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**Agriculture
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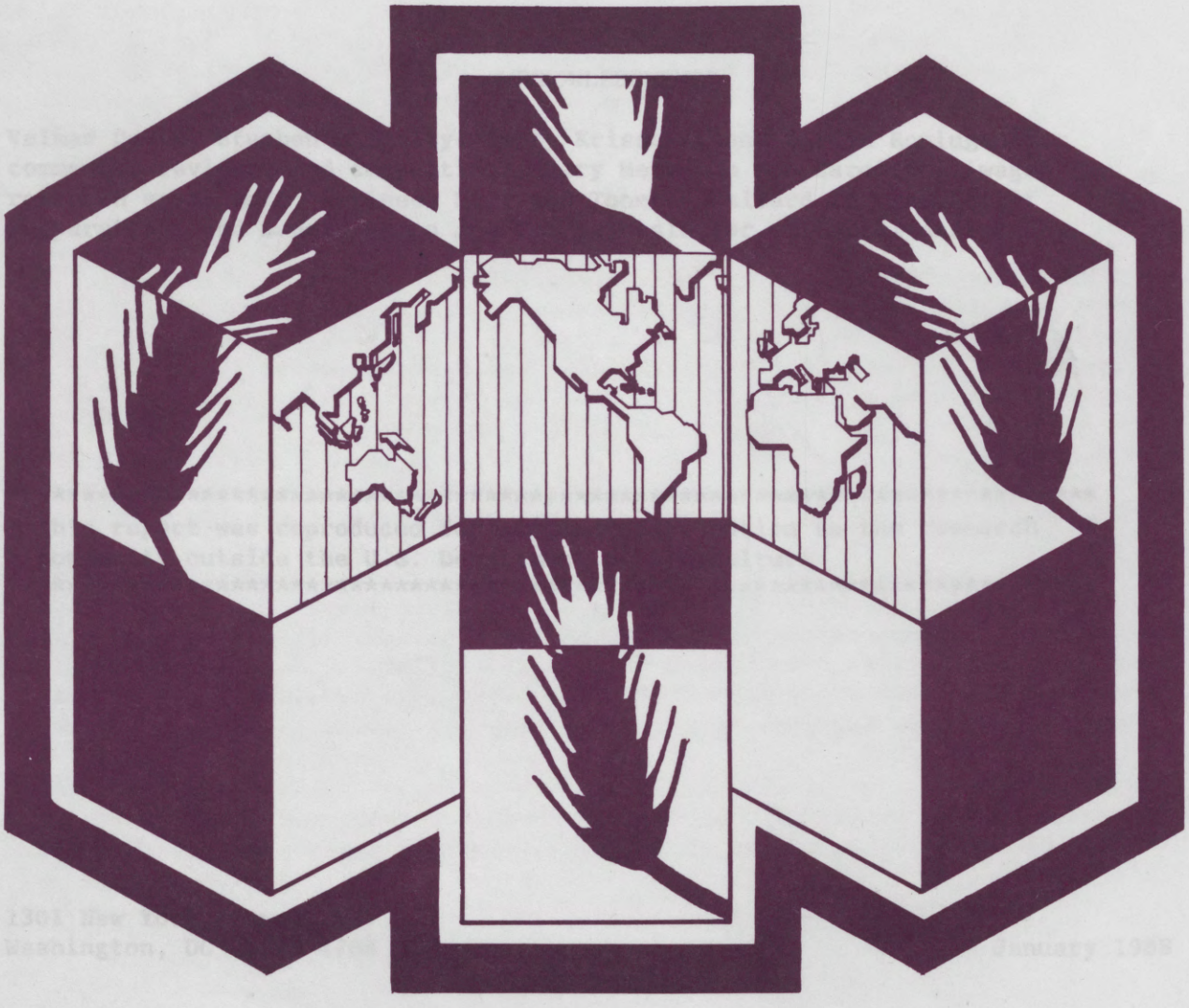
Forces that Could Expand U.S. Wheat Exports

Estimates From a World Wheat Trade Model

Jerry A. Sharples
Praveen M. Dixit



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ABSTRACT

This report examines three forces that could expand U.S. wheat exports: (1) a lower wheat price support; (2) liberalization of wheat trade by the European Community, Japan, and the United States; and (3) devaluation of the U.S. dollar. Results suggest that lowering U.S. loan rates by 25 percent could enable U.S. exports to expand by 37 percent over several years. A similar expansion in wheat exports would take place if wheat trade were liberalized. The effects of devaluation are much less apparent. Aggregate indexes of the value of the dollar can give a misleading indication of expected trade impacts. It is important to identify where the dollar is changing in value, country by country.

Keywords: Wheat, trade, elasticity, loan rate, liberalization, exchange rate, competitiveness

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PREFACE

Wheat is the king of food grains in international trade. U.S. farmers produce a major share of that market, but their share has diminished since 1981.

This report is part of a comprehensive Wheat Competitiveness Study conducted by the Economic Research Service. The study helped us to better understand competitiveness and how we compete in world agricultural markets.

The study focused on factors that relate to the competitiveness of U.S. wheat in world markets ranging from natural endowments to technology to farm and trade policies. Major exporting countries (United States, Canada, Argentina, Australia, and France) were included, as were major importing countries and regions (North Africa, China, USSR, Eastern Europe, Mexico, and Brazil).

Other information related to the competitiveness of U.S. wheat exports is summarized in U.S. Competitiveness in the World Wheat Market: Proceedings of a Research Conference. Copies can be purchased from National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161; for faster service call NTIS at (703) 487-4650.

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INTRODUCTION

Observers are saying that the United States is losing its competitive position in the world wheat market. As evidence, they point out that since 1981 the United States has exported less wheat, and its share of world wheat trade is going down. This downturn occurred after 13 years of growth in wheat export volume (figs. 1 and 2).

There are many reasons for this downward trend in U.S. wheat exports. Some can be found within U.S. agriculture and agricultural policy, such as high U.S. price supports and increases in input costs during the early eighties. Others can be found outside agriculture and the United States, such as appreciation in the value of the U.S. dollar, protectionist policies of importers, and export subsidization policies of competitors.

We examine three factors that could lead to expanded U.S. wheat exports in this report. They are: (1) a lower U.S. price support for wheat; (2) liberalization of wheat trade by the European Community (EC-10), Japan, and the United States, and (3) a devaluation of the U.S. dollar. Estimates of the possible export response to each of these forces are obtained from a world wheat trade model.

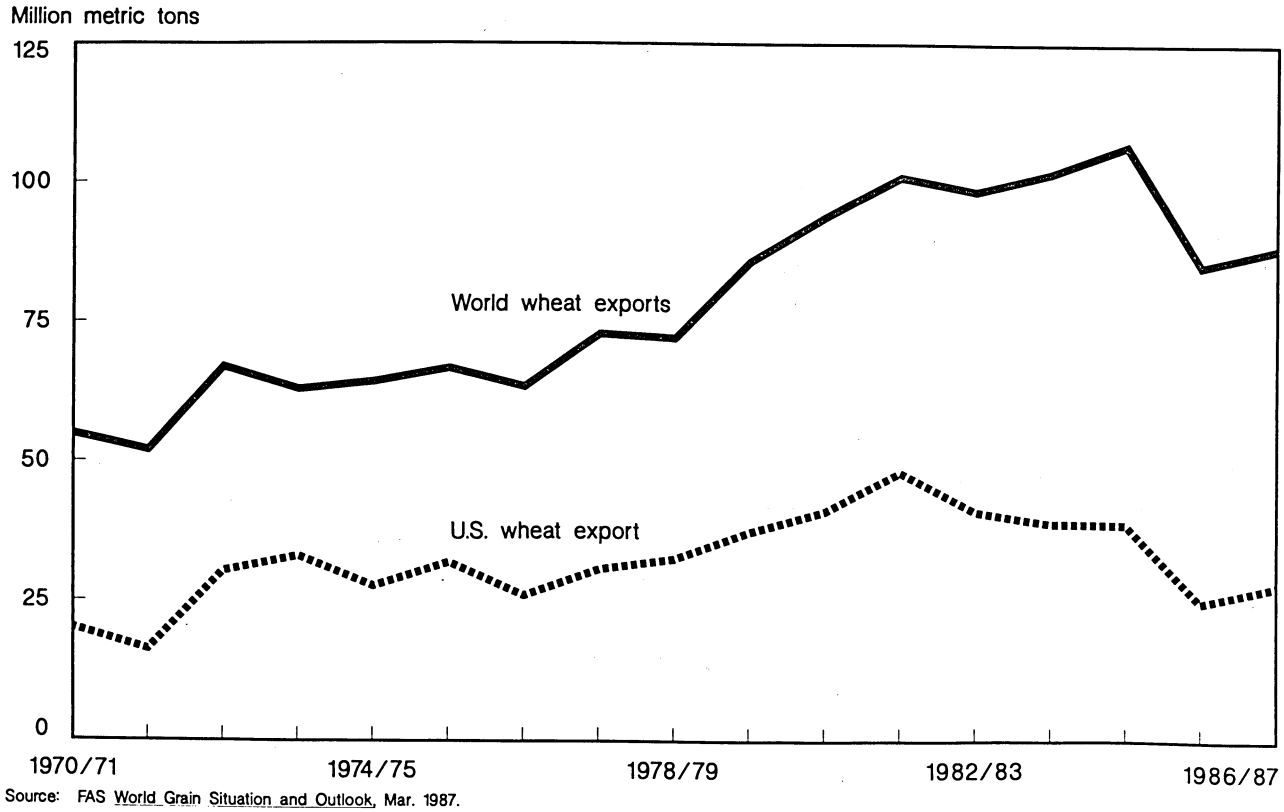
THE WORLD WHEAT TRADE MODEL

The world wheat trade model (WWTM) is a mathematical model that is characterized by two basic features: (1) it is a spatial price equilibrium model that explains trade flows based on the differences in transportation costs between importers and exporters; and (2) it is a static model that represents the world wheat market for a given year. In order to use this static, spatial equilibrium model to describe world wheat trade, we make the following assumptions:

