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INTERNATIONAL TRADE IN FEED GRAINS--1980

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This is a report of preliminary results of a research effort to determine the prospective 1980 world feed grain economy. Since the study has not yet been completed, additional information which may shed further light on the validity or interpretation of existing results will be forthcoming in the next year.

The objective of the study is threefold. First, the world production-consumption situation in 1980 is investigated. The principal purpose is to determine whether a world surplus or deficit of feed grains is likely to exist assuming no change in the present economic conditions (prices of feed grains and related commodities, trade and domestic policies). Then if either a surplus or deficit is expected under existing conditions, an assessment is made of changes likely to occur (with respect to prices, production and consumption in each country) to bring about an equilibrium situation. Second, the study attempts to determine the effect upon U. S. production, consumption, and prices of feed grains resulting from possible changes in domestic and trade policies by other nations. Third, some policy recommendations with respect to United States domestic and foreign agricultural policy will be made as a result of the analysis. Since the study has not been completed, only findings relevant to the first two objectives will be reported here.

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Feed grains are considered to be a single commodity--corn, barley, oats, and sorghum are aggregated on a weight basis. The average annual price of the aggregate commodity in each country is synthesized by weighting the price of each of the four individual grains by the proportion they make up of total production.

For the purpose of this study, the world is divided into several regions. Individual attention is given to those countries which are major importers or exporters of feed grains. Among the latter, the United States with approximately 50% of total world exports is the most important. Argentina, with about one-fourth of total exports, is second. South Africa and Canada rank third and fourth, respectively. Each of these four countries is considered on an individual basis. In total, they account for approximately 85% of total world feed grain exports.

Looking at importers, the European Economic Community (E.E.C.) accounts for about 40% of total world imports, the United Kingdom approximately 20%, and Japan nearly 10%. These three geographic units are also considered individually.

Individual demand and supply equations were estimated by regression analysis of time series data for each of the seven regions. Quantity of feed grains demanded was assumed to be a function of the price of feed grains, the number of animal units, and time, the latter to represent trends in feed conversion ratios, quality of livestock, etc. Price elasticities of supply ranged from about .25 for Argentina and South Africa to around .5 for the United States, Canada, and the E.E.C. to approximately 1.00 for the United Kingdom and Japan.

These equations, estimated from 1950-63 data, were used to represent 1980 by projecting the two independent variables--number of animal units and time--to 1980. The 1980 demand equations for feed grains are then a function solely of feed grain price.

Supply functions for the seven regions were obtained as follows: An equation representing the number of hectares harvested was first estimated for each region using 1950-63 time series data. The number of hectares was considered to be a function of the price of feed grains, the price of the most relevant substitute in production (this was wheat in most countries; however, because of wheat acreage restrictions in the United States, the relevant substitute was assumed to be soybeans), and in some cases time. Since the distributed lag technique was used, both short-run and long-run hectare price elasticities were obtained. The short-run elasticities ranged from .32 to .45, except for the United States (.57), Argentina (.26), and Japan (.01). Long-run elasticities were estimated to be 1.20 for the United States and Canada, .90 for the United Kingdom, about .60 for South Africa and the E.E.C., .26 for Argentina and .12 for Japan.

These hectare equations were then modified for 1980 by projecting any trend in the number of hectares planted to both feed grains and its closest substitute. Such an adjustment is necessary to capture the trend, if any, in total cropland available and in the relative competitive position of feed grains and its nearest substitute with all other crops. Since the estimated equations allow for substitution among feed grains and its nearest competitor, the trend in total hectares for both were projected as an aggregate.

Equations representing yield per hectare were also estimated for each of the seven regions. After experimenting with a good many variables, yield was finally estimated to be solely a function of time. Using data for the fourteen year period 1950-63, yields were projected to 1980. The largest increase in yield, 61% from 1963 to 1980, is expected to occur in South Africa, and the smallest increase, 5%, in Japan. Yields are estimated to increase 49% in the U.S. and 46% in the E.E.C.

The supply functions for 1980 for each of these seven regions were then obtained by multiplying the 1980 hectare equation by the 1980 yield projections.

The remainder of the world was divided into regions and net import-export gaps were projected to 1980. The regions and assumed net exports are as follows:

Other Western Europe	-3.2 million metric tons
E. Eruope and U.S.S.R.	+2.4 million metric tons
Other Latin America	-1.3 million metric tons
Other Africa	-o.1 million metric tons
Oceania	+1.5 million metric tons
Other Asia	+0.7 million metric tons

Since transportation costs are a significant factor in international trade, costs of transferring feed grains between countries were estimated. Inland transportation costs, loading and unloading expenses, and inspection fees, as well as port-to-port ocean costs were considered.

