The U.S. Export Response to Prices and the Impacts of Trade Liberalization: A Regional Trade Model Analysis

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Commodity modeling is like many other endeavors in science and in life--we continue to strive for completeness and perfection but may never be satisfied with the current level of our accomplishments. This is a productive attitude, because it always generates incentives for continued effort and progress. An alternative attitude adopted by some of our professional colleagues is agnostic: we do not know the underlying structure of commodity markets and perhaps cannot know it so we might as well give up and fit a reduced-form or a time series model.

An example of an ideal comprehensive modeling system we might strive for or that research administrators might dream of is illustrated in Figure 1. The components of this model include specific crop and livestock commodity supply and demand models with appropriate cross-commodity and cross-country trade linkages, explicit government policy instruments (preferably endogenous), complete industry performance measures including the net farm income components, and a fully simultaneous model of the nonagricultural macroeconomic sector. All parameters would, of course, be estimated with the very latest full information simultaneous equations estimation technique. This sounds outlandish, and it is; but it should be noted that a valiant effort at creating just such a comprehensive modeling system has been made by the International Institute of Applied Systems Analysis. Unfortunately, a fully integrated modeling system of this type quickly becomes a black box to most of us.

It is more fruitful to view Figure 1 as an inventory of the components of information that may be needed in commodity policy and trade analysis. A crucial modeling decision is to select the combination of components that is most important in a particular study or research program. When it comes to model development a good rule is to make the model as simple as possible and as complex as necessary to serve the intended purpose (Zellner 1982). For example, a U.S. crops model used for evaluation of U.S. commodity programs may need to be more complete and detailed than the U.S. crops components used in an analysis of exchange rate impacts on U.S. exports. At a policy modeling conference in 1981, Rausser and Just (1981) advised policy analysts to maintain multipurpose data sets so that models to address policy questions could be constructed on short notice. Our experience is that it is even better to maintain multipurpose data sets and empirical models of basic economic behavior, such as supply and demand relationships for major commodities in major countries and regions.

One set of economic relationships that we maintain and frequently use in the Trade and Agricultural Policy Division of CARD are the CARD/FAPRI Regional Trade Models for wheat, feed grains, and soybeans. They are used to evaluate the impacts of policy and macroeconomic changes on supply, demand, and prices of major crops in major trading countries and regions. Medium-term projections are also conducted periodically to provide a baseline for these impact analyses. These are the models that we considered appropriate to evaluate a partial trade liberalization scenario. We first describe

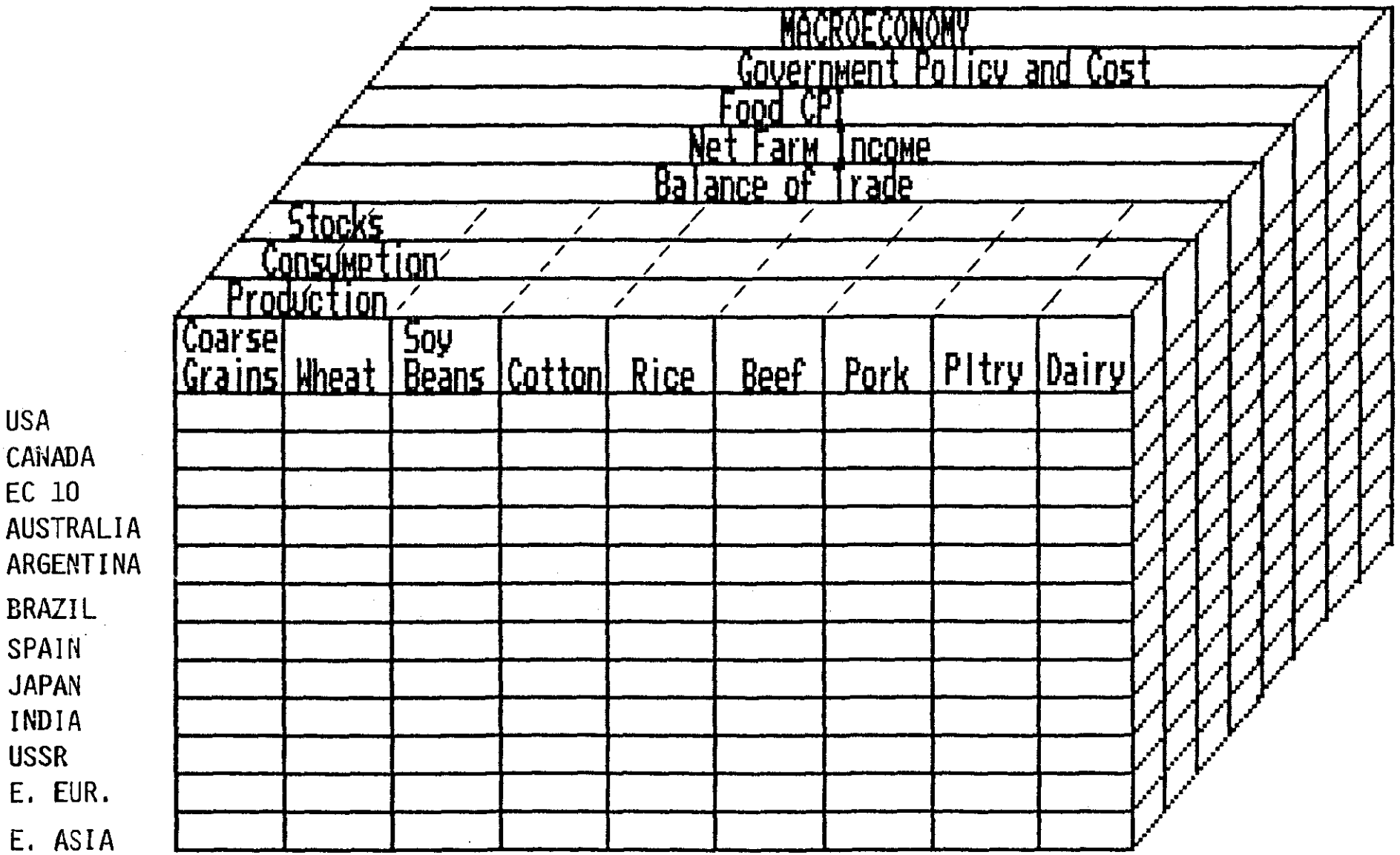

FIGURE 1. Matrix of model components for cross-commodity, cross-country, and cross-sectoral analysis

the models briefly, then demonstrate their behavioral structure by evaluating the foreign and domestic impacts of U.S. crop yield shocks. Finally, the consequences of a partial trade liberalization are evaluated with the models. In the analysis we emphasize the differences between the single commodity equilibrium results and the cross-commodity equilibrium results.

Model

The analysis is conducted with the above mentioned CARD/FAPRI regional econometric trade models developed and maintained by the Food and Agricultural Policy Research Institute (FAPRI) at Iowa State University. The trade models include wheat, coarse grains, soybeans and soymeal, and explicitly incorporate exchange rates and price transmission relationships between countries and regions. A dynamic nonspatial equilibrium approach is used in these models.

The basic elements of a nonspatial equilibrium supply and demand model are illustrated in Figure 2. Net imports and exports are determined in the model but not trade flows between specific regions. The net demands of importers (EDT) less the net supplies of other exporters (ESO) is the net excess demand facing the U.S. market (EDN). The necessary components of this model are detailed in the following equations:

$$(1)\quad EDT = \Sigma DM_i - \Sigma SM_i = \Sigma f_i(P_i, X_i) - \Sigma h_i(P_i, Z_i) \qquad i = 1,..,n \text{ Importers}$$

$$(2)\quad ESO = \Sigma SX_j - \Sigma DX_j = \Sigma h_j(P_j, Z_j) - \Sigma f_i(P_j, X_j) \qquad j = 1,..,m \text{ Exporters}$$

$$(3)\quad ESUS = h_u(P_u, Z_u) - f_u(P_u, X_u) \qquad u = \text{U.S., United States Exports}$$

$$(4)\quad ESUS = EDT - ESO \quad \text{World Market Equilibrium}$$

$$(5)\quad P_i = P_u e_i + M_i \qquad i = 1,..,n$$

$$(6)\quad P_j = P_u e_j + M_j \qquad j = 1,..,m$$

where

DM = importer demand
DX = exporter demand
e = exchange rate
M = trade margin (transport cost, tariff, subsidy, etc.)
P = domestic price
SM = importer supply
SX = exporter supply
X = vector of demand shifters
Z = vector of supply shifters

