All four cases show higher domestic prices for U.S. wheat and corn, triggering
welfare effects for domestic producers and consumers, which can be evaluated
apart from the effects on export revenue and global competitiveness.

Table 16 shows the effects of the subsidies on the sum of consumer and
producer surplus for wheat and corn, the cost of the subsidies, and the net
cost to the nation.

In all four cases, the benefits to the wheat- and corn-producing sectors do
not outweigh the subsidy costs. In all four cases, losses of $1 billion occur
in national welfare. The drive to maximize export revenue is not
self-financing.

The welfare results imply that if the goal of policy had been the maximization
of net welfare instead of net export revenue, the subsidy amounts would likely
have been much smaller. The effects on prices and international trade would
have been correspondingly smaller as well. (In future work, one could place
relative weights on policymakers' objectives with respect to producer,
consumer, and taxpayer welfare).

CONCLUSIONS

The objective of U.S. agricultural trade policy is the elimination of all
direct and most indirect export subsidies by the year 2000. This objective
can probably only be met through complicated multilateral trade negotiations
involving at least the major exporters of the relevant agricultural
commodities. One way to influence the course of negotiations is to threaten

actions which may hurt potential parties to an agreement who have been uncooperative. This report has examined the use of one such weapon, that is, targeted export subsidies in the world wheat and corn markets.

This report implicitly assumes that the EC is the major impediment to reaching an agreement. An important issue is whether the United States can influence EC behavior while improving its own world position.

Table 17 summarizes the effects of U. S. targeted subsidies for wheat and corn on net export revenue. All four cases show gains to the subsidy programs in terms of net export revenue, even if the EC targets its wheat subsidies to maximize its export revenue. A subsidy program involving more than $2.5 billion does not net the United States much additional benefit beyond that provided by the $2.5- billion program. Most gains come from the subsidization of wheat rather than of corn. Given the objective of export revenue maximization, the United States does not have the power to coerce the EC into a weakened wheat export position. Also, the net cost to the United States to such a program would be about $1 billion.

The results of this report are preliminary. The model is based on a simple specification of linear excess supply and demand functions set in a spatial equilibrium framework involving only two commodities. Additional research would need to be carried out to incorporate specific policy content. These preliminary results, however, give an indication of possible gains, and they highlight a method for evaluating those gains.

Table 16—Changes in economic welfare

Case	Wheat	Corn	Subsidy	Net effect
		Billion dollars		
Case 1	2.179	0.831	4.211	-1.201
Case 2	1.772	.851	4.082	-1.459
Case 3	1.654	.087	2.500	-.759
Case 4	1.251	.106	2.374	-1.017

Table 17—U. S. export revenue summary

Item	Base	Case 1	Case 2	Case 3	Case 4
			Billion dollars		
Wheat sales	5.328	10.179	9.279	9.028	8.136
Corn sales	5.770	6.602	6.621	5.857	5.876
Subsidy costs:					
Wheat		3.463	3.333	2.358	2.233
Corn		.748	.748	.142	.141
Net revenue	11.098	12.570	11.818	12.385	11.638

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Appendix table 1--Wheat transport costs

(Dollars per metric ton)

Country or region	Japan	South Africa	USSR	China
United States	19.24	17.22	19.43	17.32
Canada	18.99	19.68	13.92	23.32
European Community	27.55	19.92	11.81	28.29
Other Western Europe	27.55	19.92	11.81	28.29
Australia	18.84	19.68	22.78	18.20
Eastern Europe	27.55	19.92	11.81	28.29
Argentina	29.12	21.35	28.63	29.52

Country or region	Mexico	Brazil	Other Latin America	Africa
United States	7.97	11.91	12.00	29.42
Canada	11.71	16.73	12.79	29.52
European Community	17.71	11.81	19.68	18.20
Other Western Europe	17.71	11.81	19.68	18.20
Australia	21.65	21.65	21.65	19.68
Eastern Europe	17.71	11.81	19.68	18.20
Argentina	25.48	14.76	23.52	27.55

Country or region	Middle East	India	Thailand	East Asia
United States	15.86	28.04	22.14	20.17
Canada	21.06	21.15	21.40	20.02
European Community	17.96	27.80	29.52	29.52
Other Western Europe	21.27	27.80	29.52	29.52
Australia	21.27	19.83	18.30	18.30
Eastern Europe	17.76	27.80	29.52	29.52
Argentina	30.38	24.60	32.47	37.64

Country or region	Other Asia	Rest of world
United States	22.14	17.71
Canada	21.40	17.71
European Community	29.52	17.71
Other Western Europe	29.52	17.71
Australia	21.65	17.71
Eastern Europe	29.52	17.71
Argentina	32.47	24.60

Appendix table 2--Corn transport costs

(Dollars per metric ton)