Lastly, existing domestic and trade policies were studied in each of the major importing and exporting countries of the world, and consideration was given to changes that might occur in the future.

All of this information--demand and supply equations for the seven primary regions, net import-export gaps for the other regions, transportation costs, and domestic and foreign trade policies--was incorporated in a spatial equilibrium model. 1/ The model determined 1980 equilibrium quantities producted and consumed, equilibrium prices, and

1/ For a description and demonstration of this model, see D. Lee Bawden, "A Spatial Price Equilibrium Model of International Trade," Journal of Farm Economics, November 1966, pp. 862-874.

the resulting amount and direction of trade flows among all regions. Solutions were obtained for a variety of situations, and it is to these that we now turn.

Equilibrium Solutions

One solution was obtained assuming that the domestic and foreign trade policies of all countries except the United States would remain the same in 1980 as they are now. No price supports or acreage restrictions were assumed for the United States; hence U.S. prices and production could respond to the equilibrium world market. Shipments by the U.S. under PL 480 were assumed to be the same percentage of total exports in 1980 as they have been in the past. Destinations were also considered to be the same except that PL 480 shipments to Western Europe were eliminated and this amount divided among the other recipients.

This solution is shown, along with actual 1963-64 figures, in Table I. The equilibirium price in the United States is nearly six dollars a ton less than in 1963-64. This is a decrease of approximately twelve cents a bushel. U.S. production has increased 9% and U.S. exports are predicted to increase 50% under these conditions. Notice that the E.E.C., under its high threshold price of $89.60 a ton (the prices in parentheses shown for the E.E.C. and Japan are port prices), is expected to increase production by some 70%, causing a decline in its imports of about 17%. However, United Kingdom imports are predicted to increase a whopping 175%, and Japanese imports will increase nearly 30%.

It is interesting to note that while U.S. production is predicted here to increase some 9%, it is expected that this amount of feed grains can be grown on 24% less acreage than at the present time. This is due to an expected increase in yield of nearly 50% by 1980 (or an average annual increase of almost 2½ percent).

Table II is a summary of an equilibrium solution deried under the assumption that there would be a free international trade and no domestic price or acreage programs by any nation in 1980. U.S. production is shown to be 176.6 million metric tons, or an increase of some 18% from the level of 1963-64. This is the highest U.S. production figure under any of the solutions obtained to date. Yet, it is estimated that this amount of feed grains can be produced on 18% fewer acres than devoted to feed grains at the present time.

It is significant that the U.S. price under the free trade situation is almost exactly the present support price, $41.50 vs. $41.34 (These being weighted averages of all four feed grains). Under free trade, U.S. exports are estimated to increase nearly 150%, with E.E.C. imports up 130% (as opposed to down 17% under existing policies), U.K. imports up 160%, and Japanese imports up about 60%.

TABLE I

A Comparison of Actual 1963/64 Crop Year and 1980 Predicted Feed Grain Prices, Production, Consumption and Net Exports Assuming All National Trade Policies For 1980 the Same as in 1963/64 Except No Support Prices or Acreage Controls in the U.S.

Region	PRICES		PRODUCTION		CONSUMPTION		NET EXPORTS	
	1963/64 Actual	1980 Predicted	1963/64 Actual	1980 Predicted	1963/64 Actual	1980 Predicted	1963/64 Actual	1980 Predicted
	U.S. dollars per metric ton		1000 metric tons		1000 metric tons		1000 metric tons	
United States	43.22	38.33	149,949	163,752	133,526	139,491	16,419	24,261
Canada	46.14	49.16	13,771	16,302	13,286	16,302	489	0
Argentina	44.79	42.50	7,111	11,227	3,390	9,403	3,721	1,824
South Africa	47.71	46.61	4,817	9,758	2,347	7,166	2,470	2,591
E.E.C.	74.38	89.60 (58.75)	29,859	51,323	39,673	59,426	-9,814	-8,103
United Kingdom	72.57	64.33	8,286	13,601	11,906	23,368	-3,620	-9,768
Japan	122.14	105.05 (62.63)	2,331	1,662	6,456	7,616	-4,625	-5,953
Other W. Europe	-	-	-	-	-	-	-1,555	-3,200
E. Europe & U.S.S.R.	-	-	-	-	-	-	- 613	-2,400
Other Asia	-	-	-	-	-	-	386	670
Other Africa	-	-	-	-	-	-	- 685	- 128
Other Latin Amer.	-	-	-	-	-	-	- 78	-1,270
Oceania	-	-	-	-	-	-	621	1,475