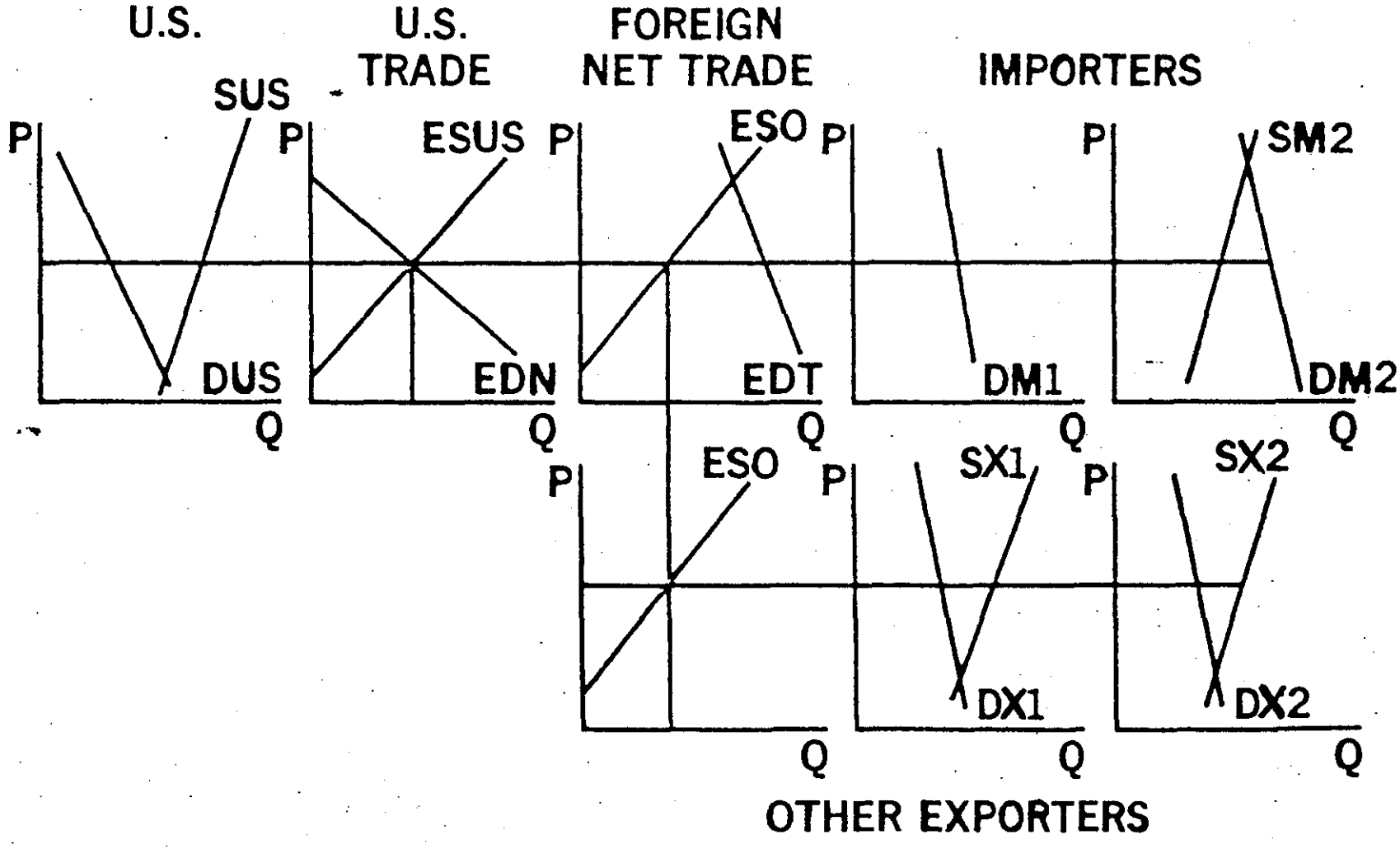

Figure 2. Illustration of the Nonspatial Equilibrium Supply and Demand Model

The major importers and exporters for each commodity are endogenized, and these differ somewhat from commodity to commodity. Those countries for which parameters have not been directly estimated with econometric techniques have been assigned price and income response elasticities based on the best judgment of trade modeling specialists. These elasticities are converted to net import elasticities and reported in Appendix Table A.8. The regional coverage and the endogenous components of internal markets are evident in the Appendix summary tables of structural elasticities. A descriptive econometric approach is employed in the specification, so there are few constraints imposed in the estimation of the structural parameters. The functional form is generally linear.

As mentioned above, the yield shocks and trade liberalization impacts were carried out for single-commodity models and also for cross-commodity models. The main objective of the cross-commodity analysis is to incorporate the cross-commodity interaction among the three crops. In that process the new price estimates arising from the yield shocks or trade liberalization impacts were passed between the models until a new cross-commodity equilibrium was obtained.

U.S. Yield Impact Analysis

Analysis of the impacts of yield or production shocks provides valuable information about the dynamic behavior of a model and should be part of the model validation. In simultaneous equation models, these and other reduced-form impact measures are more reliable than single equation elasticities in revealing the structure of the model. In complex models, single period shocks are a good test of the dynamic stability and the short-run behavior of the model. An important objective of the U.S. yield impact analysis is to reveal the U.S. export response behavior. We report the results of multi-period yield shocks, which can also be used to deduce the impacts of a one-period shock, i.e., short-run responses. All yield impacts are conducted holding government stocks, farmer owned reserve stocks, and acreage reductions constant. This makes all price impacts larger than they would be under current conditions when government stock programs absorb many of the impacts of yield variations.

Yield Impact Procedure

The multi-period yield impact was conducted by reducing yield by 5 percent each year for five years, from 1985/86 to 1989/90, and comparing the results to the baseline. In Figure 3, the continuous yield reduction in a single-commodity equilibrium raises the long-run average price and reduces supply in the United States. The export demand schedule also shifts to the left as foreign production has more time to respond to the higher price levels. The long-run

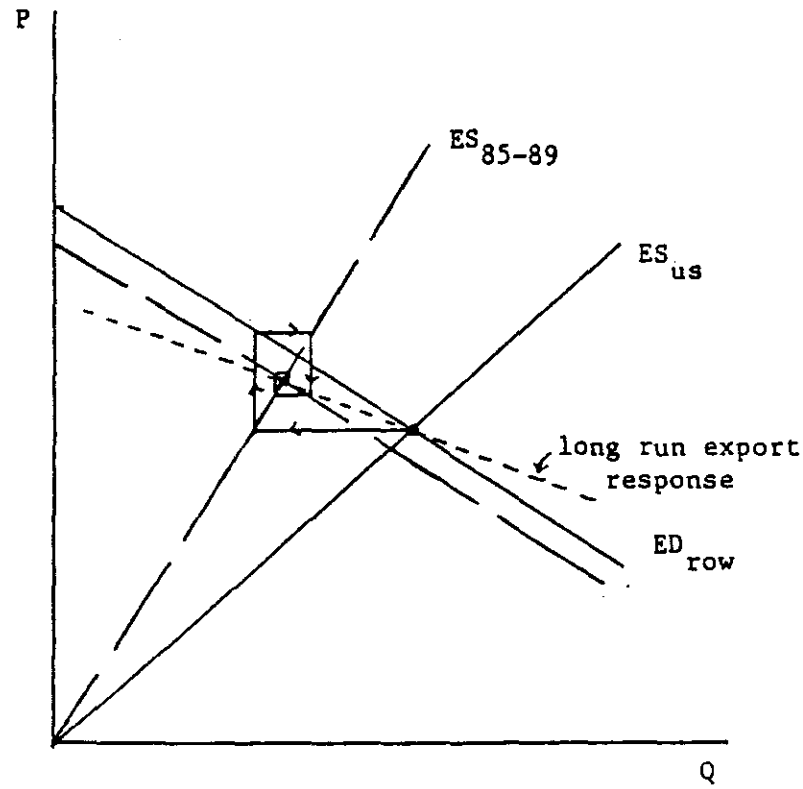

FIGURE 3. Five-Year Yield Shock Impacts on Exports in a Single-Commodity Equilibrium

export response to price changes (dashed line) is expected to be more elastic than the short-run export response.

Figure 4 illustrates the impacts of the sustained 5 percent yield reduction from 1985/86 to 1989/90 on U.S. exports in a multicommodity equilibrium. The actual U.S. domestic demand and supply are represented by D^0_{us} and S^0_{us}, and rest of the world (ROW) demand and supply are given by D^0_f and S^0_f. The middle diagram depicts the world market with actual U.S. excess supply (ES^0_{us}) and ROW excess demand ED^0_f. The world market equilibrium is at A, at which excess demand equals the excess supply. The sustained yield reduction in the U.S. shifts the excess supply curve from ES^0_{us} to ES^1_{us}. In the case of single commodity analysis, the world market clears at B. The effect world market clears at B. The effect of yield decline in the U.S. is to raise the price from P_0 to P_1 and to reduce the U.S. exports from Q_0 to Q_1. In the cross-commodity analysis, yield is reduced for all three commodities--wheat, corn, and soybeans. The yield decline for all three commodities leads to changes in the variables that enter the other models, which in turn cause further simultaneous changes in supply and demand in the U.S. and abroad.