Country or region	Canada	European Community	Other Western Europe	Japan
United States	5.00	9.05	10.92	19.24
Australia	17.71	17.71	17.71	18.84
South Africa	19.68	19.92	19.92	19.68
Eastern Europe	13.92	11.81	11.81	27.55
China	29.52	29.52	29.52	19.68
Argentina	18.25	18.25	24.99	29.12
India	30.00	30.00	30.00	30.00
Thailand	29.52	29.52	29.52	19.68

	USSR	Mexico	Brazil	Other Latin America
United States	19.43	7.97	11.91	12.00
Australia	22.78	21.65	21.65	21.65
South Africa	19.92	21.65	21.65	21.65
Eastern Europe	11.81	17.71	19.68	19.68
China	19.68	22.14	32.42	32.42
Argentina	28.63	25.48	14.76	23.52
India	19.68	30.00	30.00	30.00
Thailand	19.68	22.14	32.42	32.42

	Africa	Middle East	East Asia	Other Asia
United States	29.42	15.86	20.17	22.14
Australia	19.68	21.27	18.30	21.65
South Africa	19.68	19.68	19.68	19.68
Eastern Europe	18.20	29.52	29.52	29.52
China	19.68	19.68	19.68	19.68
Argentina	27.55	30.38	37.64	32.47
India	30.00	19.68	19.68	11.81
Thailand	19.68	19.68	19.68	19.68

	Rest of world
United States	17.71
Australia	17.71
South Africa	19.68
Eastern Europe	17.71
China	19.68
Argentina	24.60
India	30.00
Thailand	19.68

Appendix table 3--Base: Direction of wheat trade

(1,000 metric tons)

Country or region	Japan	South Africa	USSR	China	Mexico
United States	5,193	--	--	5,910	486
Canada	--	--	8,958	--	--
European Community	--	--	14,016	--	--
Other Western Europe	--	--	880	--	--
Australia	--	--	--	--	--
Eastern Europe	--	--	1,358	--	--
Argentina	--	8	--	--	--
Total	5,193	8	25,212	5,910	486

	Brazil	Other Latin America	Africa	Middle East	India
United States	--	6,583	--	16,875	--
Canada	--	--	--	--	--
European Community	--	--	--	--	--
Other Western Europe	--	--	--	--	--
Australia	--	--	11,009	--	--
Eastern Europe	--	--	--	--	--
Argentina	4,617	--	1,052	--	599
Total	4,617	6,583	12,061	16,875	599

	Thailand	East Asia	Other Asia	Rest of world	Total
United States	--	--	1,423	--	36,470
Canada	--	--	8,096	--	17,054
European Community	--	--	--	--	14,016
Other Western Europe	--	--	--	--	880
Australia	180	357	1,777	--	13,323
Eastern Europe	--	--	--	--	1,358
Argentina	--	--	--	2,512	8,788
Total	180	357	11,296	2,512	91,889

-- = No trade.

Appendix table 4--Base: Direction of corn trade

(1,000 metric tons)

Country or region	Canada	European Community	Other Western Europe	Japan	USSR
United States	42	6,313	223	13,528	16,408
Australia	--	--	--	--	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	--
China	--	--	--	--	86
Argentina	--	538	--	--	1,504
India	--	--	--	--	--
Thailand	--	--	--	--	1,162
Total	42	6,851	223	13,528	19,160

	Mexico	Brazil	Other Latin America	Africa	Middle East
United States	1,684	--	1,832	--	3,563
Australia	--	--	--	--	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	--
China	--	--	--	--	--
Argentina	--	1,044	--	3,048	--
India	--	--	--	--	--
Thailand	--	--	--	--	--
Total	1,684	1,044	1,832	3,048	3,563

	East Asia	Other Asia	Rest of world	Total
United States	--	--	--	43,593
Australia	108	--	--	108
South Africa	20	186	--	206
Eastern Europe	--	--	--	86
China	307	3,964	--	4,271
Argentina	--	--	532	6,666
India	--	6	--	6
Thailand	185	1,765	--	3,112
Total	620	5,921	532	58,048

-- = No trade.