1. The world wheat market is competitive. All countries operate as if they have no market power.

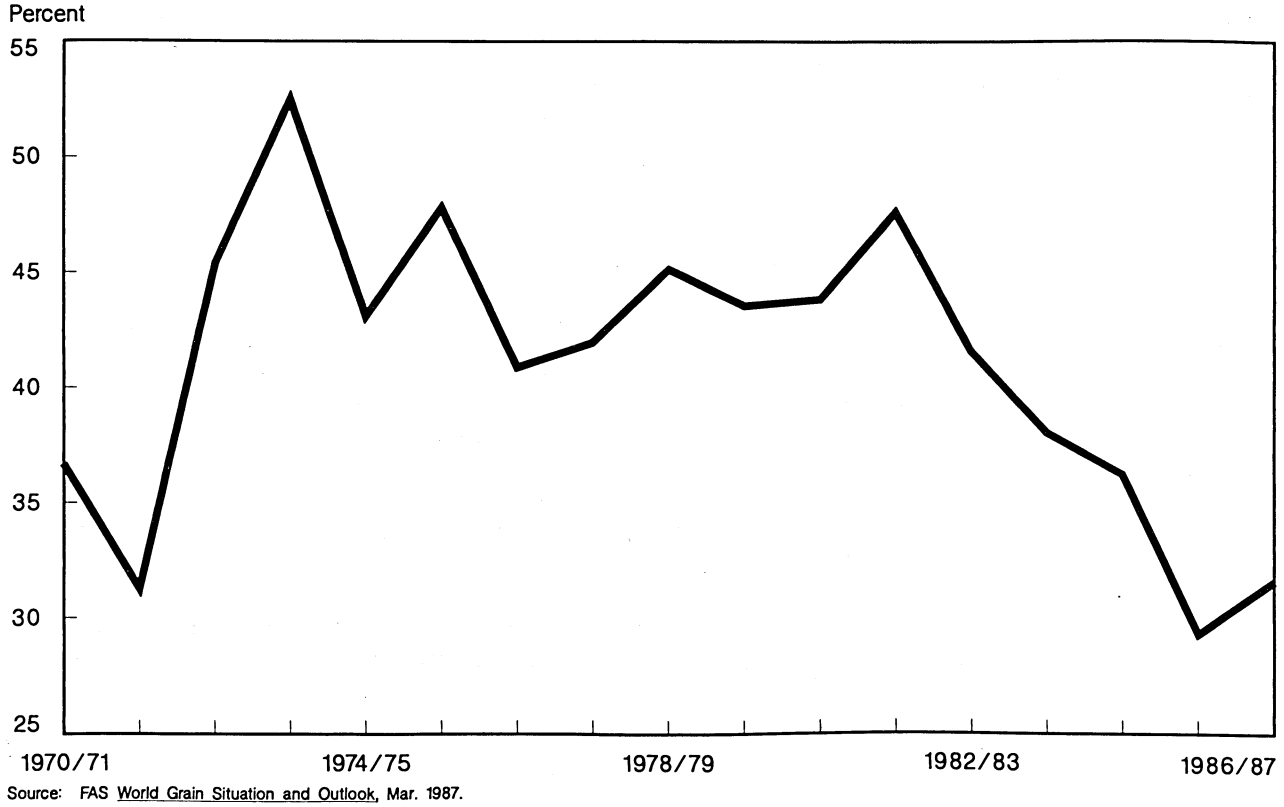
2. "Wheat" is a homogeneous commodity (the quantity traded also includes the wheat equivalent of flour). Importers do not distinguish wheat by origin.

Figure 1
U.S. and World Wheat Exports



Source: FAS World Grain Situation and Outlook, Mar. 1987.

Figure 2
U.S. Share of World Wheat Exports



Source: FAS World Grain Situation and Outlook, Mar. 1987.

3. A geographical "region," though possibly containing many countries, is one marketplace.

4. One fixed per unit transport cost exists for all wheat shipped from a specified exporting region to a specified importing region. Constant returns to scale are implied concerning transportation costs.

5. World wheat trade is in equilibrium in the year represented by the model.

6. All wheat transactions in a region are represented by one annual price expressed in U.S. dollars.

WWTM represents annual (1984/85) world wheat trade in intermediate-run equilibrium. It is assumed that all market participants (producers, consumers, and traders) have faced the prices and policies that actually existed in 1984/85 for about 3 years, and adjusted to them. The observed quantities produced, consumed, and traded in 1984/85 are thus assumed to be in an equilibrium that results after adjustment to 3 years of unchanged prices and policies. This assumption about the adjustment period enters the model through the selection of values for the supply and demand elasticities discussed below.

The adjustment period also affects the role of carryover stocks in the model. Stocks are omitted from this model because the dynamics implied by a change in stocks is inconsistent with the assumption of intermediate-run static equilibrium. Stocks are assumed to exist but do not change. Thus, they can be omitted.

Experiments are carried out by changing one or more of the WWTM parameters to represent a change in policy or other external shock. A new equilibrium solution is then obtained. The new solution represents an equilibrium that is obtained after 3 years of adjustment to the changed parameters, but all other conditions are the same as in the base year, 1984/85. Differences between the new solution and the initial or base solution are attributed to the change in policy or external shock.

The model's solution meets the conditions of a competitive market equilibrium. Given the set of domestic supply and demand functions, global economic surplus is maximized and transportation costs are minimized. Details of the structure of the model are presented in two reports, one by Holland (5) and the other by Holland and Sharples (6). 1/ The model is solved on the microcomputer using GTP, developed by Holland.

Model Features

WWTM is designed to represent the 1984/85 world wheat market. It divides the world into 20 regions plus one "other" exporting region and one "other" importing region (table 1). Six regions export wheat (Canada, United States, Argentina, Australia, EC-10, and other), and 17 regions import wheat.

The EC-10 is also included as an importing region. The two "other" regions mainly account for wheat trade that is recorded but cannot be identified by a specific region.

1/ Underscored numbers in parentheses refer to items in the References at the end of this report.

Table 1--Region names and composition

Region	Composition
Canada	Canada
United States	United States
Argentina	Argentina
Brazil	Brazil
Mexico	Mexico
Other Latin America	All Latin American countries except Argentina, Brazil, Mexico
EC-10	Belgium, Denmark, France, Greece, Ireland, Italy, Luxembourg, Netherlands, United Kingdom, West Germany
Other Western Europe	Austria, Finland, Iceland, Malta, Norway, Portugal, Spain, Sweden, Switzerland
Eastern Europe	Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Romania, Yugoslavia, Poland
Soviet Union	Soviet Union
China	Peoples Republic of China
Japan	Japan
East Asia	Brunei, Hong Kong, Indonesia, Malaysia, North Korea, Papua New Guinea, Philippines, Singapore, South Korea, Taiwan, West Samoa
Southeast Asia	Burma, Cambodia, Laos, Vietnam, Thailand
South Asia	Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka
West Asia	Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, North and South Yemen, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates
North Africa	Algeria, Egypt, Morocco, Libya, Tunisia
South Africa	Botswana, Lesotho, Namibia, South Africa, Swaziland
Central Africa	All other countries in Africa not listed above
Australia	Australia

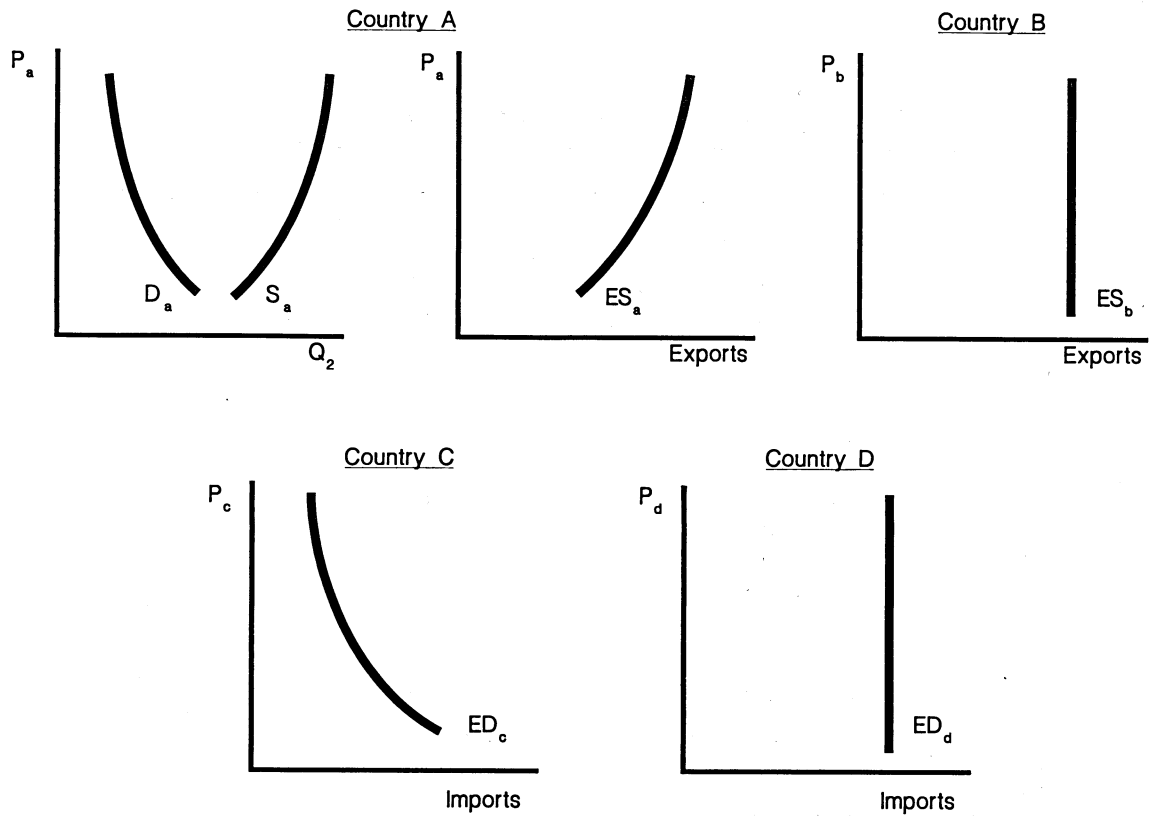
The model consists of excess demand functions for all importing regions, domestic supply and domestic demand functions for most exporting regions, a matrix of unit interregional transportation costs, and a set of constraints on trade flows. It is a synthetic model in the sense that no equations are econometrically estimated. The model is structured to exactly reproduce the quantity of wheat traded by each region and the border price for each exporting region as observed in 1984/85, given the data on transportation costs, price elasticities, and other constraints.

