Growth in World Grain and Soybean Trade and the Importance of State Trading Countries

By Martin E. Abel and Mary Smaciarz*

WORLD TRADE in grains, soybeans, and soybean products grew rapidly during the 1960s and 1970s. In recent years, the importance of trade has also grown in countries having state trading systems. Government agencies having state trading systems can provide monopoly positions; however, U.S. export sales are made by private firms. Therefore the question is raised: Can the United States compete with state trading agencies?

This issue of *Minnesota Agricultural Economist* examines the growth of world trade in grains and soybeans during 1958-72 as well as the changing importance of nations having state trading systems. Whether or not the United States should consider changing its export system in response to the changing importance of state trading nations will not be answered here. Nevertheless, a better understanding of the relative and absolute importance of nations with state trading systems can provide a better perspective on the importance of this issue.

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Exports of Minnesota Soybeans

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MINNESOTA PRODUCES about 100 million bushels of soybeans annually which, in recent years, have earned $500 million for growers. Soybean sales account for one-fourth of all cash receipts that Minnesota farmers receive from crop sales. These figures indicate soybeans' significance to Minnesota's agricultural economy.

Nearly half of Minnesota's soybeans go overseas. Therefore, strong international markets are crucial to the state's soybean industry. Anything that stimulates soybean exports benefits Minnesota soybean producers; conversely, factors inhibiting trade are detrimental.

This issue of *Minnesota Agricultural Economist* reports research conducted at the University of Minnesota about soybean exports.[1]

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Growth (continued from page 1)

Changes in world trade

World trade in wheat (table 1) increased at a fairly rapid rate between 1958 and 1972.[1] Exports increased by 70 percent, from 29.3 to 49.7 million metric tons. The average annual rate of growth was 5 percent. Imports increased by 77 percent—from 28.1 to 49.6 million metric tons—during that same time.

Coarse grain[2] trade followed a similar pattern, but the growth rate was higher than for wheat. Exports went up from 15.4 to 39.4 million tons—an increase of 156 percent. Imports went from 14.7 to 38.9 million tons—an increase of 164 percent. The annual average rates of growth for exports and imports are both about 11 percent.

Of the three groups of commodities, soybeans and soybean products[3] increased most rapidly in world trade. Total figures for soybean trade are notably smaller than are those for wheat and coarse grain, but growth in world trade has been appreciable. Total world exports in 1958 were 4.2 million tons. They increased by 357 percent to 19.2 million tons in 1972. Total imports increased by 348 percent, from 4 to 17.9 million tons. World trade in soybeans and products grew by about 25 percent per year.

Trade among nations

Data in table 2 show that the composition of trade among nations has changed over these 14 years. Positive numbers indicate net exports, and negative numbers represent net imports. Some countries that were once large exporters have become importers, and some importers have become exporters.

Wheat

Several notable changes have occurred in the composition of world wheat trade. The developed countries, as a whole, increased net exports by about 270 percent from the late 1950s to the early 1970s.

[1] The data presented are 3-year averages; one for 1957-59, referred to as 1958; and the other for 1971-73, referred to as 1972.
[2] Contains corn, barley, oats, and rye.
[3] Soybeans, soybean oil, and soybean meal.

Table 1. World trade in wheat, coarse grains, and soybeans and soybean products, 1957-59 and 1971-73 averages

	Wheat		Coarse grains		Soybeans and products	
	1957-59	1971-73	1957-59	1971-73	1957-59	1071-73
	Million metric tons					
Total exports[2]	29.3	49.7	15.4	39.4	4.2	19.2
Total imports[2]	28.1	49.6	14.7	38.9	4.0	17.9

[1] Bean Equivalent.
[2] Exports do not equal imports because of products in shipment, rounding errors, and omissions in reporting.

The U.S. share of world exports increased from 41 to 53 percent; Australia's share of world trade increased at an even faster rate, from 6 to nearly 16 percent; and Canada's share of world exports remained constant between 1958 and 1972 at about 27 percent. Together, these three countries accounted for 96 percent of 1972 world wheat exports.

Noticeable changes also occurred among the developed wheat-importing countries. The European Economic Community (EEC-9)[4] decreased its level of imports from 7.3 to 1.8 million metric tons, and its share of total world imports went from 26 to 4 percent. The EEC-9 became nearly self-sufficient in wheat during the years 1958-72. This was because of policies that encouraged domestic production and the reduction of imports. On the other hand, Japan's imports grew from 2.4 to 5.1 million metric tons, with its relative importance in total world imports increasing slightly from 8 to 10 percent. For its wheat, Japan relies almost exclusively on imports.