TABLE II

A Comparison of Actual 1963/64 Crop Year and 1980 Predicted Feed Grain Prices, Production, Consumption and Net Exports Under a System of International Free Trade

Region	PRICES		PRODUCTION		CONSUMPTION		NET EXPORTS	
	1963/64 Actual	1980 Predicted	1963/64 Actual	1980 Predicted	1963/64 Actual	1980 Predicted	1963/64 Actual	1980 Predicted
	U.S. dollars per metric ton		1000 metric tons		1000 metric tons		1000 metric tons	
United States	43.22	41.15	149,949	176,610	133,526	136,663	16,419	39,947
Canada	46.14	49.16	13,771	16,302	13,286	16,302	489	0
Argentina	44.79	45.32	7,111	11,382	3,390	9,340	3,721	2,042
South Africa	47.71	49.43	4,817	10,061	2,347	7,122	2,470	2,938
E.E.C.	74.38	61.57	29,859	40,678	39,673	64,138	-9,814	-23,460
United Kingdom	72.57	65.58	8,286	13,957	11,906	23,180	-3,620	- 9,224
Japan	122.14	65.45	2,331	1,585	6,456	8,976	-4,625	- 7,351
Other W. Europe	-	-	-	-	-	-	-1,555	- 3,200
E. Europe & U.S.S.R.	-	-	-	-	-	-	- 613	- 2,400
Other Asia	-	-	-	-	-	-	386	670
Other Africa	-	-	-	-	-	-	- 685	- 128
Other Latin Amer.	-	-	-	-	-	-	- 78	- 1,270
Oceania	-	-	-	-	-	-	621	1,475

It is evident that a movement toward free international trade in feed grains would be of considerable genefit to the United States. Production would increase substantially and the free market price would approximate the present support level; hence exports would not have to be subsidized. Presumably both taxpayers and feed grain producers in the U.S. would be better off, while feed grain users in the U.S. would be no worse off.

Table III summarizes, for the United States only, the effects of specific changes in domestic and foreign trade policies by individual countries. Alternatives 1 and 2 are those just discussed. Alternative 3 is the same as Alternative 1 expect that the present U.S price support policy is assumed to remain in existence. Payments made to U.S producers for acreage diversion are not included, however. U.S. production is considerably higher here than under Alternative 1. The support price of $41.34 a ton has brought forth a U.S. production so large that the U.S. taxpayer would have to subsidize exports some 60% in order to sell the domestic surplus of production over consumption. This of course substantially depresses the world feed grain price.

One might tentatively conclude from this that if policies of other nations remain the same, the United States will not be able to maintain its present support price unless very severe acreage controls are imposed, or exports are subsidized substantially, or large feed grain stocks are accepted.

Alternative 4 assumes that the Japanese abandon their present price support on feed grains. Under this condition the Japanese price drops from $105 a ton to a market price of $62.85 a ton. U.S. exports to Japan increase some 50% over Alternative 1; however, total U.S. exports rise only 6% and U.S. production increases less than 1%. U.S. price rises slightly, approximately one-half cent per bushel.

Alternative 5 assumes that the United Kingdom, which now has an ad valorum duty of approximately 2½% on feed grains (it actually has no import duty on some and 10% on others, averaging out to be about 2½%) imposes an ad valorum import duty of 20%. In this case U.S. exports decline approximately 6% as compared to Alternative 1, U.S. production decreases a little less than 1%, and the U.S. price drops about one-half cent per bushel.

Alternatives 6 and 7 assume two different target prices (or threshold prices) in the E.E.C. The first, $83 a ton, approximates the French price; the second, $103 a ton, approximates the German price. A comparison of these solutions with Alternative 1 indicates what might have happened had the E.E.C. adopted these price levels rather than the one they chose.