These impacts for the cross-commodity case are also illustrated in Figure 4. The U.S. domestic supply shifts further left from S^1_{us} to S^2_{us} because of the higher prices of competing crops, which resulted from their decline in yield. The U.S. domestic demand increases from D^0_{us} to D^1_{us} due to higher prices of substitute crops, a result of the decline in yields of substitute crops. The net effect of demand increase and supply decrease is to shift the U.S. excess supply further left from ES^1_{us} to ES^2_{us}. Similar cross price effects on the ROW demand and supply shift the ROW excess demand to the right from ED^0_f to ED^1_f. The resulting equilibrium is at C. As depicted in the figure, the yield decline unequivocably has a larger impact on prices in the case of cross-commodity analysis than in the case of single commodity analysis. However, the U.S. export changes in the cross-commodity analysis may be smaller or larger than those in the single-commodity analysis, depending on the cross-price effects on demand and supply in the U.S. and abroad.

Wheat Yield Impacts

In the first year of the yield impact in the case of single-commodity analysis, over 67 percent of the production loss is replaced by declining stocks, and only 20 percent comes from exports (Table 1). The wheat price increases by almost 3 percent, implying a short-run reduced-form flexibility of 0.6. The short-run response elasticity of exports relative to price is -0.9 and the value of exports increases by only 0.15 percent. The longer-term adjustments can be seen by examining the responses from the later years. By the last year of the analysis, an export decline of 4.7 percent is associated with a price increase of 3.7 percent leading to the implied export response elasticity of -1.27. As expected (Figure 3) the long-run export response to price changes is larger than the short-run response.

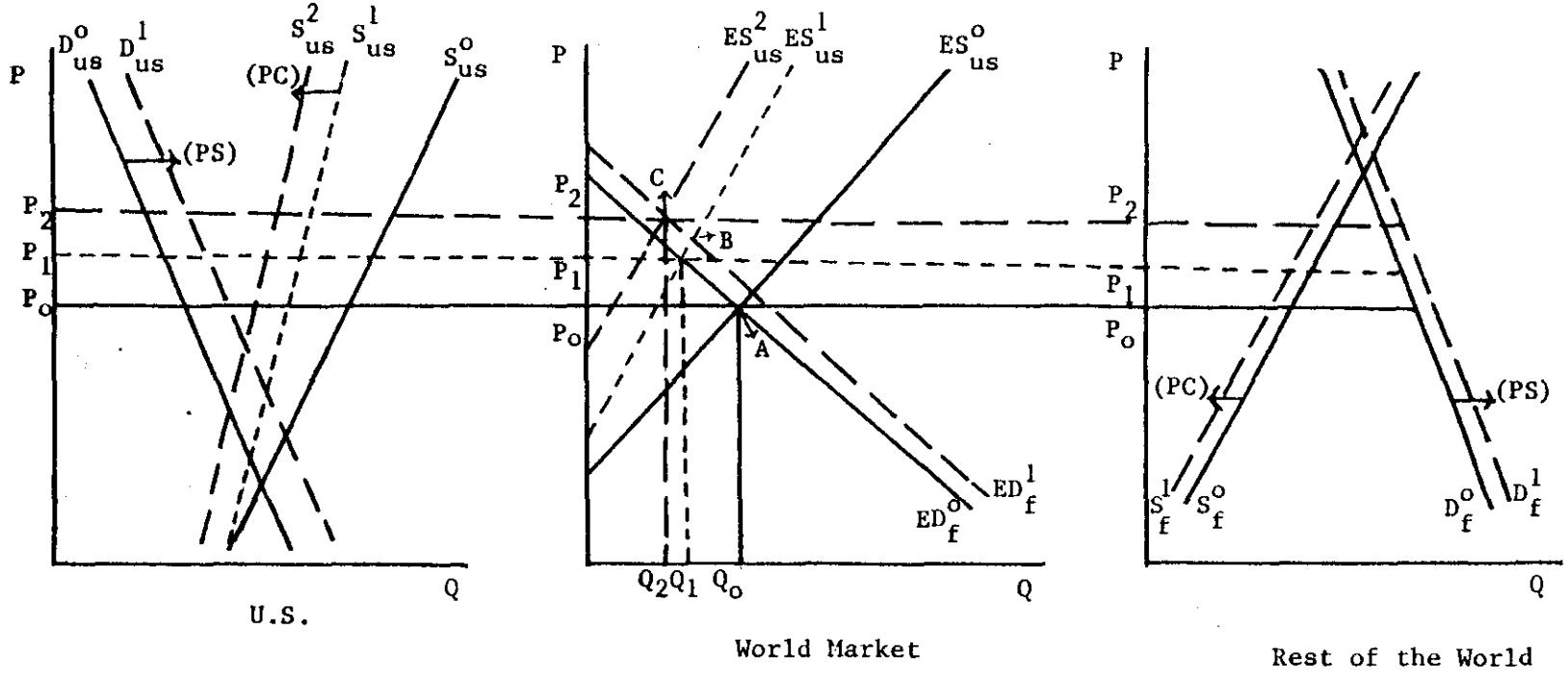

FIGURE 4. Impacts of five-year yield shock on exports in a multi-commodity equilibrium

A. Actual equilibrium

B. Single-commodity equilibrium

C. Cross-commodity equilibrium

Table 1. Impacts of 5 percent reduction in wheat yield from 1985/86 to 1989/90.

	1985/86	1986/87	1987/88	1988/89	1989/90
United States	----------(mmt)----------				
Production (base)	66.11	65.92	63.36	58.05	54.78
Single Commodity (% changes)	-5.03	-4.44	-3.48	-3.25	-3.92
Cross Commodity (% changes)	-5.03	-3.86	-2.65	-2.36	-3.03
End Stocks (base)	49.23	54.02	57.29	51.79	40.47
Single Commodity (% changes)	-4.60	-4.60	-3.57	-3.26	-4.32
Cross Commodity (% changes)	-5.29	-4.95	-3.72	-3.37	-4.52
Feed Use (base)	8.85	10.37	7.46	8.14	8.33
Single Commodity (% changes)	-4.07	-7.26	-8.21	-5.11	-4.38
Cross Commodity (% changes)	6.34	-1.50	-0.70	1.96	2.59
Exports (base)	26.67	29.72	31.71	34.45	36.60
Single Commodity (% changes)	-2.59	-6.52	-6.37	-5.29	-4.68
Cross Commodity (% changes)	-4.74	-7.70	-6.80	-5.51	-4.86
	----------($/Bushel)----------				
Farm Price (base)	3.00	2.50	2.36	2.30	2.37
Single Commodity (% changes)	2.88	7.2	6.22	4.34	3.69
Cross Commodity (% changes)	17.14	26.46	21.74	16.52	15.63
	----------($ Million)----------				
Value of Exports (base)	2940	2730	2750	2911	3187
Single Commodity (% changes)	0.15	0.36	-0.52	-1.10	-1.23
Cross Commodity (% changes)	0.56	2.22	1.85	1.35	1.31
Value of Production (base)	7287	6055	5494	4906	4770
Single Commodity (% changes)	-2.31	2.58	2.51	1.01	-0.07
Cross Commodity (% changes)	0.40	6.46	6.31	4.71	3.94
	----------(mmt)----------				
Competitor Exports (base)	54.60	55.123	57.83	60.00	61.15
Single Commodity (% changes)	0.15	0.46	0.79	1.03	1.06
Cross Commodity (% changes)	0.13	-0.27	-0.23	-0.12	-0.16
Net Imports (base)	79.80	84.82	39.42	94.26	97.72
Single Commodity (% changes)	-0.76	-1.99	-1.75	-1.28	-1.09
Cross Commodity (% changes)	-1.49	-2.88	-2.56	-2.09	-1.92

In the case of cross-commodity analysis, wheat exports decline by 4.74 percent in response to a 17.14 percent increase in prices in the first year, giving a short-run export response elasticity of -0.28. In the long run, larger stocks adjustments cause even larger supply impacts in the later years than in the first year. Thus, the price impacts increase in the second and third years before declining. The implied export response elasticity in the last year is -0.31, which is higher than the short-run implied export elasticity. For convenience, the export elasticities are summarized below.

Implied export elasticities of wheat in response to prices.

	1985/86	1986/87	1987/88	1988/89	1989/90
Single commodity	-0.90	-0.90	-1.02	-1.22	-1.27
Cross commodity	-0.28	-0.29	-0.31	-0.33	-0.31

One important point to note is that the implied export elasticities for the cross-commodity case are significantly smaller than those for the single-commodity case. The smaller elasticities for the cross-commodity analysis are due to the simultaneous yield decline in wheat, corn, and soybeans that increases the prices of all three commodities. Since all three prices move in the same direction, the substitution effects partially offset the own price effect, leading to smaller quantity adjustments and smaller elasticities. Furthermore, as illustrated in Figure 4, price increases in the cross-commodity analysis are considerably higher than in the single-commodity analysis (also see Table 1). This larger price increase is a result of the cross-price effects that decrease the U.S. export supply and increase the ROW excess demand for U.S. wheat.