The Centrally Planned Countries as a group became major importers of wheat between 1958 and 1972. The most dramatic changes within this group of countries is represented by the Soviet Union and China. In 1958, the Soviet Union exported about 4.9 million metric tons of wheat or about 17 percent of total world exports. In 1972, it

[4] Includes Belgium, Luxembourg, France, West Germany, Italy, the Netherlands, Denmark, Ireland, and the United Kingdom.

became an importer, accounting for 2.9 million metric tons—about 6 percent of total world imports. The changed trading position of the Soviet Union reflects, in part, a policy shift toward increasing domestic food consumption and greater reliance on imports to accomplish it.

The changing position of China is even more dramatic, going from virtually no trade in wheat in 1958 to imports of 5.2 million metric tons, or 11 percent of world imports, in 1972.

There was a modest decline in wheat imports by Eastern Europe and a sharp decline in its relative position in world trade.

The Developing Countries have also increased their imports of wheat at a rapid rate, from 9.2 to 26.8 million metric tons between 1958 and 1972. Argentina, the one major wheat exporter among the Developing Countries, had a decline in exports—from 2.4 to 2 million metric tons.

Coarse grains

During those 14 years there has been a significant change in country or regional composition of coarse grain trade. As a group, the Developed Countries were sizeable importers in 1958, but grew to be very large exporters by 1972. The Centrally Planned Countries moved in just the opposite way, changing from rather small exporters to very large importers. The Developing Countries increased their exports slightly over these years, but many changes within this grouping were concealed by the aggregate movement.

The United States is largely responsible for the Developed Countries' shift from importers to

Table 2. Net exports of wheat, coarse grains, and soybeans and soybean products and percent of world trade, by region, 1957-59 and 1971-73 averages

	Wheat				Coarse grains				Soybeans and products[3]			
	1957-59		1971-73		1957-59		1971-73		1957-59		1971-73	
	M.M.T.[1][2]	Percent	M.M.T.[1][2]	Percent	M.M.T.[1][2]	Percent	M.M.T.[1][2]	Percent	M.M.T.[1][2]	Percent	M.M.T.[1][2]	Percent
Developed	10.928		40.169		—2.803		7.363		.184		1.849	
U.S.A.	12.033	41	26.192	53	6.917	45	24.632	63	3.045	73	16.886	88
Canada	7.980	27	13.656	28	1.563	10	3.837	10	—.252	—6	—.381	—2
EEC-9	—7.322	—26	—1.760	—4	—9.738	—66	—12.554	—32	—1.462	—36	—9.223	—52
Other West Europe	—1.200	—4	—.661	—1	—1.830	—12	—4.492	—12	—.275	—7	—1.862	—10
South Africa	—.122	—	.090	—	.836	5	2.027	5	—	—	—.007	—
Japan	—2.380	—8	—5.093	—10	—1.383	—9	—7.672	—20	—.881	—22	—3.529	—20
Australia/ New Zealand	1.939	7	7.745	16	.805	5	1.585	4	—.001	—	—.035	—
Centrally planned	—.474		—13.214		.531		—10.168		.294		—1.360	
East Europe	—5.345	—19	—4.154	—8	—.727	—5	—3.108	—8	—.222	—6	—.755	—4
Soviet Union	4.897	17	—2.933	—6	1.183	8	—4.841	—12	—.565	—14	—.321	—2
China	.001	—	—5.214	—11	.047	—	—2.162	—6	1.081	26	—.280	—2
Other Asia	—.027	—	—.913	—2	.028	—	—.007	—	—	—	—.004	—
Developing	—9.243		—26.827		2.926		3.245		—.296		.902	
Mexico	—.001	—	—.475	—1	—.596	—4	—.231	—1	—.007	—	—.049	—
Central America and Caribbean	—.804	—3	—1.861	—4	—.040	—	—.509	—1	—.010	—	—.147	—1
Argentina	2.419	8	1.979	—4	2.644	17	5.256	13	—	—	—.001	—
Brazil	—1.617	—6	—2.189	—4	—.079	—1	.439	1	.031	1	2.357	12
Other South America	—.901	—3	—2.809	—6	.315	2	—.624	—2	—.020	—1	—.158	—1
North Africa	—1.258	—4	—4.049	—8	.187	1	—.291	—1	—.037	—1	—.124	—1
Central Africa	—.593	—2	—1.603	—3	.098	1	—.125	—	.011	—	—.010	—
East Africa	—.157	—1	—4.793	—10	.194	1	.070	—	.002	—	—.002	—
Middle East	—.849	—3	—3.242	—7	.273	2	—1.004	—3	—.122	—3	—.553	—3
South Asia	—4.074	—15	—4.793	—10	—.053	—	—	—	—.004	—	—.191	—1
Southeast Asia	—.154	—1	—.378	—1	.280	2	1.517	4	.008	—	—.016	—
East Asia	—1.254	—4	—2.614	—5	—.297	—2	—1.262	—3	—.148	—4	—.204	—1

[1] In million metric tons.
[2] A positive number denotes net exports and a negative number denotes net imports.
[3] Bean equivalent.

exporters. The United States almost quadrupled its exports from 1958 to 1972, enabling it to hold almost two-thirds of the world export market for coarse grains in 1972. Exports from Canada and South Africa more than doubled, and those from Australia almost doubled during the same period. These three nations maintained their share of world trade.