Appendix table 5—Case 1: Direction of wheat trade

(1,000 metric tons)

Country or region	Japan	South Africa	USSR	China	Mexico
United States	5,363	--	--	10,640	486
Canada	--	--	15,837	--	--
European Community	--	--	9,632	--	--
Other Western Europe	--	--	632	--	--
Australia	--	--	--	--	--
Eastern Europe	--	--	1,358	--	--
Argentina	--	8	--	--	--
Total	5,363	8	27,479	10,640	486

	Brazil	Other Latin America	Africa	Middle East	India
United States	--	6,692	--	17,224	--
Canada	--	--	--	--	--
European Community	--	--	1,090	--	--
Other Western Europe	--	--	--	--	--
Australia	--	--	11,469	--	--
Eastern Europe	--	--	--	--	--
Argentina	4,876	--	132	--	599
Total	4,876	6,692	12,691	17,224	599

	Thailand	East Asia	Other Asia	Rest of world	Total
United States	--	--	11,712	--	52,117
Canada	--	--	--	--	15,837
European Community	--	--	--	--	10,722
Other Western Europe	--	--	--	652	--
Australia	189	403	--	--	12,061
Eastern Europe	--	--	--	--	1,358
Argentina	--	--	--	2,555	8,170
Total	189	403	11,712	2,555	100,917

-- = No trade.

Appendix table 6--Case 1: Direction of corn trade

(1,000 metric tons)

Country or region	Canada	European Community	Other Western Europe	Japan	USSR
United States	42	7,007	1,240	13,722	17,775
Australia	--	--	--	--	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	86
China	--	--	--	--	--
Argentina	--	223	--	--	1,615
India	--	--	--	--	--
Thailand	--	--	--	--	--
Total	42	7,230	1,240	13,722	19,476

	Mexico	Brazil	Other Latin America	Africa	Middle East
United States	1,684	--	2,373	--	4,439
Australia	--	--	--	--	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	--
China	--	--	--	--	--
Argentina	--	1,044	--	3,048	--
India	--	--	--	--	--
Thailand	--	--	--	--	--
Total	1,684	1,044	2,373	3,048	4,439

	East Asia	Other Asia	Rest of world	Total
United States	--	--	--	48,282
Australia	83	--	--	83
South Africa	35	171	--	206
Eastern Europe	--	--	--	86
China	524	3,479	--	4,003
Argentina		--	530	6,460
India	--	6	--	6
Thailand	--	2,994	--	2,994
Total	642	6,650	530	62,120

-- = No trade.

Appendix table 7--Case 2: Direction of wheat trade

(1,000 metric tons)

Country or region	Japan	South Africa	USSR	China	Mexico
United States	5,496	--	--	11,612	486
Canada	--	--	11,268	--	--
European Community	--	--	16,664	--	--
Other Western Europe	--	--	405	--	--
Australia	--	--	--	--	--
Eastern Europe	--	--	719	--	--
Argentina	--	8	--	--	--
Total	5,496	8	29,056	11,612	486

Country or region	Brazil	Other Latin America	Africa	Middle East	India
United States	--	6,870	--	16,925	--
Canada					
European Community	--	--	2,665	--	--
Other Western Europe					
Australia	--	--	10,539	--	--
Eastern Europe	--	--	--	639	--
Argentina	5,089	--	--	--	599
Total	5,089	6,870	13,204	17,564	599

Country or region	Thailand	East Asia	Other Asia	Rest of world	Total
United States	--	--	8,165	--	49,554
Canada	--	--	3,816	--	15,084
European Community	--	--	--	699	20,028
Other Western Europe	--	--	--	--	405
Australia	195	439	--	--	11,173
Eastern Europe	--	--	--	--	1,358
Argentina	--	--	--	1892	7,588
Total	195	439	11,981	2591	105,190

-- = No trade.

Appendix table 8--Case 2:   Direction of corn trade

(1,000 metric tons)

Country or region	Canada	European Community	Other Western Europe	Japan	USSR
United States	39	7,734	1,214	13,464	17,603
Australia	--	--	--	--	--
South Africa	--	--	--	206	--
Eastern Europe	--	--	--	--	86
China	--	--	--	6	6
Argentina	3	467	--	--	1,484
India	--	--	--	--	--
Thailand	--	--	--	6	28
Total	42	8,201	1,214	13,682	19,207

	Mexico	Brazil	Other Latin America	Africa	Middle East
United States	1,575	--	2,317	--	4,435
Australia	--	--	--	--	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	--
China	--	--	--	--	--
Argentina	109	1,044	--	3,048	--
India	--	--	--	--	--
Thailand	--	--	--	--	--
Total	1,684	1,044	2,317	3,048	4,035

	East Asia	Other Asia	Rest of world	Total
United States	--	--	--	48,381
Australia	85	--	--	85
South Africa	--	--	--	206
Eastern Europe	--	--	--	86
China	361	3,834	--	4,207
Argentina	--	--	522	6,677
India	--	--	6	6
Thailand	191	2,777		3,002
Total	637	6,611	528	62,650

No trade.