Supply and Demand Functions

Examples of the model's supply and demand equations are shown in figure 3. Four export regions (Canada, United States, Argentina, and Australia) have both domestic supply and domestic demand functions for wheat as shown by curves S_a and D_a for country A. Each is a constant price-elasticity function with price (P_a) representing world (border or f.o.b.) price. This means that the domestic supply function implicitly incorporates producers' supply responses to domestic price signals, plus all distortions that exist between the domestic and world price. Examples of distortions are production subsidies and border policies that cause the domestic price to differ from the world price. The same interpretation of distortions holds for the domestic demand function. The respective price elasticities are shown in table 2. 2/

2/ Discussion of wheat production policies that are implicit in the U.S. supply function is included in each of the experiments.

Figure 3
Country Examples in the World Wheat Trade Model



"Supply" is defined for this model as normal production in 1984/85. The quantity of wheat exported by each of the four exporting countries is the difference between quantity supplied and quantity demanded at the border price. Thus, an excess supply function (such as ES_a for country A in figure 3) is implied but not explicitly modeled. Actual quantities exported in 1984/85 are given in table 2.

It is assumed that wheat exports of two exporting regions, EC-10 and other, do not respond to world price. Thus, these two regions have a constant quantity exported equal to their actual exports of wheat in 1984/85. Their excess supply functions look like ES_b as shown in figure 3 for country B. The EC-10 is represented by this type of excess supply function in order to capture the impact of the Common Agricultural Policy (CAP). The policy is designed to stabilize domestic wheat prices by isolating them from the volatility of world market prices. For the purposes of this modeling activity, the CAP is assumed to accomplish its objective.

The model contains one excess demand function for each wheat-importing region. This function relates the quantity of wheat imported to the world (border or c.i.f.) price. The price elasticity in table 3 is assumed to implicitly incorporate all forces that affect the linkage between the border price and imports, for example, domestic or trade policy or foreign exchange constraints. It is assumed that eight importing regions will not adjust the quantity of wheat imported in response to a change in world price (price elasticity of excess demand is zero). The excess demand functions for these regions are constant equal to the actual quantity of wheat imported in 1984/85--equivalent to ED_d for country D in figure 3. The remaining importing regions have constant elasticity excess demand functions (such as ED_c for country C). See Holland and Sharples for more information on these price elasticities (6).

Table 2--Net wheat exports, 1984/85, and elasticities of supply and demand of wheat-exporting regions

Region	Net exports	Price elasticity of 1/	
		Supply	Demand
	1,000 metric tons		
United States	38,092	0.40	-0.10
Canada	19,456	.40	-.30
Argentina	8,034	.40	-.10
Australia	15,265	.40	0
EC-10	17,500	0	0
Other	8,212	0	0
Total	106,559	--	--

-- = Not applicable.
1/ With respect to world price.

Transportation Costs, Price Adjustments, and Exchange Rates

The model contains price equations that link the import price, transportation costs, other sources of price differentials, and the export price. The equation is:

$$P_j = ((P_i * E_i) + T_{ij} + A_j) / E_j \quad (1)$$

where:

P_j is the c.i.f. price of importing region j, U.S. dollars per metric ton,

P_i is the f.o.b. price of exporting region i, U.S. dollars per metric ton,

E_i and E_j are exchange rates of regions i and j relative to the base currency, U.S. dollars,

T_{ij} is the cost per ton of transporting wheat from region i to region j, and

A_j is a price adjustment for exporting wheat from region j to account for other price differentials among exporting countries.

Table 3--Net wheat exports, 1984/85, and elasticities of excess demand for wheat-importing regions

Region	Net exports	Elasticity of excess demand 1/
	1,000 metric tons	
Mexico	488	-0.20
Brazil	5,400	-.20
Other Latin America	7,061	-.40
EC-10	2,283	0
Other Western Europe	1,690	0
Eastern Europe	2,602	0
Soviet Union	28,100	-.25
China	7,500	-.80
Japan	5,722	0
East Asia	4,315	-.40
Southeast Asia	1,465	-.80
South Asia	6,580	-.80
West Asia	11,882	0
North Africa	12,684	0
Central Africa	5,680	-.80
South Africa	470	0
Other	2,627	0
Total	106,549	--

-- = Not applicable.
1/ With respect to world price.

For the first two experiments, including initial model parameterization (BASE scenario), all exchange rates are equal to 1.0, implying that prices for all regions are expressed in U.S. dollars. Exchange rate adjustments are examined in the third experiment.

Transportation costs are based on actual charges reported for 1984/85 (table 4). Rates for little-used routes are extrapolated from similar routes with more data. In addition, a price adjustment per ton exported was added at the border for exports from Canada ($18.60), Argentina (-$18.00), EC-10 (-$15.00), and Australia ($4.30) to account for wheat quality differences and other factors that caused actual export prices in 1984/85 to differ among exporters by more than the transportation cost differentials (A_j in equation 1). No attempt was made to equate the model's c.i.f. prices for importing regions with actual prices. Those data are not available for most regions.

Trade Constraints

The model contains constraints that represent bilateral trade agreements that existed in 1984/85 (the "greater than or equal to" values shown in table 5). These constraints placed lower limits on specified wheat trade flows. For example, the Soviet Union had agreements with all major wheat exporters. Table 5 also shows where the model has equality constraints rather than price-responsive functions to represent fixed quantities imported.

Table 4--Transportation costs: World wheat trade model, 1984/85

Importing regions	Exporting regions					
	Canada	United States	Argentina	EC-10	Australia	Other
	Dollars per metric ton					
Mexico	11.71	7.97	25.48	17.71	21.65	19.68
Brazil	16.73	11.91	14.76	11.81	21.65	19.68
Other Latin America	12.79	12.00	23.52	19.68	21.65	19.68
EC-10	8.51	9.05	18.25	1/	17.71	19.68
Other Western Europe	15.50	10.92	24.99	7.67	17.71	19.68
Eastern Europe	9.59	11.51	20.66	7.87	20.66	19.68
Soviet Union	13.92	19.43	28.63	11.81	22.78	19.68
China	23.32	17.32	29.52	28.29	18.20	19.68
Japan	18.99	19.24	29.12	27.55	18.84	19.68
East Asia	20.02	20.17	37.64	29.52	18.30	19.68
Southeast Asia	21.40	22.14	32.47	29.52	21.65	19.68
South Asia	21.15	28.04	24.60	27.80	19.83	19.68
West Asia	24.11	17.71	33.36	19.92	22.29	19.68
North Africa	16.73	13.38	27.75	18.45	21.06	19.68
Central Africa	29.52	29.42	27.55	18.20	19.68	19.68
South Africa	19.68	17.22	21.35	19.92	19.68	19.68
Other	17.71	17.71	24.60	17.71	17.71	19.68

1/ This trade flow is prohibited in the model.

Table 5--Trade flow constraints and total net trade constraints

Importing regions	Exporting regions						
	Canada	United States	Argentina	EC-10	Australia	Other	Total
			1,000 metric tons				
Mexico	--	--	--	1/≥25	--	2/ =34	
Brazil	≥1,300	--	--		--	=434	
Other Latin America	--	--	--	≥600	--	=347	--
EC-10	--	--	--	--	--	--	=2,283
Other Western Europe	--	--	--	--	--	--	=1,690
Eastern Europe	≥100	--	--	--	--	=1,114	=2,602
Soviet Union	≥6,000	≥6,000	≥3,600	≥5,700	≥1,800	=1,934	--
China	≥2,700	≥2,400	≥673	--	≥1,500	--	--
Japan	≥1,300	--	--	--	>900	--	=5,722
East Asia	--	--	--	--	--	=1,329	--
Southeast Asia	--	--	--	--	--	--	--
South Asia	--	--	--	--	--	--	--
West Asia	≥900	--	≥300	--	≥1260	=1,572	=1,882
North Africa	≥950	--	--	--	≥1500	=1,397	=2,684
Central Africa	≥100	--	≥40	--	--	=51	--
South Africa	--	--	--	--	--	--	=470
Other	--	=952	=140	=1,173	=362	--	=2,627
Total	--	--	--	=17,500	--	=8,212	--

-- = Not applicable.
1/ ≥ represents a constraint imposed by a bilateral trade agreement.
2/ = is an equality constraint indicating no quantity response to changes in the border wheat price.
Source: Foreign Agricultural Service, USDA.

THE BASE SOLUTION

Through a process of adjustments in equation intercepts and adjustments in border price differentials, the actual quantities of wheat traded by region and the border export prices in 1984/85 (table 6) were closely approximated by the BASE solution (table 7). This close approximation is not evidence of a valid model; it only shows the modeler's persistence in tuning the model.

A more useful check of validity is to compare the model's estimates of trade flows with actual trade flows in 1984/85. One obvious difference between the BASE solution (table 7) and actual trade in 1984/85 (table 6) is that the model has fewer trade flows. The United States actually exported wheat to all importing regions in 1984/85, and the other exporting regions shipped to most of them (table 5). The model suggests that competitive trade would be more specialized--a familiar trait of models of this type that only include transportation costs and a few trade restrictions as the determinants of trade flows. Other determinants likely exist but are not included in the model. Examples of determinants are: importers may wish to diversify their source of supply for political reasons; wheat from one exporter may not have the same

quality characteristics as wheat from another exporter; price and transportation cost relationships may change over the marketing year.

The model does, however, show some of the major trade patterns. Australia mainly ships to nearby Asian countries, and the EC-10 mainly ships to nearby North Africa, the Soviet Union, and the rest of Europe. The United States captures most of the Latin American trade. The model accurately replicates actual trade with the Soviet Union and China, but those trade flows are primarily determined by bilateral agreements that show up as minimum trade flow constraints in the model.