Had the French price of approximately $83 per ton been selected as the target price by the E.E.C., it is estimated that U.S. production in 1980 would be nearly 2% higher than under the existing E.E.C. target

TABLE III

United States Production, Consumption, Net Exports, Prices and Producer Income in 1980 Under Alternative Policies

POLICY ALTERNATIVE	PRODUCTION	CONSUMPTION	NET EXPORTS	PRICE	PRODUCER INCOME
	1000 metric tons			$/m.t.	$1000
1. All Policies Except U.S. Price Support and Acreage Restrictions	163,752	139,491	24,261	38.33	6,276,614
2. Free International Trade	176,610	136,663	39,947	41.15	7,267,502
3. Trade With Existing National Policies	174,822	136,474	38,348	41.34[1/]	7,228,042[2/]
4. Same as (1) But No Japanese Price Support	164,956	139,267	25,689	38.54	6,357,404
5. Same as (1) But U.K. Ad Valorem Duty = 20%	162,426	139,734	22,692	38.08	6,185,182
6. Same as (1) But EEC Target Price = $83.00/Ton	166,266	139,033	27,233	38.78	6,292,675
7. Same as (1) But EEC Target Price = $103/Ton	158,720	140,425	18,295	37.39	5,934,541
8. Same as (1) But U.K. is Part of the EEC	157,908	140,559	17,349	37.26	5,883,652
9. Same as (1) But U.S. Ocean Costs 50% Higher	162,124	139,791	22,333	38.03	6,165,576

1/ The U.S. export price is $16.85 plus transportation costs.

2/ The U.S. subsidy amounts to $770,430,000.00, or about 10% of gross income.

price. U.S. price would be about 1¼ cents a bushel higher and total U.S. exports would be up some 12%. On the other hand, if the German price had been selected, U.S. production in 1980 would be 3% less than under the present E.E.C. target price, U.S. price would be down 2½ cents a bushel and U.S. exports down nearly 20%. Contrary to some studies done in the past, this indicates that the selection of a target price by the E.E.C. was of considerable significance to the United States since its level would have a substantial effect upon U.S. production, prices, and exports.

Alternative 8 considers the United Kingdom to be a part of the E.E.C. Such a merger is predicted to have the following effect upon the United States: U.S. production would drop almost 4% in comparison with Alternative 1, U.S. prices would decline nearly 2½ cents a bushel, and U.S. exports would fall almost 30%. Such dramatic changes occur because the U.K. would replace its present low barriers to feed grain imports with the relatively high ones maintained by the E.E.C.

Of those alternatives considered and summarized in Table III, U.S. production is at its lowest under this alternative. Inasmuch as it is believed that the U.K. will eventually become a member of the E.E.C., it would perhaps behoove the feed grain industry to look more closely into the probable effects of such a merger, for these tentative solutions indicate that they might be substantial.

The last alternative involves shipping rates for U.S. exports. PL 480 shipments must now be carried by U.S. bottoms. U.S. shipping rates are at least 50% higher on the average than those of ships under other flags. Alternative 9 explores the possibility that all U.S. exports must be shipped at rates 50% above those considered in the previous alternatives. Such a policy would reduce U.S. exports by nearly 10% and would decrease U.S. production by 1½%.

Concluding Remarks

These results are preliminary. Evidence to date indicates that our estimates of total world feed grain consumption might be understated since the trend in animal units was merely extrapoliated to 1980. Dramatic increases in world population, rising per capita incomes, and an income elasticity of demand for meat greater than 1 are likely to cause the demand for meat animals to increase at an increasing rate.

To the extent that published production, consumption and price data in some countries do not reflect actual figures, some bias is expected in the demand and supply equations estimated from these data. Also, the net import and export gaps for those regions not considered individually are made under rather restrictive assumptions. These, along with several other assumptions, will be changed in future runs of the model to assess the sensitivity of the solutions to alternative assumptions.

This study is also limited in that it is made independently of commodities related to feed grains in demand and supply. For example, the interaction of feed grain production with wheat production is extremely important, and any complete study should encompass both commodities. A judgment on the desirability of a particular policy whose direct effect is on feed grains might well be different when its secondary effects on wheat (or soybeans) is also accounted for. Studies of international trade in wheat and beef, similar to the feed grain study discussed here, are now underway and will be completed sometime very soon. During the next year these three studies will be merged in order to better assess the effects of specific changes in policies upon each of these three commodities.

While the results of our study are preliminary, perhaps three tentative conclusions can be drawn from them. First, unless there is a substantial increase in PL 480 feed grain exports, it appears the U.S. will require less acreage to produce feed grains in 1980 than it is using at the present time. This despite the fact that U.S exports are predicted to increase some 50% over the next 15 years.

The second conclusion is that the United Kingdom's entry into the E.E.C. is likely to have a very significant effect upon the U.S. feed grain economy.

Last is the conclusion that unless large amounts of land presently used for feed grain production are diverted to other uses, the United States cannot maintain its present domestic price support policy without either accruing substantial stock of feed grains or subsidizing exports considerably more than it has in the past.