Feed Grains Yield Impacts

The yield impacts in the feed grains model are evaluated by reducing the U.S. corn yield, and the results are reported for all feed grains. For the single-commodity analysis, in the first year more than 51 percent of the production loss comes out of feed use, 32 percent out of exports, and about 16 percent out of stocks (Table 2). The corn price increases by more than 10 percent, implying a reduced-form flexibility of two. The short-run response elasticity of exports relative to price is -1.38, and the long-run implied elasticity is -1.59. The export impacts increase from the second year onwards, whereas the price impacts show continuous declines except for the year 1988/89.

In the case of cross-commodity analysis, the exports decline by 1.9 percent in response to a 1.9 percent increase in prices in the first year, resulting in a short-run response elasticity of 1. In the long run, both export and price impacts exhibit significant

Table 2. Impacts of 5 percent reduction in corn yield from 1985/86 to 1989/90.

	1985/86	1986/87	1987/88	1988/89	1989/90
United States			(mmt)		
Production (base)	225.18	192.34	191.55	190.61	194.24
Single Commodity (% changes)	-4.98	-4.46	-4.47	-4.57	-4.58
Cross Commodity (% changes)	-4.98	-5.24	-5.03	-4.95	-4.97
End Stocks (base)	86.42	90.68	89.82	83.77	77.42
Single Commodity (% changes)	-2.12	-1.17	-1.02	-1.04	-2.15
Cross Commodity (% changes)	-2.44	-1.80	-1.52	-1.41	-2.56
Feed Use (base)	104.15	114.10	115.55	116.72	116.26
Single Commodity (% changes)	-3.44	-2.04	-1.78	-1.85	-1.71
Cross Commodity (% changes)	-2.28	-0.91	-0.86	-01.09	-0.84
Food Use (base)	22.35	22.99	23.45	23.93	24.99
Single Commodity (% changes)	-0.13	-0.09	-0.07	-0.07	-0.06
Cross Commodity (% changes)	-0.17	-0.13	-0.11	-0.09	-0.09
Exports (base)	41.28	44.00	45.57	47.48	49.96
Single Commodity (% changes)	-13.94	-15.92	-14.56	-13.85	-12.21
Cross Commodity (% changes)	-16.21	-21.58	-19.47	-17.51	-15.71
			($/Bushel)		
Farm Price (base)	2.37	1.98	1.87	1.82	1.89
Single Commodity (% changes)	10.13	8.08	7.75	7.97	7.67
Cross Commodity (% changes)	12.87	12.37	11.50	10.99	10.85
			($ Million)		
Value of Exports (base)	3852	3430	3355	3402	3818
Single Commodity (% changes)	-2.97	-4.16	-3.26	-2.83	-2.41
Cross Commodity (% changes)	0.28	-0.60	-0.38	-0.13	-0.03
Value of Production (base)	21010	14993	14102	13657	14453
Single Commodity (% changes)	5.04	3.99	3.62	3.63	3.20
Cross Commodity (% changes)	7.63	7.32	6.62	6.11	5.80
			(mmt)		
Competitor Feed Grains Exports	28.32	27.90	29.74	30.69	31.68
Single Commodity (% changes)	1.16	4.41	3.15	2.75	2.56
Cross Commodity (% changes)	0.26	4.25	2.89	2.44	2.22
Feed Grains Net Imports	74.28	77.66	81.69	84.78	88.52
Single Commodity (% changes)	-7.31	-4.77	-6.98	-6.76	-5.98
Cross Commodity (% changes)	-8.31	-10.70	-9.81	-8.92	-8.07

changes, giving an export response elasticity of -1.45 for the last year. By the last year, more than 72 percent of the supply loss (including production plus beginning stocks) is coming out of exports, 18 percent out of stocks, and 10 percent out of feed use. The implied export elasticities are summarized below.

Implied export elasticities of feed grains in response to prices

	1985/86	1986/87	1987/88	1988/89	1989/90
Single commodity	-1.38	-1.97	-1.88	-1.74	-1.59
Cross commodity	-0.99	-1.52	-1.67	-1.58	-1.45

As in the case of wheat, the cross-commodity export response elasticities are smaller than the single-commodity export response elasticities, but the magnitude of the change is not as great in the case of feed grains.

Soybean Yield Impacts

In the first year of the yield impact in the single-commodity case, about 43 percent of the production loss is absorbed by a decline in crush, 33 percent by exports, and 24 percent by stocks (Table 3). Soybean prices increase by almost 11 percent, implying a short-run reduced-form flexibility of about two. Soybean exports decline by 4.5 percent, giving a short-run response elasticity of -0.42 relative to price. A sustained production shortfall in soybeans increases soybean prices as well as soymeal prices, but the net effect is a decline in crushing margins. Thus, exports of beans fall, and exports of meal increase, except in the first year. The competitors, Brazil and Argentina, gain part of the soybean market lost by the United States, but increasing U.S. meal exports partially offset its soybean export decline. By the last year, 54 percent of the supply loss (including production plus beginning stocks) is coming out of exports, 29 percent out of stocks, and 11 percent out of crush. An export decline of 5.2 percent is associated with a price increase of 6.3 percent, implying a long-run export elasticity response of -0.83 percent. Again, the export response to price changes is higher in the long-run than in the short-run.

For the cross-commodity analysis, the short-run response elasticity of exports relative to price is -0.37, and the long-run elasticity is -0.7. The summary of bean export elasticities is given below. As in the case of wheat and corn, cross-commodity export response elasticities are lower than single-commodity export response elasticities.

Table 3. Impacts of 5 percent reduction in soybean yield from 1985/86 to 1989/90.

	1985/86	1986/87	1987/88	1988/89	1989/90
United States			(mmt)		
Bean Production (base)	57.18	52.83	53.48	55.90	57.51
Single Commodity (% changes)	-5.01	-2.56	-2.25	-2.80	-3.03
Cross Commodity (% changes)	-5.01	-4.71	-3.80	-4.70	-5.13
End Stocks (base)	14.21	13.72	10.91	9.33	6.99
Single Commodity (% changes)	-4.93	-5.16	-5.87	-7.09	-10.02
Cross Commodity (% changes)	-4.32	-6.03	-6.89	-8.51	-12.10
Crush (base)	28.85	30.45	31.38	31.92	32.28
Single Commodity (% changes)	-4.28	-1.30	-0.99	-1.24	-1.23
Cross Commodity (% changes)	-4.42	-3.11	-2.26	-2.48	-2.69
Bean Exports (base)	20.41	20.41	22.45	23.11	25.12
Single Commodity (% changes)	-4.54	-4.65	-4.27	-4.96	-5.21
Cross Commodity (% changes)	-4.77	-6.51	-6.23	-7.77	-8.08
Meal Exports (base)	4.91	5.05	5.55	5.81	5.90
Single Commodity (% changes)	-3.61	2.70	2.21	1.93	2.66
Cross Commodity (% changes)	-7.24	-1.90	-0.90	-0.17	0.02
			($/Bushel)		
Bean Farm Price (base)	5.28	4.96	4.85	4.84	5.04
Single Commodity (% changes)	10.72	6.09	4.75	5.75	6.28
Cross Commodity (% changes)	12.90	12.08	9.49	11.29	11.61
			($/Short Ton)		
Meal Price (Decatur) (base)	151.23	150.35	147.47	143.47	150.32
Single Commodity (% changes)	14.14	8.02	6.70	7.92	8.37
Cross Commodity (% changes)	17.55	16.06	13.36	15.57	16.02
			(Million $)		
Value Bean Exports (base)	3960	3720	4001	4110	4652
Single Commodity (% changes)	5.37	0.81	-0.05	0.12	0.31
Cross Commodity (% changes)	7.17	4.17	2.03	1.97	1.81
Value Bean + Meal Exports (base)	4778	4557	4903	5029	5630
Single Commodity (% changes)	6.63	3.34	2.32	2.81	3.25
Cross Commodity (% changes)	8.05	7.35	5.37	6.16	6.31
			(mmt)		
Competitor Exports					
Bean Exports (base)	3.30	4.97	4.87	4.63	4.31
Single Commodity (% changes)	4.31	3.13	4.94	7.75	9.09
Cross Commodity (% changes)	4.13	4.24	7.05	11.96	14.86

Table 3. continued

	1985/86	1986/87	1987/88	1988/89	1989/90
	(mmt)				
Meal Exports (base)	10.58	10.88	11.22	11.61	11.95
Single Commodity (% changes)	-1.01	-0.40	-0.24	-0.33	-0.48
Cross Commodity (% changes)	-0.96	-0.64	-0.37	-0.57	-0.61
World					
Bean Net Imports (base)	24.30	26.05	27.45	28.58	29.48
Single Commodity (% changes)	-3.23	-3.04	-2.62	-2.76	-3.11
Cross Commodity (% changes)	-3.44	-4.29	-3.84	-4.35	-4.71
Meal Net Imports (base)	16.21	16.43	17.32	18.01	18.46
Single Commodity (% changes)	-1.75	0.57	0.55	0.41	0.54
Cross Commodity (% changes)	-2.82	-1.01	-0.53	-0.42	-0.39

Implied export elasticities of soybeans in response to prices

	1985/86	1986/87	1987/88	1988/89	1989/90
Single commodity	-0.42	-0.76	-0.90	-0.86	-0.83
Cross commodity	-0.37	-0.54	-0.66	-0.69	-0.70

There is a cross-commodity effect within the soybean sector as declining U.S. soybean exports are somewhat offset by increasing soybean meal exports. The net effect of this substitution can be evaluated by looking at the change in the combined value of soybean and soymeal exports in Table 3. In all cases this combined value increases as the prices of both commodities increase. Thus, the combined export response for the two commodities is inelastic. The value increases less in the long run, implying less inelastic behavior; and it increases more in the cross-commodity case, implying more inelastic behavior. This is consistent with all the other results.