Table 6--Actual 1984/85 world wheat trade flows, domestic use, total use, and f.o.b. wheat prices 1/

Importing regions	Exporting regions						
	Canada	United States	Argentina	EC-10	Australia	Other	Total
			1,000 metric tons				
Mexico	24	--	--	--	430	34	488
Brazil	1,192	3,070	604	100	--	434	5,400
Other Latin America	1,469	4,051	944	200	50	347	7,061
EC-10	1,264	945	74	--	--	--	2,283
Other Western Europe	140	618	32	900	--	--	1,690
Eastern Europe	259	74	55	1,100	--	1,114	2,602
Soviet Union	7,619	6,076	4,071	6,600	1,800	1,934	28,100
China	2,801	2,440	673	92	1,494	--	7,500
Japan	1,385	3,327	--	--	1,010	--	5,722
East, South, and Southeast Asia	622	6,309	185	552	3,373	1,329	12,370
West Asia	1,253	2,746	1,120	1,295	3,896	1,572	11,882
North Africa	950	4,657	10	3,420	2,250	1,397	12,684
Other Africa	502	2,803	126	2,068	600	51	6,150
Other	--	952	140	1,173	362		2,627
Total exports	19,456	38,092	8,034	17,500	15,265	8,212	106,559
Domestic use	5,400	31,400	4,500	2/	3,300	2/	2/
Total use	24,856	69,492	12,534	2/	18,565	2/	2/
			Dollars per metric ton				
F.o.b. wheat price	164	145	124	3/132	151	--	--

-- = No trade.

1/ Some adjustments were made to equate sums of flows with total trade by region.

2/ Not applicable

3/ EC-10 f.o.b. price was estimated by subtracting the average restitution payment per ton from the border equivalent intervention price.

Source: FAS, USDA, and various issues of Foreign Agriculture Trade of the United States, ERS, USDA.

EXPERIMENT 1: EFFECTS OF LOWERING U.S. WHEAT LOAN RATE

The first factor to be examined with the model is a decrease in the U.S. wheat loan rate. One of the key questions that came up during the debate on the Food Security Act of 1985 was "How much will U.S. wheat exports increase in response to a decrease in the wheat loan rate?" Policymakers and the Secretary of Agriculture apparently thought the export response would be substantial. In the 1985 Act, Congress provided the Secretary with the authority to make large decreases in the loan rate. The Secretary then lowered the wheat loan rate for 1986 to the lowest level allowed by law--about a 25-percent decrease. The purpose was to expand exports.

Table 7--BASE solution: Estimated 1984/85 world wheat trade flows, domestic use, and f.o.b. wheat price

Importing region	Exporting regions						
	Canada	United States	Argentina	EC-10	Australia	Other	Total
			1,000 metric tons				
Mexico	--	429	25	--	--	34	488
Brazil	1,300	1,084	2,660	--	--	434	5,478
Other Latin America	--	6,097	600	--	--	347	7044
EC-10	2,094	189	--	--	--	--	283
Other Western Europe	--	--	--	1,690	--	--	1690
Eastern Europe	1,024	--	--	464	--	1,114	2602
Soviet Union	6,000	6,000	3,600	8,722	1,800	1,934	28056
China	2,700	2,655	673	--	1,500	--	7528
Japan	1,300	3,522	--	--	900	--	5722
East Asia	--	--	--	--	5,321	1,329	6650
Southeast Asia	865	--	--	--	--	--	865
South Asia	2,222	--	--	--	2,625	--	4847
West Asia	900	7,850	300	--	1,260	1,572	11882
North Africa	950	8,837	--	--	1,500	1,397	12684
Central Africa	100	--	40	5,451	--	51	5642
South Africa	--	470	--	--	--	--	470
Other	--	952	140	1,173	362	--	2627
Total exports	19,456	38,085	8,038	17,500	15,268	8,212	106559
Domestic use	5,403	31,402	4,501	1/	3,300	1/	1/
Total use 2/	24,859	69,487	12,539	1/	18,568	1/	1/
			Dollars per metric ton				
F.o.b. wheat price	164	145	124	132	151	147	146

-- = No trade.

1/ Not estimated by the model.

2/ Production equals total use in the model.

Our first experiment was designed to obtain the model's estimate of what would happen specifically to U.S. exports and generally to world wheat trade if the world price were to drop 25 percent. We assume that the supply of wheat for export by the United States is such that a 25-percent decrease in the loan rate, under 1984/85 market conditions, would result in a corresponding 25-percent drop in the world wheat price, f.o.b. United States.

This is modeled by increasing the quantity of wheat produced in the United States (shifting the supply function right) by the amount necessary to reduce the border price 25 percent. In other words, we are moving down along the model's implicit U.S. demand-for-exports function. This LOW PRICE solution shows the impact, under 1984/85 world market conditions, of a sustained increase in U.S. supply of wheat that is large enough to lower the world price 25 percent (table 8).

Table 8--LOW PRICE solution: Estimated 1984/85 world wheat trade flows, domestic use, and f.o.b. wheat price

Importing region	Exporting regions						
	Canada	United States	Argentina	EC-10	Australia	Other	Total
			1,000 metric tons				
Mexico	--	456	25	--	--	34	515
Brazil	1,300	3,114	923	--	--	434	5,771
Other Latin America	--	6,870	600	--	--	347	7,817
EC-10	--	2,283	--	--	--	--	2,283
Other Western Europe	--	568	--	1,122	--	--	1,690
Eastern Europe	1,488	--	--	--	--	1,114	2,602
Soviet Union	7,947	6,000	3,600	8,573	1,800	1,934	29,854
China	2,700	4,326	673	--	1,500	--	9,199
Japan	1,300	3,522	--	--	900	--	5,722
Southeast Asia	865	--	--	--	--	--	865
South Asia	2,222	--	--	--	2,625	--	4,847
West Asia	900	7,850	300	--	1,260	1,572	11,882
North Africa	950	8,837	--	--	1,500	1,397	12,684
Central Africa	100	--	40	5,451	--	51	5,642
South Africa	--	470	--	--	--	--	470
Other	--	952	140	1,173	362	--	2,627
Total exports	19,456	38,085	8,038	17,500	15,268	8,212	106,559
Domestic use	5,403	31,402	4,501	1/	3,300	1/	1/
Total use 2/	24,859	69,487	12,539	1/	18,568	1/	1/
			Dollars per metric ton				
F.o.b. wheat price	164	145	124	132	151	147	146

-- = No trade.
1/ Not estimated by the model.
2/ Production equals total use in the model.

Since the focus of this experiment is not on the United States, we are not concerned with exactly what happens within the United States to enable the assumed shift in its supply function to take place. The shift could represent a combination of a lower wheat loan rate, release of Government-controlled stocks, and expansion of wheat plantings on acreage formerly withheld from production under Government wheat programs.

A comparison of the LOW PRICE solution with the BASE solution (table 9) shows total world imports (and exports) increasing 7.7 million tons--7 percent.

Table 9--Wheat trade by regions, 1984 BASE solution and LOW PRICE solution to the world wheat trade model 1/

Region	1984 BASE	LOW PRICE	Change	
	-------1,000 metric tons-------			Percent
Importing regions:				
Mexico	488	515	27	5.5
Brazil	5,478	5,771	293	5.3
Other Latin America	7,044	7,817	773	11.0
EC-10 Import	2,283	2,283	0	0
Other Western Europe	1,690	1,690	0	0
Eastern Europe	2,602	2,602	0	0
Soviet Union	28,056	29,854	1,798	6.4
China	7,528	9,199	1,671	22.2
Japan	5,722	5,722	0	0
East Asia	6,650	7,336	686	10.3
Southeast Asia	865	1,050	185	21.4
South Asia	4,847	5,888	1,041	21.5
West Asia	11,882	11,882	0	0
North Africa	12,684	12,684	0	0
Central Africa	5,642	6,823	1,181	20.9
South Africa	470	470	0	0
Other	2,627	2,627	0	0
Total	106,558	114,213	7,655	7.2
Exporting regions:				
Canada	19,455	16,685	-2,770	-14.2
United States	38,085	52,160	14,075	37.0
Argentina	8,038	6,301	-1,737	21.6
EC-10	17,500	17,500	0	0
Australia	15,268	13,355	-1,913	-12.5
Other	8,212	8,212	0	0
Total	106,558	114,213	7,655	7.2
	---------Dollars per ton--------			
U.S. export price	145	109	-36	-24.7

1/ The LOW PRICE solution assumes that the United States expands exports and lowers price supports enough to lower world export price almost 25 percent below the BASE price.

Most of the increase in imports is indicated for the Soviet Union, China, the rest of Asia (excluding West Asia), and Central Africa.

As a result of the 25-percent drop in world wheat prices, the LOW PRICE solution shows exports decreasing 14 percent from Canada, 22 percent from Argentina, and 13 percent from Australia (table 9). EC-10 and other showed no change in wheat exports because their exports are assumed not to respond to world prices.

The LOW PRICE solution indicates that U.S. exports could increase 14 million tons (37 percent) relative to actual 1984/85 market conditions as a result of the price drop. This would occur if the above adjustments in wheat trade in other countries took place and if the United States had the additional wheat available to export at the lower price. Remember, this is a new equilibrium that is assumed to follow 3 years of adjustment to the 25-percent reduction in world price. All other conditions of the 1984/85 year are assumed to remain the same.

The data in table 9 can be used to estimate the price elasticity of demand for U.S. wheat exports. At the midpoint of the price-quantity changes, the (arc) elasticity is -1.1 after the 3-year period of adjustment. This estimate of -1.1 is lower than the mean value of -1.9 reported by Gardiner and Dixit in their survey of the literature (3). But, as indicated in the same study, longrun estimates have ranged from -0.2 to -6.7.

Our model results indicate that lowering loan rates affects U.S. wheat exports considerably. This differs from the results of Langley and Price's study which examines the implications on U.S. wheat exports of varying the U.S. loan rate for wheat (8). Their study indicates that a 1-percent drop in the wheat loan rate increases U.S. wheat exports by only 0.2 percent, compared with 1.2 percent in our study. The difference in the estimated impact can be attributed to the effects that loan rates have on world prices. While our results assume a 25-percent drop in the world price in response to a 25-percent drop in U.S. loan rate, Langley and Price's study shows only a 9-percent drop in the U.S. (world) price for a 25-percent decline in the loan rate (8).