Appendix table 9--Case 3: Direction of wheat trade

(1,000 metric tons)

Country or region	Japan	South Africa	USSR	China	Mexico
United States	5,375	--	--	7,049	486
Canada	--	--	15,070	--	--
European Community	--	--	10,353	--	--
Other Western Europe	--	--	633	--	--
Australia	--	--	--	--	--
Eastern Europe	--	--	1,358	--	--
Argentina	--	8	--	--	--
Total	5,375	8	27,414	7,049	486

	Brazil	Other Latin America	Africa	Middle East	India
United States	--	6,737	--	17,164	--
Canada	--	--	--	--	--
European Community	--	--	--	--	--
Other Western Europe	--	--	--	--	--
Australia	--	--	11,525	--	--
Eastern Europe	--	--	--	--	--
Argentina	4,896	--	1,210	--	599
Total	4,896	6,737	12,735	17,164	599

	Thailand	East Asia	Other Asia	Rest of world	Total
United States	--	--	10,779	1,226	48,816
Canada	--	--	900	--	15,970
European Community	--	--	--	--	10,353
Other Western Europe	--	--	--	--	633
Australia	188	405	--	--	12,118
Eastern Europe	--	--	--	--	1,358
Argentina	--	--	--	1,333	8,046
Total	188	405	11,679	2,559	97,294

-- = No trade.

Appendix table 10--Case 3: Direction of corn trade

(1,000 metric tons)

Country or region	Canada	European Community	Other Western Europe	Japan	USSR
United States	42	4,398	858	13,526	17,386
Australia	--	--	--	--	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	86
China	--	--	--	--	1,478
Argentina	--	2,226	--	--	--
India	--	--	--	--	--
Thailand	--	--	--	--	--
Total	42	6,624	858	13,526	18,950

	Mexico	Brazil	Other Latin America	Africa	Middle East
United States	1,684	--	2,057	--	3,627
Australia	--	--	--	--	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	--
China	--	--	--	--	--
Argentina	--	1,044	--	3,048	--
India	--	--	--	--	--
Thailand	--	--	--	--	--
Total	1,684	1,044	2,057	3,048	3,627

	East Asia	Other Asia	Rest of world	Total
United States	519	--	--	44,097
Australia	102	--	--	102
South Africa	--	206	--	206
Eastern Europe	--	--	--	86
China	--	2,752	--	4,230
Argentina	--	--	523	6,841
India	6	--	--	6
Thailand	--	3,094	--	3,094
Total	621	6,058	523	58,662

-- = No trade.

Appendix table 11—Case 4: Direction of wheat trade

(1,000 metric tons)

Country or region	Japan	South Africa	USSR	China	Mexico
United States	5,516	8	--	8,074	477
Canada	--	--	7,318	--	9
European Community	--	--	20,028	--	--
Other Western Europe	--	--	373	--	--
Australia	--	--	--	--	--
Eastern Europe	--	--	1,358	--	--
Argentina	--	--	--	--	--
Total	5,516	8	29,077	8,074	486

	Brazil	Other Latin America	Africa	Middle East	India
United States	--	6,925	727	17,522	599
Canada	--	--	--	--	--
European Community	--	--	--	--	--
Other Western Europe	--	--	--	--	--
Australia	--	--	11,044	--	--
Eastern Europe	--	--	--	--	--
Argentina	5,107	--	1,474	--	--
Total	5,107	6,925	13,245	17,522	599

	Thailand	East Asia	Other Asia	Rest of world	Total
United States	195	250	4,112	1,710	46,115
Canada	--	--	7,849	--	15,176
European Community	--	--	--	--	20,028
Other Western Europe	--	--	--	--	373
Australia	--	191	--	--	11,235
Eastern Europe	--	--	--	--	1,358
Argentina	--	--	--	884	7,465
Total	195	441	11,961	2,594	101,750

-- = No trade.

Appendix table 12—Case 4: Direction of corn trade

(1,000 metric tons)

Country or region	Canada	European Community	Other Western Europe	Japan	USSR
United States	42	5,182	831	13,380	16,847
Australia	--	--	--	104	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	86
China	--	--	--	--	1,734
Argentina	--	2,451	--	--	--
India	--	--	--	--	--
Thailand	--	--	--	--	--
Total	42	7,633	831	13,484	18,667

	Mexico	Brazil	Other Latin America	Africa	Middle East
United States	1,684	--	1,999	--	3,623
Australia	--	--	--	--	--
South Africa	--	--	--	--	--
Eastern Europe	--	--	--	--	--
China	--	--	--	--	--
Argentina	--	1,044	--	3,048	--
India	--	--	--	--	--
Thailand	--	--	--	--	--
Total	1,684	1,044	1,999	3,048	3,623

	East Asia	Other Asia	Rest of world	Total
United States	617	--	--	44,205
Australia	--	--	--	104
South Africa	--	206	--	206
Eastern Europe	--	--	--	86
China	--	2,709	--	4,443
Argentina	--	--	515	7,058
India	--	6	--	6
Thailand	--	3,102	--	3,102
Total	617	6,023	515	59,210

-- = No trade.