Trade Liberalization Impacts

The impact of trade liberalization is evaluated by removing existing policies that inhibit the transmission of world market price variability to domestic markets. The degree to which price insulation currently exists varies by commodity and region, so specific changes to remove these barriers are defined for each model. The results do not reflect a complete trade liberalization, since not all commodities and countries are endogenous in these models. Internal policies that do not directly affect price transmission at the border are not altered.

The impacts of trade liberalization analysis are illustrated in Figure 5. The U.S. actual domestic market is represented by supply, S^0_{us}, and demand, D^0_{us}. The actual excess supply of U.S. is given by ES^0_{us} in the middle diagram. The ROW demand and supply are represented by D^0_f and S^0_f, and they are kinked and inelastic because of the artificially maintained high support prices in some foreign countries. The resulting ROW excess demand is given by ED^0_f in the middle diagram.

Removing the price insulation policies in the foreign countries trade will shift the foreign domestic supply from S^0_f to S^1_f and the foreign domestic demand from D^0_f to D^1_f. These changes cause the excess demand to shift from ED^0_f to ED^1_f. In the case of single-commodity analysis, the world market equilibrium is at B. Trade liberalization increases the export prices from P_0 to P_1 and also the quantity of U.S. exports from Q_0 to Q_1.

In the cross-commodity analysis, trade is liberalized for all three commodities, leading to changes in prices of all three commodities. These price changes lead to cross-price effects,

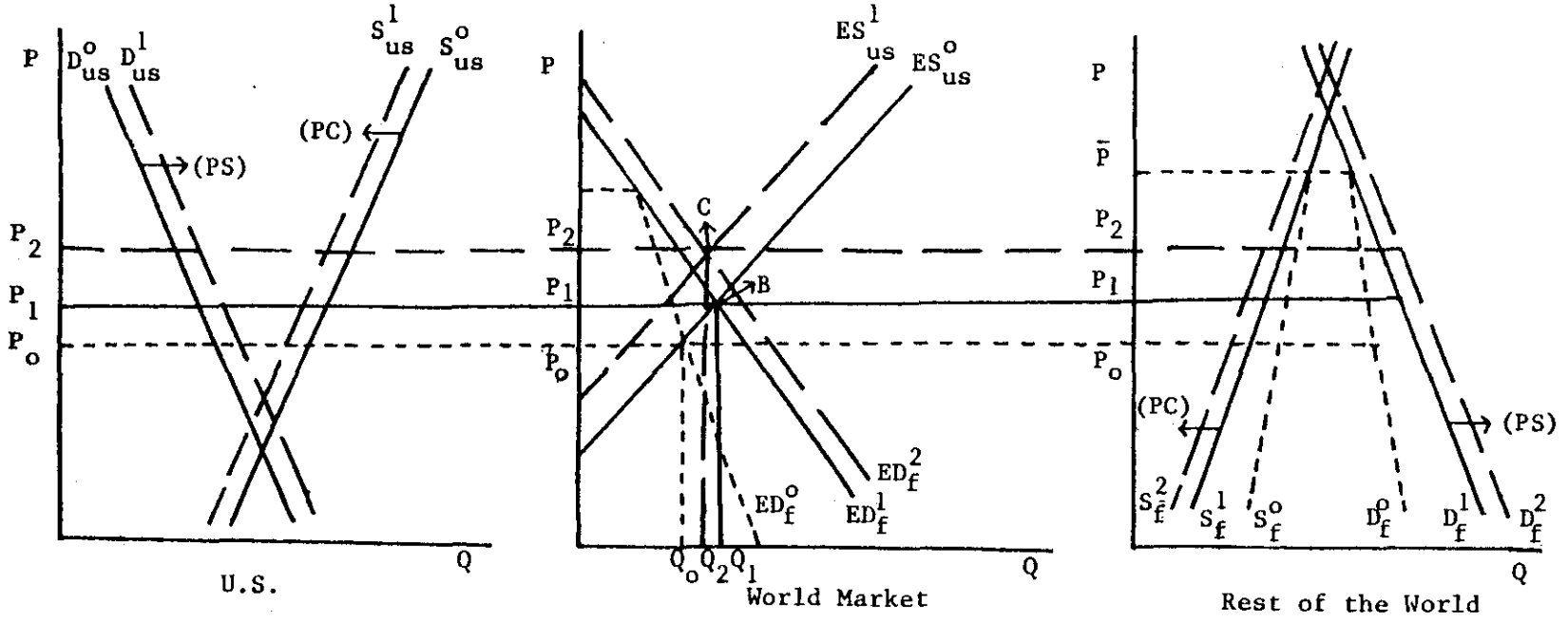

FIGURE 5. Impact of Trade Liberalization on U.S. Exports.

B. Single-Commodity Equilibrium

C. Cross-Commodity Equilibrium

causing simultaneous changes in the demand and supply. The U.S. domestic supply shifts left from S^0_{us} to S^1_{us} because of the higher prices of competing crops, and the U.S. domestic demand increases from D^0_{us} to D^1_{us} due to higher prices of substitute crops. The net effect of demand increase and supply decrease is to shift the U.S. excess supply from ES^0_{us} to ES^1_{us}. Similar cross-price effects on the ROW demand and supply shift the ROW excess demand further right from ED^1_f to ED^2_f. The resulting equilibrium for trade liberalization in the cross-commodity analysis is at C. In this case, the export price exhibits further rise from P_1 to P_2. The exports could conceivably be higher or smaller than the single-commodity case depending on the cross-price effects on demand and supply in the United States and ROW.

Procedure and Results for Wheat

The wheat trade model includes many protected markets--the EC, India, Japan, U.S.S.R., China, and Eastern Europe. It must be assumed that the Central Planned Economies would not alter their domestic price insulation policies, so the EC, India, and Japan are the ones affected by the trade liberalization in this analysis. For the EC, Rotterdam prices are used to reflect border prices for wheat prices; barley prices are permitted to adjust with the wheat price. For India and Japan, border prices are constructed by adding transport costs to U.S. prices of wheat and (for India only) sorghum. These prices are then linked to U.S. prices and exchange rates. In all cases, these changes reduce internal prices.

In the case of single-commodity analysis, the result of these changes in trade policy is to reduce EC wheat production and exports, and increase prices, production, and exports for the United States (Table 4). U.S. exports rise by more than 27 percent in 1989/90. The increase in U.S. exports crowds out the domestic use of wheat for feed and stocks. By the last year of the analysis, EC exports have dropped by three-fourths. Canada's and Argentina's exports show moderate increases. The total exports by competitors declined by more than 17 percent in the last year. However, the net imports by the importers show a smaller decrease due to the higher market price.

As illustrated in Figure 5, in the case of cross-commodity trade liberalization, the wheat prices rise more than in the single-commodity case because of the cross-price effects. By the last year of the analysis, the supply, including production plus beginning stocks, increases by about 5 mmt, whereas exports increase by 9.7 mmt. This larger export increase draws down the domestic stocks and also reduces the feed use. The magnitude of the decrease in feed use is smaller than in the single commodity case because the substitute (soybean) price effects dominate the own price effect. In the last year, Canada's and Argentina's exports increase by 7.2 percent and 4.2 percent. EC exports decline by almost 75 percent and Australia's exports show a small decline of 1.3 percent. The United States and EC prices move in opposite directions, U.S. prices

Table 4. Impact of trade liberalization in the wheat sector.