Does our experiment give a realistic assessment of what would actually happen in the late eighties from a comparable shift in the U.S. supply function? Obviously, many conditions would not be the same as in this experiment. Several qualifications of the results need to be noted. First, the forces influencing trade are constantly changing. Only 1 year after the marketing year studied here, the quantities imported and exported significantly changed. But that is not to say that 1984/85 is any less representative of the late eighties.

Second, the model results are based on the assumption that none of the other exporting countries, or importing countries, change their policies as a result of a lower world wheat price. If policy changes took place, the results would change. For example, the LOW PRICE solution implies that the EC-10 would have to pay much higher wheat export subsidies to maintain the same level of exports. The higher budget cost might lead to an adjustment in their CAP. If the EC-10 lowered domestic wheat prices or discouraged wheat production for export, their exports would drop. This policy adjustment would lead to higher world prices and more exports by the United States and other exporters. If

this sequence of events occurred, the LOW PRICE solution would have underestimated the expansion of U.S. exports.

Third, some economists point out that a 25-percent reduction in the wheat loan rate could be seen as leading to increased uncertainty in world wheat markets. A U.S. domestic policy of lower loan rates and less Government grain stocks might not provide world market stability as in the past. Increased uncertainty could cause producers in other countries and those in the United States to produce less at a given price level. This would tend to increase the world wheat price. Developing countries importing wheat might react to the perception of increased instability by pushing harder for wheat self-sufficiency. This could take the form of domestic price policies more favorable to producers. Thus, they might produce more and import less, lowering world price.

All of the above conditions could modify the results obtained from the model. But, the basic conclusion should still be valid, a decrease in the U.S. loan rate and an associated decrease in the world price should significantly increase U.S. wheat exports over a 3-year period.

EXPERIMENT 2: REMOVING POLICY DISTORTIONS

The EC-10, Japan, and the United States are major participants in the world wheat market. They probably will be major participants in future agricultural trade negotiations. Historically, they have pursued agricultural and trade policies that protected their domestic wheat sector from the world market. Each has policies that protect domestic wheat producers. The domestic price faced by wheat consumers in Japan and the EC-10 is much higher than the world price. These domestic policies may be subject to examination in future trade negotiations. In this experiment, WWTM is used to estimate the impact on the world wheat market if the EC-10, Japan, and the United States removed policies that protected their domestic wheat sectors.

The EC-10 uses a variable levy to stabilize the internal wheat price--usually well above the world price. Production is not controlled so the excess above domestic needs is sold on the world market with the aid of export subsidies. Japan similarly maintains domestic producer prices at nearly six times the world price, but domestic wheat production is quite small so most of their needs are met with imports. Japanese consumers also pay much more than the world price for wheat. Their imports are managed by state trading agencies and with import licenses. The U.S. wheat policy does not distort world price signals to consumers, but it does provide producers with production subsidies and induces them to control production.

The above policy distortions are built into the BASE scenario of the model. In that scenario, Japan and the EC-10 do not respond to world wheat price changes. The U.S. excess supply function reflects the fact that 18.5 million acres of potential wheat acreage are idle in 1984.

In this experiment, a so-called FREE TRADE solution is obtained with the wheat trade model. This experiment gives an indication of how world wheat trade might change as a result of major changes in domestic and trade policies. Four modifications are made in the BASE set of assumptions. First, Japan is assumed to eliminate import restrictions and become a price-responsive importer. Japan's revised excess demand function has a world price elasticity

of -0.15 and passes through the point representing actual quantity imported and domestic price in 1984/85.

Second, the EC-10 is assumed to eliminate wheat trade restrictions so that domestic producers and consumers face the local equivalents of the world price. Inserted into the model are an EC-10 domestic demand function with a world price elasticity of -0.3 and a domestic supply function with an elasticity of 0.4. These replace the price-inelastic excess supply function that is in the BASE scenario.

Third, free trade for the United States is assumed to mean (1) no production control and (2) no price or income support. As a result, the excess wheat supply function for the United States is increased (shifted right) by 10 million tons. The increase in U.S. production is assumed to be obtained from 18.5 million acres of idled wheat land in 1984/85.

Fourth, all bilateral trade agreements are removed from the model. The first three changes imply major shifts in wheat trade. Many of those changes cannot fully take place in the model if the minimum trade flow constraints remain; thus, they are removed.

Results for the FREE TRADE solution are summarized in table 10. Notice that the number of trade flows (ignoring flows to or from other) decrease substantially relative to the BASE solution (table 7). This is the result of removing the restrictions representing bilateral agreements.

The trade-liberalizing measures assumed for the United States, the EC-10, and Japan had very little impact on the model's estimate of global imports in 1984/85--about a 1-percent drop from the BASE results (table 11). There are, however, major changes in trade shares. Net wheat exports by the EC-10 dropped 13.6 million tons (nearly 90 percent) to only 1.6 million tons. This was nearly offset by an increase in U.S. exports of 11.4 million tons (30 percent) and an increase by all other exporters of 1.3 million tons (3 percent).

The model estimates that the trade-liberalizing measures would raise world wheat prices about 5 percent. The price rises because the world price-increasing impacts of the policy changes in the EC-10 and Japan more than offset the world price-decreasing policy changes in the United States.

There are several characteristics worth emphasizing about the FREE TRADE solution. First, at a border price of $152 per ton, the elasticity of excess demand facing the United States (the elasticity of demand for U.S. exports) is -2.0. 3/ It was -1.1 in the BASE model. The increase in price elasticity is due to the removal of trade restrictions by the EC-10 and Japan. Second, the results are very sensitive to the price elasticities assumed for the EC-10. For example, if the elasticity of demand is increased from -0.3 (used in the FREE TRADE solution) to -0.4, the EC-10 becomes a net importer of wheat.

We consider the FREE TRADE scenario to represent an upper limit on the increase in the U.S. supply of wheat. One could argue that the

3/ This estimate is obtained by making a small change in U.S. supply and obtaining a new solution. The elasticity is obtained by comparing the change in f.o.b. U.S. price and the change in U.S. exports--equivalent to moving along the FREE TRADE U.S. export demand function.

supply-increasing effect of direct payments offsets the supply-decreasing effect of production control. If true, removing U.S. wheat programs would not shift the U.S. wheat supply function. We examined this scenario with the model. We obtained a revised FREE TRADE solution by assuming that there would be no shift in the U.S. supply function as a result of removing U.S. wheat programs. The results showed a 13-percent increase in the U.S. export price and only a 10-percent increase in U.S. exports. U.S. wheat exports increased 4 million tons, EC-10 exports dropped 10 million tons (67 percent), and remaining exporters increase exports 3 million tons.

A number of other studies have also examined the consequences of agricultural trade liberalization by a group of industrialized countries (table 12). Tyers

Table 10--FREE TRADE solution: Estimated 1984/85 world wheat trade flows, domestic use, total use, and f.o.b. wheat price

Importing regions	Exporting regions						
	Canada	United States	Argentina	EC-10 1/	Australia	Other	Total
				1,000 metric tons			
Mexico	--	450	--	--	--	34	484
Brazil	--	5,007	--	--	--	434	5,441
Other Latin America	--	6,578	--	--	--	347	6,925
Other Western Europe	--	1,690	--	--	--	--	1,690
Eastern Europe	--	1,488	--	--	--	1,114	2,602
Soviet Union	20,284	4,905	--	418	--	1,934	27,541
China	--	7,282	--	--	--	--	7,282
Japan	--	4,591	--	--	1,603		6,194
East Asia	--	--	--	--	5,235	1,329	6,564
Southeast Asia	--	--	--	--	837	--	837
South Asia	--	--	2651	--	2,074	--	4,725
West Asia	--	10,310	--	--	--	1,572	11,882
North Africa	--	11,287	--	--	--	1,397	12,684
Central Africa	--	--	--	--	5,420	51	5,471
South Africa	--	--	470	--	--	--	470
Other	--	952	140	1,173	362	--	2,627
Total exports	20,284	49,533	8,268	1,591	15,531	8,212	103,419
Domestic use	77	31,257	4,484	58,107	330	2/	2/
Total use	25,561	80,790	12,752	59,698	18,831	2/	2/
				Dollars per metric ton			
F.o.b. wheat price	176	152	129	144	157	154	152

-- = No trade.

1/ Net exports. In this version of the model, EC-10 is eliminated as an importing region.

2/ Not estimated by the model.

and Anderson used a partial equilibrium, static, 30-country-region model of world grains, livestock, and sugar (GLS) markets to analyze the effects of a simultaneous removal of distortions in all industrial market economies for all GLS commodities (11). Their results are similar to ours in that world wheat price rises moderately, world wheat volume falls slightly, and the EC-10 loses the most in the world wheat market. Their results differ from ours to the extent that Canada gains much more in their study, and that Japanese wheat

Table 11--Wheat trade by regions, 1984 BASE solution and FREE TRADE solution to the world wheat trade model

Region	1984 BASE	LOW PRICE	Change	
	-------1,000 metric tons-------			Percent
Importing regions:				
Mexico	488	484	-4	-0.8
Brazil	5,478	5,441	-37	-.7
Other Latin America	7,044	6,925	-119	-1.7
Other Western Europe	1,690	1,690	0	0
Eastern Europe	2,602	2,602	0	0
Soviet Union	28,056	27,541	-515	-1.8
China	7,528	7,282	-246	-3.3
Japan	5,722	6,194	472	8.2
East Asia	6,650	6,564	-86	-1.3
Southeast Asia	865	837	-28	-3.2
South Asia	4,847	4,725	-122	-2.5
West Asia	11,882	11,882	0	0
North Africa	12,684	12,684	0	0
Central Africa	5,642	5,471	-171	-3.0
South Africa	470	470	0	0
Other	2,627	2,627	0	0
Total 1/	104,275	103,419	-856	-.8
Exporting regions:				
Canada	19,456	20,284	828	4.3
United States	38,084	49,533	11,449	30.1
Argentina	8,038	8,268	230	2.9
EC-10 2/	15,217	1,591	-13,626	-89.5
Australia	15,268	15,531	263	1.7
Other	8,212	8,212	0	0
Total 3/	104,275	103,419	-856	-.8
	---------Dollars per ton---------			
U.S. export price	145	152	7	4.9

1/ Imports by the EC-10 of 2,283 tons are removed.
2/ Net exports.
3/ Includes net exports of EC-10.