	1985/86	1986/87	1987/88	1988/89	1989/90
United States			(mmt)		
Production (base)	66.11	65.92	63.36	58.05	54.78
Single Commodity (% changes)	0.00	1.91	5.18	8.51	11.31
Cross Commodity (% changes)	0.00	2.19	5.71	9.24	12.18
End Stocks (base)	49.23	54.02	57.29	51.79	40.47
Single Commodity (% changes)	-2.13	-3.42	-3.11	-3.09	-3.41
Cross Commodity (% changes)	-2.46	-3.69	-3.30	-3.28	-3.68
Feed Use (base)	8.85	10.37	7.46	8.14	8.33
Single Commodity (% changes)	-12.38	-23.60	-43.14	-45.94	-48.70
Cross Commodity (% changes)	-3.12	-14.71	-31.21	-34.66	-37.01
Exports (base)	26.67	29.72	31.71	34.45	36.60
Single Commodity (% changes)	8.13	15.32	20.49	24.90	27.62
Cross Commodity (% changes)	5.68	12.83	18.66	23.43	26.30
			($/Bushel)		
Farm Price (base)	3.00	2.50	2.36	2.30	2.37
Single Commodity (% changes)	8.76	23.48	32.70	38.99	41.05
Cross Commodity (% changes)	10.08	25.70	35.30	41.87	44.23
			($ Million)		
Value of Exports (base)	2940	2730	2750	2911	3187
Single Commodity (% changes)	17.49	42.25	60.44	73.24	79.74
Cross Commodity (% changes)	16.18	41.73	61.10	74.77	81.86
Value of Production (base)	7287	6055	5494	4906	4770
Single Commodity (% changes)	8.80	25.97	39.67	50.85	60.74
Cross Commodity (% changes)	10.14	28.61	43.12	55.00	65.82
Canada			(mmt)		
Exports (base)	17.50	19.03	19.85	20.26	20.59
Single Commodity (% changes)	0.94	3.20	7.22	12.02	16.32
Cross Commodity (% changes)	1.08	1.48	3.40	6.44	9.12
Australia					
Exports (base)	15.70	14.56	15.57	15.81	16.06
Single Commodity (% changes)	0.42	0.54	0.30	0.29	0.35
Cross Commodity (% changes)	0.32	-0.07	-0.63	-0.93	-1.13

Table 4. continued

	1985/86	1986/87	1987/88	1988/89	1989/90
Argentina			(mmt)		
Exports (base)	6.10	6.48	7.23	7.85	8.43
Single Commodity (% changes)	0.20	1.74	3.14	3.70	3.89
Cross Commodity (% changes)	0.23	1.98	3.43	3.99	4.18
European Community					
Exports (base)	15.30	15.05	15.19	16.08	16.07
Single Commodity (% changes)	-19.87	-46.33	-60.76	-72.87	-77.76
Cross Commodity (% changes)	-18.19	-43.92	-58.28	-70.40	-74.85
Competitors					
Exports (base)	54.60	55.12	57.83	60.00	61.15
Single Commodity (% changes)	-5.12	-11.20	-13.01	-14.90	-14.31
Cross Commodity (% changes)	-4.63	-11.26	-13.88	-16.42	-16.32
World					
Net Imports (base)	79.80	84.82	89.42	94.26	97.72
Single Commodity (% changes)	-0.79	-1.91	-1.15	-0.39	1.39
Cross Commodity (% changes)	-1.27	-2.82	-2.36	-1.89	-0.36
Prices			(Percent)		
Cross Commodity					
U.S.	10.03	26.07	35.01	42.48	43.94
India	-9.03	-18.66	-20.07	-24.11	-22.33
EC-10	-16.91	-27.58	-32.23	-36.88	-36.75

from 10 to 45 percent and EC prices from -17 to -36.5 percent (Table 4).

Procedure and Results for Feed Grains

The major protected markets in the feed grain model are the EC and the U.S.S.R. while Argentina taxes feed grain exports. It is assumed that the Central Planned Economies would not change their domestic price insulation policies, so the EC policy is the one affected by the trade liberalization in this analysis. The Rotterdam corn price replaces the corn threshold price and is linked to the U.S. price of corn. EC barley price is linked to the Rotterdam price of corn as well. Argentine tax rates have been endogenized in a separate study of Argentina and are projected to decline to zero by 1988/89. In the trade liberalization analysis, the positive tax rates projected for 1985/86 to 1987/88 have been reduced to zero.

A summary of the impacts of these policy changes is given in Table 5. In the single-commodity analysis, trade liberalization increases U.S. corn prices by 7.6 to 11.1 percent. Because of the higher prices, U.S. production shows moderate increases. By the last year of the analysis, U.S. exports rise by 9.5 percent, most of which is drawn from domestic private stocks and feed use. Competitors' exports decline sharply. In the last year, competitors' exports are reduced by more than 38 percent (about 12.0 million metric tons). The net imports by importers decline 8.3 percent (about 7.3 million metric tons) as world price rises. So it is clear that the higher U.S. exports replace the competitors' export loss. EC exports fall significantly and EC moves from a net exporter to a net importer in some years. Other exporters' exports show moderate increases.

In the case of cross-commodity analysis, as illustrated in Figure 5, price increases more than that of single-commodity analysis. Production increases more, because the own price effect offsets the competing crop (soybean) price effect. But in the case of feed use, the substitute (wheat and soymeal) price effects are larger than the own price, causing feed use to increase after the first year. Export increases are much smaller than in the single-commodity case.

Prices in the exporting countries increase significantly. Argentine prices increase more than the others in the first two years, because of the removal of Argentine export taxes. EC barley prices decline by more than 50 percent in the last four years. EC exports decline significantly and EC becomes a net importer in some years. Canada's exports decline by 9.4 percent in the last year. This decline occurs because wheat prices increase substantially more than feed grain prices. In Canada this shifts production from barley to wheat, and reduces barley exports. The combined wheat and barley exports still increase.

Table 5. Impact of trade liberalization in the feed grain sector.

	1985/86	1986/87	1987/88	1988/89	1989/90
United States			(mmt)		
Production (base)	225.18	192.34	191.55	190.61	194.24
Single Commodity (% changes)	0.00	0.50	0.78	0.88	1.01
Cross Commodity (% changes)	0.00	1.29	2.04	2.18	2.30
End Stocks (base)	86.42	90.68	89.82	83.77	77.42
Single Commodity (% changes)	-1.39	-1.34	-1.22	-1.31	-1.40
Cross Commodity (% changes)	-1.75	-1.84	-1.84	-2.23	-2.49
Feed Use (base)	104.15	114.10	115.55	116.72	116.26
Single Commodity (% changes)	-2.50	-2.42	-2.27	-2.52	-2.37
Cross Commodity (% changes)	-1.22	0.98	2.47	3.29	3.27
Food Use (base)	22.35	22.99	23.45	23.93	24.99
Single Commodity (% changes)	-0.10	-0.10	-0.09	-0.09	-0.09
Cross Commodity (% changes)	-0.12	-0.14	-0.14	-0.16	-0.15
Exports (base)	41.28	44.00	45.57	47.48	49.96
Single Commodity (% changes)	9.27	8.53	8.82	9.79	9.47
Cross Commodity (% changes)	6.81	3.53	2.37	1.21	1.55
			($/Bushel)		
Farm Price (base)	2.37	1.98	1.87	1.82	1.89
Single Commodity (% changes)	7.59	9.85	10.16	10.99	11.11
Cross Commodity (% changes)	8.86	13.13	15.51	18.96	19.31
			($ Million)		
Value of Exports (base)	3852	3430	3355	3402	3717
Single Commodity (% changes)	17.51	20.40	21.23	23.06	22.55
Cross Commodity (% changes)	-0.95	-0.33	0.98	1.88	2.14
Value of Production (base)	21010	14993	14102	13657	14453
Single Commodity (% changes)	7.56	10.25	10.77	11.66	11.92
Cross Commodity (% changes)	8.82	14.29	17.35	20.92	21.44
Argentina			(mmt)		
Corn/Sorghum (base)	12.17	11.19	10.73	10.72	10.99
Single Commodity (% changes)	1.30	1.67	5.51	3.43	2.45
Cross Commodity (% changes)	1.41	2.02	6.16	4.40	3.60
Canada					
Corn/Barley Exports (base)	5.72	5.83	5.94	6.04	6.05
Single Commodity (% changes)	0.80	10.25	10.44	9.40	9.43
Cross Commodity (% changes)	1.91	6.80	-1.98	-6.76	-9.40

Table 5. continued

	1985/86	1986/87	1987/88	1988/89	1989/90
Australia	----------(mmt)----------				
Barley Exports (base)	3.77	3.28	2.99	2.73	2.59
Single Commodity (% changes)	2.92	6.40	8.36	9.86	10.81
Cross Commodity (% changes)	2.65	4.88	5.69	5.86	6.56
European Community					
Barley Exports (base)	6.20	6.40	6.81	7.24	7.63
Single Commodity (% changes)	-75.97	-103.09	-106.28	-105.52	-98.74
Cross Commodity (% changes)	-73.92	-99.54	-101.95	-100.22	-93.31
Thailand					
Corn Sorghum Exports (base)	4.09	4.16	4.11	4.17	4.35
Single Commodity (% changes)	0.21	1.68	1.76	1.64	1.61
Cross Commodity (% changes)	0.24	2.00	2.39	2.55	2.78
Competitors					
Feed Grains Exports (base)	28.32	27.90	29.74	30.69	31.68
Single Commodity (% changes)	-28.33	-38.03	-37.86	-39.88	-38.06
Cross Commodity (% changes)	-27.12	-37.13	-38.43	-40.61	-38.99
World					
Feed Grains Net Imports (base)	73.94	76.82	79.99	82.26	85.48
Single Commodity (% changes)	-5.67	-8.93	-9.05	-9.23	-8.57
Cross Commodity (% changes)	-6.58	-11.46	-12.94	-14.45	-13.54
Prices	----------(Percent)----------				
Cross Commodity					
U.S. Corn	8.86	13.13	15.51	18.96	19.31
EC Barley	-37.49	-52.08	-56.41	-58.56	-57.21
Argentina Corn	20.79	21.28	22.70	25.07	23.78
Australia Barley	11.71	20.25	24.32	29.44	28.48
Thailand	10.60	17.80	21.04	25.27	24.72

Procedure and Results for Soybeans

Relatively few markets in the soybean sector are currently insulated from world price variability. The price and trade policies in this model include the high and fixed corn prices in the European Community and Spain, the Brazilian export tax rates that favor meal over beans, and the fixed domestic meal prices in Brazil. The fixed corn prices are replaced in the model by the Rotterdam corn price, which is linked to the U.S. corn price and exchange rates. The Brazilian meal price is permitted to fluctuate with world price changes, and the margins in the price linkages are reduced by the amount of the current tax rates (13 percent for beans and 11 percent for meal) times the baseline price levels.

A summary of the impacts of these changes is given in Table 6. In the case of single-commodity analysis, the results indicate losses to the U.S. and Argentine soybean sectors, gains to Brazilian soybean producers, and losses to Brazil's crushing industry. The lower corn prices in the EC and Spain reduce demand for soymeal and the beans from which meal is derived. This causes U.S. exports of soybeans and meal to fall and leads to lower soybean prices (-3.6 to -7.4 percent), meal prices (-8 to -13 percent), and export values of beans and meal (-3.5 to -6.4 percent). Production falls by 2 to 5 percent in the U.S. The competitors' (Brazil and Argentina) bean exports rise, indicating that the loss of the U.S. bean export market is captured by competitors.

Meal exports in Brazil also decline in the first four years, but the expansion of soybean exports more than compensates for this loss. When the export taxes are removed, the policy bias favoring meal exports is eliminated. Soybean exports respond and domestic soybean prices rise. Soymeal prices, the crushing margin, and crush fall. By the last year of this analysis, Brazil's bean exports rise by almost 56 percent.

In the case of cross-commodity analysis, except for the first year, both bean and meal prices increase in the United States. By the last year of the analysis bean price rises by 1.9 percent and meal price by less than 1 percent. U.S. (competitors) exports decline (increase) more than those of the single-commodity case. Domestic stocks and crush decline more because the soybean price effect dominates the cross-price (corn) effect.

Overall, current grain policies in Europe benefit the soybean industry in exporting countries, and Brazil's export tax policies appear to be damaging to their own soybean industry.

Summary

In this study, wheat, feed grain, and soybean trade models were used to quantify trade and policy interactions among the major

Table 6. Impact of trade liberalization in the soybean and soymeal sectors.

	1985/86	1986/87	1987/88	1988/89	1989/90
United States			(mmt)		
Bean Production (base)	57.18	52.83	53.48	55.90	57.51
Single Commodity (% changes)	0.00	-1.96	-3.84	-4.58	-4.82
Cross Commodity (% changes)	0.00	-2.69	-3.65	-4.92	-5.50
End Stocks (base)	14.21	13.72	10.91	9.33	6.99
Single Commodity (% changes)	1.49	1.90	1.39	0.42	0.93
Cross Commodity (% changes)	1.18	0.41	0.04	-1.27	-1.40
Crush (base)	28.85	30.45	31.38	31.92	32.28
Single Commodity (% changes)	0.79	-0.94	-1.50	-1.38	-1.26
Cross Commodity (% changes)	0.69	-1.35	-1.42	-1.71	-2.12
Bean Exports (base)	20.41	20.41	22.45	23.11	25.12
Single Commodity (% changes)	-2.16	-3.91	-6.57	-8.69	-9.51
Cross Commodity (% changes)	-1.80	-4.39	-6.48	-9.02	-9.95
Meal Exports (base)	4.91	5.05	5.55	5.81	5.90
Single Commodity (% changes)	-8.50	-18.86	-16.13	-13.33	-17.63
Cross Commodity (% changes)	-4.23	-12.40	-9.58	-7.48	-14.09
			($/Bushel)		
Bean Farm Price (base)	5.28	4.96	4.85	4.84	5.04
Single Commodity (% changes)	-6.54	-7.44	-4.94	-3.57	-6.47
Cross Commodity (% changes)	-1.45	1.06	2.37	5.15	1.90
			($/Short Ton)		
Meal Price (Decatur) (base)	151.23	150.35	147.47	143.47	150.32
Single Commodity (% changes)	-10.58	-12.89	-9.48	-7.94	-12.78
Cross Commodity (% changes)	-1.81	0.04	2.25	5.80	0.51
			($ Million)		
Value Bean Exports (Base)	3960	3720	4001	4110	4652
Single Commodity (% changes)	-8.57	-10.91	-10.88	-12.12	-15.10
Cross Commodity (% changes)	-3.28	-3.54	-4.43	-4.83	-8.47
Value Meal Exports (Base)	819	837	902	919	978
Single Commodity (% changes)	-20.44	-34.62	-28.50	-24.96	-36.67
Cross Commodity (% changes)	-6.42	-11.84	-5.59	1.52	-12.63
Value Bean + Meal Exports (base)	4778	4557	4903	5029	5630
Single Commodity (% changes)	-3.51	-6.37	-5.25	-4.57	-6.38
Cross Commodity (% changes)	-1.10	-2.18	-1.03	0.27	-2.20

Table 6. continued

	1985/86	1986/87	1987/88	1988/89	1989/90
Brazil	----------(mmt)----------				
Bean Exports (base)	0.30	1.99	2.19	2.22	2.11
Single Commodity (% changes)	185.31	32.66	41.68	47.26	55.87
Cross Commodity (% changes)	166.65	32.72	43.30	53.07	65.01
Meal Exports (base)	7.90	7.89	8.01	8.22	8.40
Single Commodity (% changes)	-8.49	-4.96	-7.98	-9.32	1.36
Cross Commodity (% changes)	-6.25	-2.15	-5.06	-6.20	4.52
Argentina					
Bean Exports (base)	3.00	2.98	2.68	2.41	2.20
Single Commodity (% changes)	0.36	0.69	0.65	0.45	1.05
Cross Commodity (% changes)	-0.09	0.23	0.49	1.03	2.31
Meal Exports (base)	2.68	2.99	3.21	3.39	3.55
Single Commodity (% changes)	-0.42	-0.97	-1.31	-1.60	-2.02
Cross Commodity (% changes)	0.06	-0.25	-0.37	-0.52	-0.81
Competitors					
Bean Exports (base)	3.30	5.93	4.87	4.63	4.31
Single Commodity (% changes)	17.18	11.31	19.11	22.89	27.88
Cross Commodity (% changes)	15.07	11.10	19.74	25.98	33.01
Meal Exports (base)	10.58	10.88	11.22	11.61	11.95
Single Commodity (% changes)	-6.44	-3.86	-6.07	-7.07	0.36
Cross Commodity (% changes)	-4.65	-1.63	-3.72	-4.54	2.93
World					
Bean Net Exports (base)	24.30	26.05	27.45	28.58	29.48
Single Commodity (% changes)	0.52	-0.49	-1.98	-3.32	-4.03
Cross Commodity (% changes)	0.54	-0.92	-1.80	-3.08	-3.65
Meal Net Exports (base)	16.21	16.43	17.32	18.01	18.46
Single Commodity (% changes)	-6.78	-8.35	-9.10	-8.85	-5.40
Cross Commodity (% changes)	-4.32	-4.89	-5.48	-5.34	-2.60
Prices	----------(Percent)----------				
Cross Commodity					
U.S. Beans	-1.45	1.06	2.37	5.15	1.90
U.S Meal	-1.81	0.04	2.25	5.80	0.51

importing and exporting regions. This study reports the results of two analyses that were conducted using these models. These analyses are the impact of a sustained 5 percent decline in U.S. crop yields from 1985/86 to 1989/90, and the impact of a trade liberalization scenario. These analyses were carried out for both single-commodity and cross-commodity models. The purpose of the cross- commodity analysis is to incorporate the cross-commodity interactions among the three crops.