Table 12--Changes in selected variables due to a reduction in agricultural protection by industrial economies

Item	World wheat trade model (WWTM), 1984 1/	IIASA study, 1990 1/	Tyers and Anderson study, 1985 1/
		Percent	
World price	5	18	2
U.S. exports	30	19	8
EC exports	90	-98	20
Japanese imports	8	2	-18
World trade	-1	-2	-1

1/ Refers to the year represented by model results.

imports decline despite liberalization. This decline is the result of reduced utilization of imported wheat for domestic feed purposes, given large increases in ruminant meat imports.

Results from the International Institute for Applied Systems Analysis (IIASA) study that explores the consequences of trade liberalization by the Organization for Economic Cooperation and Development (OECD) countries are also similar to ours (10). World wheat trade volume increases by 2 percent in the IIASA study. World wheat price, on the other hand, increases by 18 percent--more than the 5 percent in our study and the 2 percent in Tyers and Anderson's study. The EC-10, as with ours and the Tyers and Anderson study, bears the bulk of the costs. In the IIASA study, EC-10 wheat exports in 1990 decline by 98 percent, indicating nearly a reversal of trade direction. Japanese imports increase by 2 percent, even less than in our study. In general, our results indicate that our static, partial equilibrium single-commodity model provides results that are comparable with the multi-year partial equilibrium multicommodity Tyers and Anderson study, and the general equilibrium, multicommodity IIASA study.

EXPERIMENT 3: DEPRECIATION OF THE U.S. DOLLAR

The fall in the value of the U.S. dollar is seen by economists as a force to increase U.S. wheat exports. In this section, the WWTM is used to estimate the impact of the depreciation of the dollar on U.S. wheat exports, holding all other forces constant.

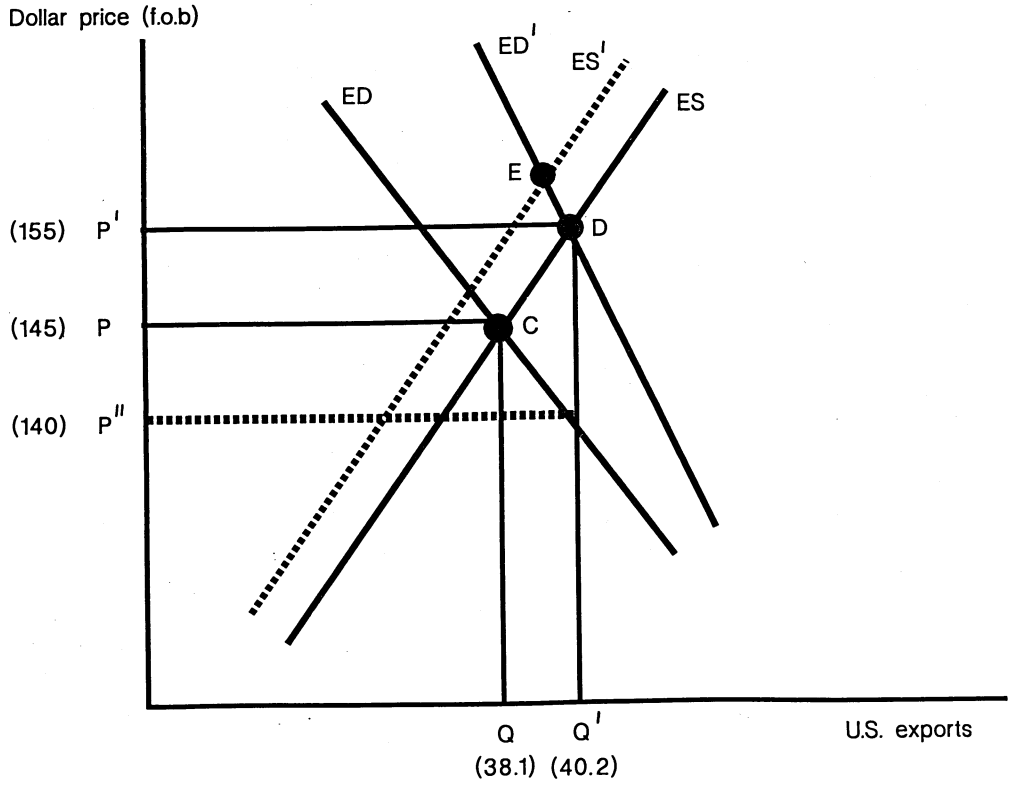
Economic theory implies that depreciation of the dollar should have an impact as shown in figure 4. Assume that the U.S. excess supply function for wheat is represented by ES. Excess supply is the amount available for export after domestic needs are met, over a range of prices. The demand for U.S. wheat exports (the sum of all excess demand functions for all importing countries minus the sum of all excess supply functions for all other exporting countries) is represented by ED. Before depreciation, the wheat market is in equilibrium at C in figure 4, with the United States exporting quantity Q of wheat at price P. Price P represents both the U.S. wheat price (f.o.b.) and the world wheat price in U.S. dollars.

Now assume that the dollar had a one-time decrease in value relative to all other currencies. From the U.S. perspective, the drop in the dollar's value would give the appearance of a shift in the export demand function to ED' (fig 4). The excess demand functions and excess supply functions in other countries would not shift as measured in their own currencies. But since the dollar is now cheaper relative to everyone else's currency, the rest of the world would demand more wheat from the United States for a given dollar price--thus, the shift from ED to ED'. After a new market equilibrium is reached at point D, the United States exports quantity Q' at price P'. As far as the rest of the world is concerned, the price of U.S. wheat fell to P" because after devaluation the dollar is worth less in terms of their local currency. Thus, depreciation of the dollar leads to a higher U.S. export price and an increase in the quantity exported.

There are other adjustments to a depreciated dollar that take place in the U.S. economy that would have an indirect impact on domestic supply and demand, and on ES in figure 4. The most noticeable would be the increased cost of some production inputs. For example, internationally priced inputs such as oil could cost more in the United States following a depreciation of the dollar. The increased production costs would shift the excess supply function in figure 4 from ES to ES'. As a result of this added adjustment, a price-quantity equilibrium would be established at E, implying less expansion in exports but an even higher domestic price than at D.

Figure 4 is a gross simplification of the real world. It implies that there is just one exchange rate and two currencies--the dollar and the currency of

Figure 4
Impact of a Devaluation of the U.S. Dollar on U.S. Wheat Exports



the rest of the world. The WWTM is somewhat more realistic, having 22 regions and having the potential of a multiple of 22 exchange rates. For simplicity, however, all wheat prices in the model are stated in U.S. dollars for the BASE solution and the experiments reported above. To obtain a rough estimate of how U.S. wheat exports might respond to a dollar devaluation, a set of experiments is conducted with the WWTM. First, a uniform 10-percent drop in the dollar against all currencies is examined. This is equivalent to moving from C to D in the simple analysis shown in figure 4. Second, the impact on U.S. exports, taking into account the impact of the depreciated dollar on U.S. production inputs, is examined. Third, the effects on U.S. exports of actual changes in the value of the dollar compared with the currencies of all importing and exporting regions are studied.

Results of a Uniform Devaluation of the U.S. Dollar

Data assembled by ERS, USDA, show that the U.S. dollar peaked in value during the second quarter of 1985 relative to aggregates of currencies of wheat importers and other wheat exporters. By the fourth quarter of 1985, it had depreciated 5.4 percent in real terms against currencies of wheat importers. Against currencies of other wheat exporters, the U.S. dollar fell 5.9 percent during the same period. It continued to drop in 1986. These data suggest that it is reasonable to use the same percentage devaluation of the U.S. dollar against currencies of other exporters and currencies of wheat importers during this time period. For demonstration purposes, a 10-percent devaluation is evaluated.

A new solution is obtained (called 0.9XRATE) after the uniform 10-percent devaluation of the U.S. dollar is added to the model. The difference between the BASE solution and the 0.9XRATE solution gives an estimate of how the world wheat market would adjust to the devaluation. As with the other experiments, it is assumed that nothing else changes from the 1984/85 market conditions modeled in the BASE scenario, and the new equilibrium is achieved after a 3-year period of adjustment.

The comparison of the 0.9XRATE solution with the BASE shows that a 10-percent devaluation of the U.S. dollar expands U.S. exports 5.6 percent (table 13). The results imply an exchange rate-export volume elasticity of -0.56. Devaluation also increases the wheat export price in the United States by nearly 7 percent. Thus, point D in figure 4 represents a price of $155 and exports of 40.2 million tons. The combined affect of the increased volume and increased price causes wheat export sales revenue to increase 13 percent.

The devaluation of the dollar, relative to all other currencies, means that all other countries perceive a lower world wheat price in their own currencies. The impacts of lower prices are shown in the model results.

Importing countries purchase an additional 1.26 million tons of wheat and other exporters reduce wheat sales 0.88 million ton (1.26 plus 0.88 equal 2.14--the increase in U.S. exports). Canada, Argentina, and Australia account for the decrease in exports.

From the U.S. perspective, world wheat prices appear to be higher after the dollar devaluation. For example, the Canadian export price is $164 per ton (in Canadian and U.S. dollars--the exchange rate = 1.0) in the BASE solution, but it increases to $176 (in U.S. dollar units) in the 0.9XRATE solution (table 14). But, with the U.S. dollar depreciating 10 percent relative to the

Canadian dollar, the Canadians witness a drop in the domestic wheat price to $157 in Canadian dollars (Canadian/U.S. exchange rate = 1.11).

The pattern of wheat trade flows in the 0.9XRATE solution (table 14) is about the same as in the BASE solution, except for a major shift from Canada to the United States of the EC-10 import market and a shift from the EC-10 to Canada of the East European import market.

There have been other attempts in the literature to estimate the impact on U.S. wheat exports of a uniform devaluation/appreciation in the value of the

Table 13--Wheat trade by regions, 1984 BASE solution and 0.9XRATE solution to the world wheat trade model

Region	1984 BASE	0.9XRATE	Change	
	1,000 metric tons			Percent
Importing regions:				
Mexico	488	492	4	0.8
Brazil	5,478	5,524	46	.8
Other Latin America	7,044	7,164	120	1.7
EC-10 import	2,283	2,283	0	0
Other Western Europe	1,690	1,690	0	0
Eastern Europe	2,602	2,602	0	0
Soviet Union	28,056	28,342	286	1.0
China	7,528	7,799	271	3.6
Japan	5,722	5,722	0	0
East Asia	6,650	6,771	121	1.8
Southeast Asia	865	898	33	3.8
South Asia	4,847	5,028	181	3.7
West Asia	11,882	11,882	0	0
North Africa	12,684	12,684	0	0
Central Africa	5,642	5,840	198	3.5
South Africa	470	470	0	0
Other	2,627	2,627	0	0
Total	106,558	107,818	1,260	1.2
Exporting regions:				
Canada	19,455	19,069	-386-	2.0
United States	38,085	40,223	2,138	5.6
Argentina	8,038	7,818	-220	-2.7
EC-10	17,500	17,500	0	.0
Australia	15,268	14,996	-272	-1.8
Other	8,212	8,212	0	0
Total	106,558	107,818	1,260	1.2
	Dollars per ton			
U.S. export price	145	155	10	6.9

U.S. dollar. Figueroa obtained U.S. excess demand exchange rate elasticity estimates of about -0.20 for wheat with a 15-region (6 exporters and 9 importers) Armington-type model of the world wheat and corn markets (2). Longmire and Morey, using a two-country model of world wheat trade, show that an across-the-board 10-percent real appreciation of the U.S. dollar results in an exchange rate elasticity (multiplier) of export demand for wheat of -0.67 (9). Krissoff and Morey, in a three-country extension of the same model, obtained an exchange rate elasticity estimate of -0.77 (7). Both these estimates are fairly close to our estimate of -0.56, but much smaller than some other estimates in the literature.

Chambers and Just, using the special drawings rights (SDR) per U.S. dollar as the exchange rate variable, obtained an exchange rate elasticity for wheat

Table 14--0.9XRATE solution: Estimated 1984/85 world wheat trade flows, domestic use, total use, and f.o.b wheat price

Importing regions	Exporting regions						
	Canada	United States	Argentina	EC-10	Australia	Other	Total
			1,000 metric tons				
Mexico	--	433	25	--	--	34	492
Brazil	1,300	13,504	2,440	--	--	434	5,524
Other Latin America	--	6,217	600	--	--	347	7,164
EC-10 import	617	1,666	--	--	--	--	2,283
Other Western Europe	--	--	--	1,690	--	--	1,690
Eastern Europe	1,488	--	--	--	--	1,114	2,602
Soviet Union	6,020	6,000	3,600	8,988	1,800	1,934	28,342
China	2,700	2,926	673	--	1,500	--	7,799
Japan	1,300	3,522	--	--	900	--	5,722
East Asia	--	--	--	--	5,442	1,329	6,771
Southeast Asia	898	--	--	--	--	--	898
South Asia	2,796	--	--	--	2,232	--	5,028
West Asia	900	7,850	300	--	1,260	1,572	11,882
North Africa	950	8,837	--	--	1,500	1,397	12,684
Central Africa	100	--	40	5,649	--	51	5,840
South Africa	--	470	--	--	--	--	470
Other	--	952	140	1,173	362	--	2,627
Total exports	19,069	40,223	7,818	17,500	14,996	8,212	107,818
Domestic use	5,463	31,189	4,517	1/	3,300	1/	1/
Total use 2/	24,532	71,411	12,335	1/	18,296	1/	1/
			U.S. dollars per metric ton				
F.o.b wheat price	176	155	132	141	162	157	156

-- = No trade.
1/ Not estimated by the model.
2/ Production equals total use in the model.

exports of -2.05 (1). Note, however, that apart from the differing time periods, Chambers and Just used a nominal exchange rate index. One would normally expect elasticity estimates based on nominal rates to be higher if the rate of inflation has been relatively lower as has been the case in the United States compared with other industrialized countries. Haley and Krissoff, in a recent study, indicate that the cumulative effect of a 1-percent depreciation in the real value of the U.S. dollar is to expand U.S. wheat exports by 2.45 percent (4). Their implied elasticity (multiplier) is nearly four times our value of -0.56. The primary reason for this difference may be the time period under analysis. Haley and Krissoff use a dynamic, quarterly model for 1973-84 to obtain their estimates. Our estimate is based on a synthetic model that borrows supply and demand parameters estimated over a much longer period of time, including the fixed exchange rate regime. For our one-commodity static model to yield an export demand elasticity of -2.45, the excess supply elasticity of the United States would have to be very high. This would occur if the United States excess supply function is perfectly elastic--the case where the loan rate provides a floor to domestic prices.

Exchange Rates and Production Costs

The impact of the depreciated dollar on U.S. production input prices is examined in this experiment. As was shown in figure 4, a drop in the value of the dollar can cause an increase in the prices of some production inputs and, thus, shift left the U.S. excess supply function. This modification is added to the above model specification to yield a second exchange rate scenario labeled 0.9XRATE2 and represented by point E in figure 4.

Of the total cost of producing wheat in the United States, about $35 per ton account for inputs that are internationally traded--mainly petroleum and petroleum-derivative products. We assumed that the prices of these inputs will increase in (inverse) proportion to the decrease in the value of the dollar. This probably overstates the price adjustment since world petroleum prices are usually quoted in U.S. dollars and, therefore, tend to move in step with the value of the dollar. This assumption, however, will give an upper bound estimate of the shift one could expect in the U.S. excess supply function. A 10-percent devaluation of the U.S. dollar, under the above assumption, would increase wheat input costs $3.50 per ton. A shift of that magnitude in the U.S. supply function was made in the model.

Results in tables 15 and 16 show that the small shift in the U.S. supply function has a small impact on the world wheat market. It causes a 1-percent decrease in U.S. exports and a 1-percent increase in world price--compared with the 0.9XRATE solution. Because of the higher world wheat price, importers decrease wheat purchases by 0.2 million tons and other exporting countries increase their wheat exports by 0.2 million tons (table 16). These changes offset the decrease of 0.4 million tons in U.S. exports. These small numbers represent an upper bound on the shift in the U.S. excess supply function. They suggest that the impact of the change in the dollar exchange rate on the excess supply function is small relative to its impact on exports.

Exchange Rates by Country

The section examines the effect on the model's estimates of U.S. wheat exports and the world market of actual changes in exchanges rates by country for March 1985 and February 1986. March 1985 corresponds to the end of the first

quarter of 1985 when the U.S. dollar reached its peak as measured by trade-weighted indices. February 1986 represent 1 year of change.

Table 17 shows the percentage change in nominal and real exchange rates over the period for selected countries. Note that there are considerable differences among countries in the amount of change in the value of the local currency relative to the U.S. dollar. The dollar appreciated among currencies of Canada, Argentina, and Mexico, and the largest devaluation was relative to the EC-10's European Currency Unit (ECU).

A new solution (XRATE3) is obtained after the currencies of various countries/regions are altered by the E_i index shown in table 18. A comparison of the XRATE3 solution results with the BASE results shows very

Table 15--0.9XRATE2 Solution: Estimated 1984/85 world wheat trade flows, domestic use, total use, and f.o.b. wheat price

Importing regions	Exporting regions						
	Canada	United States	Argentina	EC-10	Australia	Other	Total
			1,000 metric tons				
Mexico	--	432	25	--	--	34	491
Brazil	1,300	1,288	2,494	--	--	434	5,516
Other Latin America	--	6,194	600	--	--	347	7,141
EC-10	888	1,395	--	--	--	--	2,283
Other Western Europe	--	--	--	1,690	--	--	1,690
Eastern Europe	1,443	--	--	45	--	1,114	2,602
Soviet Union	6,000	6,000	3,600	8,969	1,800	1,934	28,303
China	2,700	2,877	673	--	1,500	--	7,750
Japan	1,300	3,522	--	--	900	--	5,722
East Asia	--	--	--	--	5,421	1,329	6,750
Southeast Asia	892	--	--	--	--	--	892
South Asia	2,684	--	--	--	2,314	--	4,998
West Asia	900	7,850	300	--	1,260	1,572	11,882
North Africa	950	8,837	--	--	1,500	1,397	12,684
Central Africa	100	--	40	5,623	--	51	5,814
South Africa	--	470	--	--	--	--	470
Other	--	952	140	1,173	362	--	2,627
Total exports	19,157	3,9817	7,872	17,500	15,057	8,212	107,615
Domestic use	5,450	31,161	4,513	1/	3,300	1/	1/
Total use 2/	24,607	70,978	12,385	1/	18,357	1/	1/
			Dollars per metric ton				
F.o.b. wheat price	178	157	134	142	163	159	157

-- = No trade.
1/ Not estimated by the model.
2/ Production equals total use in the model.

little increase in U.S. exports (table 19). Exports would increase about 1 percent, while the wheat export price would increase slightly more than 1 percent. The combined price and quantity change causes U.S. export revenue to increase by 2.4 percent.

The world wheat market does not change very much in response to changes in the value of the dollar. World wheat trade remains virtually unchanged. Canadian and Argentine wheat exports increase moderately, while Australian exports decline slightly because of the 6-percent appreciation in the value of the

Table 16--0.9XRATE and 0.9XRATE2 solutions to the world wheat trade model by region

Region	0.9XRATE	0.9XRATE2	Change	
	1,000 metric tons			Percent
Importing regions:				
Mexico	492	491	-1	0.2
Brazil	5,524	5,516	-8	-.1
Other Latin America	7,164	7,141	-23	-.3
EC-10 import	2,283	2,283	0	0
Other Western Europe	1,690	1,690	0	0
Eastern Europe	2,602	2,602	0	0
Soviet Union	28,342	28,303	-39	-.1
China	7,799	7,750	-49	-.6
Japan	5,722	5,722	0	0
East Asia	6,771	6,750	-21	-.3
Southeast Asia	898	892	-6	-.7
South Asia	5,028	4,998	-30	-.6
West Asia	11,882	11,882	0	0
North Africa	12,684	12,684	0	0
Central Africa	5,840	5,814	-26	-.4
South Africa	470	470	0	0
Other	2,627	2,627	0	0
Total	107,818	107,615	-203	-.2
Exporting region:				
Canada	19,069	19,157	88	.5
United States	40,223	39,817	-406	-1.0
Argentina	7,818	7,872	54	.7
EC-10	17,500	17,500	0	0
Australia	14,996	15,057	61	.4
Other	8,212	8,212	0	0
Total	107,818	107,615	-203	-.2
	Dollars per ton			
U.S. export price	155	157	2	1.3

Australian dollar. EC-10 exports do not fall despite a 46-percent appreciation in the value of the ECU relative to the U.S. dollar. The EC-10 is assumed to maintain the CAP and export a fixed quantity of wheat irrespective of market conditions. Among importers, Mexico reduces its imports by nearly 6 percent, while South Asia and Central Africa increase their wheat imports by 9 and 3 percent, respectively.