The results of the yield impacts demonstrate that export response to supply and price changes varies with commodity and with the duration of the changes. In the cross-commodity analysis, corn exports are the most responsive to price changes and wheat exports are the least responsive. For all three commodities, the magnitude of the export response to changes in price increases with time.

The trade liberalization impacts show significant adjustments in prices and trade flows compared with the baseline. The soybean sector growth is slowed by the reduction of feed grain prices in the European Community, but Brazil benefits from the removal of its export taxes. World wheat prices increase by 10 to 45 percent and prices in the EC decline by 17 to 37 percent as price barriers are removed. Total trade increases slightly in the last year of the analysis, but there is a major shift in export patterns. The EC exports decline by nearly 12 million tons while other exporters sell increased volumes. Similar changes occur in feed grains. The European Community becomes a net importer of feed grains, and its domestic prices fall by 37 to 59 percent. Canada's exports decline in the cross-commodity analysis.

Comparisons of results of single-commodity and cross-commodity analyses for yield impacts indicate that prices (exports) are, in general, higher (lower) in the cross-commodity analysis than in the single-commodity analysis. But the implied export response elasticities are lower in the cross-commodity analysis than in the single-commodity analysis.

Results of cross-commodity analysis of trade liberalization have directions of change similar to those of single-commodity analysis, even though the magnitudes of changes are different.

APPENDIX

FAPRI Regional Trade Model Specifications and Estimated Elasticities

Table A.1. Price elasticities of supply and demand from the soybean trade model/

	Soybean Price	Soymeal Price	Soyoil Price	Value of Meal and Oil	Corn Price
U.S.					
Production	0.71				
Soybean crush	-2.08			1.96	
Soybean stocks	-0.69				
Soymeal demand		-0.41			0.19
Soyoil demand			-0.45		
Soyoil stocks			-0.13		
Brazil					
Production	0.08				
Soybean crush	-0.50			1.00	
Soymeal demand		-0.34			-0.21
Argentina					
Production	0.27				
Soybean crush	-2.26			2.50	
Soymeal demand		-0.18			
EC					
Soybean crush	-1.91			1.99	
Soymeal demand		-0.27			0.25
Spain					
Soybean crush	-4.87			5.05	
Soymeal demand		-0.32			0.44
Japan					
Soybean crush	-0.26			0.16	
Soymeal demand		-0.07			
Eastern Europe					
Soybean crush	-2.20			1.84	
ROW					
Soymeal demand		-0.30			

Table A.2. Price transmission elasticities of soybean and soymeal prices of other regions with respect to U.S. soybean and soymeal prices.

Regions	Soybean Price	Soymeal Price
Brazil	1.80	1, 0[a]
Argentina	0.97	0.96
European Community	0.90	0.88
Spain	0.86	0.84
Japan	0.91	0.53
Eastern Europe	0.88	0.88
ROW	--	1.00

[a]The domestic soymeal price is subject to government control and hence does not respond to U.S. soymeal price. The U.S. soymeal price is used for the Brazil soymeal export price and thus price transmission elasticity is 1.

Table A.3. Summary of estimated domestic supply and demand elasticities from the wheat trade model.

Country	Elasticity with respect to: Wheat Price	Barley Price	Sorghum Price	Rice Price	Soymeal Price	Income
U.S.						
Production	0.20					
Food demand	-0.14					0.55
Feed demand	-3.01		1.17			
Stock demand	-0.28					
Canada						
Production	0.38	-0.30				
Feed demand	-0.12					
Stock demand	-0.28					
Australia						
Production	0.01	-0.63				
Stock demand	-0.43					
Argentina						
Producton	0.50					
Food demand	-0.16					
EC						
Production	0.66					
Feed demand	-3.11	6.04			0.08	
India						
Production	0.44		-0.04			
Food demand	-0.45			0.48		0.73
Japan						
Total use	-0.12					0.22
USSR						
Food demand						0.23
China						
Total use						0.59
Eastern Europe						
Total use						0.28

Table A.4. Price transmission elasticities of wheat prices of other regions with respect to world price.[a]

Regions	RGULFUS U.S. Wheat Gulf Port Price
Canada	
Wheat export price	1.13
Australia	
Wheat export price	0.97
Argentina	
Wheat farm price	0.28
Japan	
Wheat resale price	0.28

[a]Price transmission elasticities for other regions--European Community, India, and Centrally Planned Economies are zero.

Table A.5. Summary of estimated production elasticities from the feed grains model.

Country	Elasticities of: Corn Price	Sorghum Price	Barley Price	Wheat Price	Soybean Price	Cassava Price	Rice Price
U.S.							
Corn	0.06				-0.06		
Canada							
Barley			0.74	-0.47			
Corn	0.26				-0.20		
Australia							
Barley			0.34	-0.29			
Argentina							
Sorghum		0.10					
Corn	1.10	-0.97					
Thailand							
Corn and Sorghum	0.30					-0.06	-0.28
EC(10)							
Corn	0.39						
Barley			0.70				

Table A.6. Summary of estimated domestic demand elasticities from the feed grains model.

Country	Elasticities of: Corn Price	Sorghum Price	Barley Price	Soymeal Price	Wheat Price	Cassava Price	Livestock Product Price	Income
U.S.								
Corn food	-0.03							0.62
Corn feed	-0.44			0.13	0.39			
Corn stock	-1.25							
Canada								
Barley and corn total use		-0.08	0.14	0.05			0.25	
Australia								
Barley total use			-1.16		0.78			
Argentina								
Corn total use	-0.14	0.14						
Sorghum total use	0.98	-3.17						
Thailand								
Corn and sorghum total use	-0.14					0.14	0.25	
South Africa								
Feed grain net imports								2.00
EC(10)								
Corn feed	-0.05			0.05				0.88
Corn food	-0.70							
Barley feed			-0.26	0.02				0.06
Barley food			-0.39					0.58
Spain								
Corn	-0.21							
Soviet Union								
Feed grain total use								0.37
Japan								
Corn and sorghum total use	-0.20			0.16				
corn and sorghum stock	-0.46	-0.45					0.95	

Table A.7. Price transmission elasticities of feed grain prices with respect to U.S. feed grain prices.

Country	U.S. Corn Price	U.S. Barley Price	U.S. Sorghum Price
Canada			
Barley		0.84	
Corn	0.96		
Australia			
Barley		1.12	
Argentina			
Corn	1.10		
Sorghum			1.14
Thailand			
Corn	1.12		
South Africa			
Feed grain	0.0	0.0	0.0
EC(10)			
Corn	0.0		
Barley		0.0	
Spain			
Corn	0.75		
USSR			
Feed grain	0.0	0.0	0.0
Japan			
Corn	0.97		

Table A.8. Computation of price and income elasticities for net import demand in selected regions not included in the econometric model.

Region	Net Imports (1)	Domestic Consumption (2)	(2)/(1)	$\frac{(2)-(1)}{(1)}$	$\frac{n}{\text{Income Elast.}}$	Adj. Income Elast. $\left(n \times \frac{(2)}{(1)}\right)$	e_d Demand Elast.	e_s Supply Elast.	e_I Price Trans.	Adjusted Net Import Elasticity*
	1000 MT									
WHEAT										
North Africa and Middle East[a]	20026.0	48098.0	2.41	1.41	0.35	0.841	-0.2	0.2	0.4	-0.306
OWES Europe	220.0	9268.0	42.127	41.127	0.15	6.32	-0.2	0.2	0.25	-4.163
Oth. Asia[b]	12328.0	28505.0	2.31	1.31	0.40	0.925	-0.5	0.2	0.2	-0.362
Oth. Sou. America[c]	8312.0	12016.0	1.446	0.446	0.25	0.361	-0.2	0.2	0.5	-0.378
ROW**	16300.0	61100.0	5.42	4.42	0.40	2.17	-0.4	0.28	0.25	-0.500
FEEDGRAINS										
High Income East Asia	8263.0	9513.0	1.151	0.151	0.45	0.518	-0.7	0.2	0.6	-0.502
East Europe	3390.0	70891.0	20.912	19.912	0.35	7.32	-0.3	0.2	0.25	-2.550
ROW**	27500.0	17600.0	7.057	6.057	0.40	2.82	-0.5	0.2	0.25	-1.100
SOYMEAL										
China	475.0	1019.0	2.145		0.40	0.86				
USSR	1211.0	2358.0	2.00		0.30	0.58				
ROW**	8200.0	14920.0	1.820	0.820	0.40	0.73	-0.3	0.2	0.5	-0.355
SOYBEAN										
China	568.6	8775.0	15.433		0.2	3.09				
USSR	1269.0	1785.0	1.41		0.3	0.42				

*computed as $e_d e_I \left(\frac{(2)}{(1)}\right) - e_s e_I \left(\frac{(2)-(1)}{(1)}\right)$

**rest of world includes all countries and regions not listed in Tables A.1 to A.8

[a]excludes Egypt

[b]excludes India

[c]excludes Central America

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