Trade flow patterns also remain much the same. The only significant change is that South America reduces its imports from Australia and substitutes it for imports from Canada.

These results suggest that the 1985-86 change in the value of other countries' currencies relative to the U.S. dollar would have a very small impact upon U.S. exports. This prediction of a small shift in exports can be attributed to a number of factors. For one, the U.S. dollar has remained largely unchanged or appreciated slightly with respect to currencies of most other exporters. Second, the largest devaluation has been with respect to the EC-10's ECU, but the export policies of the EC-10 ensure that it maintains a fixed volume of wheat exports. The U.S. wheat market cannot, therefore, reap

Table 17--Nominal and real exchange rates, March 1985 and February 1986 1/ 2/

Country	Nominal exchange rate			Real exchange rate			Model index
	March 1985	February 1986	Change	March 1985	February 1986	Change	
Canada	0.7246	0.7143	-1.43	0.7925	0.7880	-0.6	0.99
Australia	.6944	.6993	.70	.7799	.8262	5.9	1.06
Argentina	.0033	.0012	-61.74	1.8753	1.8587	-.9	.99
EC-10 3/	.6667	.9709	45.63	.8039	1.1705	45.6	1.46
Japan	.0039	.0054	40.07	.0034	.0047	38.8	1.39
China	--	--	--	--	--	--	1.00
Soviet Union	--	--	--	--	--	--	1.00
Spain	.0055	.0068	24.69	.0074	.0097	31.9	1.32
Portugal	.0055	.0066	19.02	.0119	.0151	26.8	1.27
Venezuela	.1333	.1333	0.00	.1720	.1779	3.4	1.03
Egypt	1.4286	1.4286	0.00	2.0765	2.1880	5.4	1.05
Iran	.0104	.0122	16.90	.0170	.0198	16.7	1.17
India	.0772	.0808	4.77	.0898	.1006	12.0	1.12
Bangladesh	.0377	.0329	-12.71	.0464	.0466	.5	1.00
Indonesia	.0009	.0009	-2.55	.0011	.0011	.3	1.00
Brazil	.0002	.0001	-68.18	.0122	.0122	.2	1.00
Mexico	.0049	.0025	-49.18	.0357	.0272	-23.8	.76
France	.0989	.1397	41.20	.1193	.1684	41.2	1.41
West Germany	.3021	.4292	42.06	.2827	.3920	38.7	1.39
South Africa	.5025	.4808	-4.33	.7141	.7577	6.1	1.06
Kenya	.0606	.0620	2.17	.0875	.0917	4.8	1.05
United States	1.0000	1.0000	0	1.0000	1.0000	0	1.00

-- = Not applicable.
1/ Nominal exchange rate = U.S. dollar per foreign currency unit.
2/ Real exchange rate = (nominal exchage rate)*(CPI U.S./CPI foreign).
3/ Real exchange rate for EC-10 based on CPI for France.

any benefits from the devaluation. Finally, two major importers--the Soviet Union and China--had no changes in exchange rates.

CONCLUSIONS

In this report, three forces are examined that could lead to expanded U.S. wheat exports: (1) a lower wheat price support; (2) liberalization of wheat trade by the EC, Japan, and the United States; and (3) devaluation of the U.S. dollar. Estimates of the possible export response to each of these forces are obtained from three experiments using a static, spatial equilibrium WWTM.

Many assumptions have to be made to reduce complex world wheat trade to a rather simple model. The model results, however, give indications of the changes in U.S. wheat exports that might be associated with each of the three forces.

The model is designed to represent the 1984/85 world wheat market. The following question is asked of the model, "What would have happened under 1984/85 conditions if a specific change had been made?" The answer is obtained by comparing two solutions of the model; the BASE solution, which

Table 18--Exchange rate index and representative countries

Country or region	Ei	Countries used to calculate Ei
Importing regions:		
Mexico	0.76	Mexico
Brazil	1.00	Brazil
Other Latin America	1.03	Venezuela
Other Western Europe	1.46	EC-10 (ECU) 1/
Eastern Europe	1.30	Portugal
Soviet Union	1.00	--
China	1.00	--
Japan	1.39	--
East Asia	1.00	Japan
Southeast Asia	1.00	Indonesia
Asia	1.12	--
West Asia	1.17	India, Bangladesh
North Africa	1.05	Iran
Central Africa	1.05	Egypt
South Africa	1.05	Kenya
Other	1.00	--
Exporting regions:		
Canada	.99	Canada
United States	1.00	United States
Argentina	.99	Argentina
EC-10	1.46	EC-10 (ECU) 1/
Australia	1.06	Australia
Other	1.00	--

-- = Not applicable.
1/ ECU = European Currency Unit

describes as closely as possible actual wheat trade in 1984/85, and an alternative solution obtained after the model is modified to represent the change being analyzed. Differences between the two solutions are assumed to take place over a 3-year adjustment period.

The first experiment examines the impact on global trade of a drop in the U.S. loan rate. The emphasis is on how the rest of the world would adjust trade to a 25-percent decrease in the U.S. export price of wheat. Major assumptions behind this analysis are: (1) a 25-percent drop in the loan rate (as occurred between 1985 and 1986) leads to a 25-percent drop in both the U.S. export

Table 19--Wheat trade by regions, 1984 BASE solution and 0.9XRATE3 solution to the world wheat trade model.

Region	1984 BASE	0.9XRATE3	Change	
	1,000 metric tons			Percent
Importing regions:				
Mexico	488	461	-27	-5.5
Brazil	5,478	5,466	-12	-.2
Other Latin America	7,044	7,096	52	.7
EC-10 import	2,283	2,283	0	0
Other Western Europe	1,690	1,690	0	0
Eastern Europe	2,602	2,602	0	0
Soviet Union	28,056	27,978	-78	-.3
China	7,528	7,462	-66	.9
Japan	5,722	5,722	0	0
East Asia	6,650	6,621	-29	-.4
Southeast Asia	865	858	-7	-.8
South Asia	4,847	5,262	415	8.6
West Asia	11,882	11,882	0	0.
North Africa	12,684	12,684	0	0.
Central Africa	5,642	5,816	174	3.1
South Africa	470	470	0	0.
Other	2,627	2,627	0	0.
Total	106,558	106,980	422	.4
Exporting regions:				
Canada	19,455	19,689	234	1.2
United States	38,085	38,464	379	1.0
Argentina	8,038	8,178	140	1.7
EC-10	17,500	17,500	0	0
Australia	15,268	14,937	-331	-2.2
Other	8,212	8,212	0	0
Total	106,558	106,980	422	.4
	Dollars per ton			
U.S. export price	145	147	2	1.4

price and the world price levels, (2) the United States can expand exports to meet global needs at the lower price by depleting stocks or by diverting less land from production, and (3) other countries do not change their policies in retaliation.

Results suggest that after about 3 years of adjustment, the lower U.S. loan rate and associated lower world price level would enable U.S. wheat exports to expand about 37 percent. Thus, the price elasticity of demand for U.S. wheat exports is about -1.1 over a 3-year period of adjustment. Global wheat imports would increase 7 percent with the additional amount being purchased mainly by the Soviet Union, China, the rest of Asia, and Central Africa. Wheat exports by Argentina, Australia, and Canada would decrease 15 percent, while there would be no change in EC-10 exports.

In the second experiment, Japan, the United States, and the EC-10 are assumed to eliminate their domestic and trade policies for wheat. This experiment is difficult to handle with a one-commodity model since the results depend upon policy changes that also take place with the other commodities and in other countries. The results for wheat, however, provide a rough approximation of what world trade would look like with no domestic protection for wheat in these three major regions.

Results show that Japanese imports would modestly increase (8 percent), but EC-10 exports would greatly decrease (90 percent). U.S. exports would increase by 30 percent. Additional U.S. exports would come from added production from land normally idled by Government wheat programs. The above shifts among exporters would be just about offsetting -- there would be very little change in total world wheat trade, and world wheat prices would increase only about 5 percent. Thus, there would be very little impact on other countries. Sensitivity analysis shows that these results are sensitive to the elasticities of supply and demand used for the EC-10, and to the assumed impact of U.S. policies on U.S. wheat production.

The third set of experiments look at the wheat trade impact of a devalued U.S. dollar. First, a uniform 10-percent devaluation relative to all other currencies is examined. Model results suggest that after the world had about 3 years to adjust to the devaluation, U.S. wheat exports would increase between 5 and 6 percent.

The actual change in exchange rates of various currencies relative to the dollar, between March 1985 and February 1986, was put into the model. This was a period of substantial devaluation of the U.S. dollar relative to European and Japanese currencies. The results showed, however, that U.S. wheat exports would increase less than 1 percent in response to these adjustments in exchange rates. This prediction of a small shift in exports is due to (1) countries such as Japan and the EC-10--whose currencies significantly depreciated relative to the U.S. dollar--do not adjust wheat trade to world price changes, (2) the Soviet Union and China--large importers--had no change in exchange rates, and (3) other exporters had little real change in exchange rates relative to the U.S. dollar. This last experiment shows the importance of identifying, country-by-country, where the dollar is changing in value. Aggregate indices of the value of the dollar can give a misleading indication of expected trade impacts.

The above results are first approximations using a simple single-commodity model. Reliability of the results could be improved by using a two- or three-

or n-commodity model that dealt with the close substitution between wheat and other commodities in both production and consumption. Further, the issues discussed in this report are not unique to wheat; they simultaneously affect many commodities. Research is needed to build one or more multicommodity trade models that can adequately handle commodity interaction, while remaining relatively simple and easy to use.

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