The EEC-9 increased its imports from 9.7 to 12.6 million metric tons, but its share of total world imports fell. The same pattern prevailed in other Western European countries. Japan increased its imports of coarse grains from 1.4 to 7.7 million metric tons, and its share in the import market went from 9.4 to 19.7 percent between 1958 and 1972.

The change in the Centrally Planned Countries' trade position for coarse grains is very similar to that for wheat. The Soviet Union changed from a sizeable exporter,

accounting for 7.7 percent of world exports, to a major importer that accounts for 12.4 percent of total world imports. The shift in policy affecting wheat also affected its coarse grain trade. Imports by Eastern European Countries increased more than 300 percent, and their share of total world imports went from 5 to 8 percent. In 1972, China went from being a small exporter to an importer, accounting for about 6 percent of total world imports of coarse grains.

Although their total position in world trade did not change much, many changes in composition of trade have occurred among the Developing Countries. Brazil, formerly an importer, is now a small exporter. Argentina's exports doubled, but its share of world exports decreased from 17 to 13 percent. The major change accounting for growth in exports of the

Developing Countries was in Southeast Asia, primarily Thailand. Southeast Asia was a small exporter in 1958, exporting 280 thousand metric tons of coarse grains—1.8 percent of the export market. In 1972, its exports increased to 1.5 million metric tons and its share in the export market increased to 3.8 percent.

Soybeans

Compared to the other commodities considered here, soybean trade in the late 1950s was low, even though the level of trade in soybeans and soybean products stood at about 19 million tons per year in 1972, this was still substantially below the level of 1958 wheat trade and about the same as for coarse grains traded in 1958. Together with the overall rapid expansion of soybean trade have been changes in the country or regional composition of trade. The

Developed Countries increased their exports tenfold. The Centrally Planned Countries followed a pattern similar to the one for coarse grains, going from small exporters to a significant level of imports. The Developing Countries moved in just the opposite direction; they were net importers and are now net exporters. The shift from importer to exporter is accounted for almost exclusively by Brazil's rapid growth of soybean production and exports.

The United States dominates the export market. From 1958 to 1972, its exports increased from 3 to 16.9 million metric tons and its share of total world exports from 73 to 88 percent. Brazil is the other exporting country which increased its exports significantly, from virtually nothing in 1958 to 2.4 million metric tons in 1972. China, which exported 1.1 million metric tons in 1958, accounting for 26 percent of total world exports, became a net importer by 1972.

During the study period, the Developed Countries accounted for the major increases in imports—EEC-9, Other Western Europe, and Japan.

State trading countries

Some people in the United States are concerned about the growing importance of state trading countries in world trade of grains and soybeans. This concern revolves around whether or not state trading monopolies have a competitive advantage over the United States' free enterprise system of agricultural production and trade. Observations here deal with the quantitative importance of state trading countries, not the relative competitive power of state trading countries.

State trading countries can arbitrarily be broken into two major categories: (1) all buying, selling, handling, storing, and shipping is done exclusively by the government (i.e. Centrally Planned Countries); (2) In many countries, a monopoly exists, having sole responsibility for exports, imports, or domestic distribution of one or more commodities of interest. The monopoly agency may be a government organization, a producer group that is granted monopoly power by government, or a combination of the two. Commodities under the control

of the monopoly agencies also vary from just a few economically important ones to many traded commodities. Some of these monopoly agencies may rely on the private sector for storage, transportation, and other functions.

In Canada, the Canadian Wheat Board has a monopoly position in the export of wheat and coarse grains. Australia has export monopolies for wheat and feed barley. The Australian Wheat Board and Australian Barley Board control international marketing much the same way as does the Canadian Wheat Board. In both Canada and Australia, these marketing boards are primarily producer-controlled organizations which have been granted monopoly power by their governments. The only other Developed Country with a marketing system of this type is Japan. The Japanese Food Agency, a government agency, determines the import quantities of wheat and feed barley.

In contrast are those countries where trade is carried out by the private sector, allowing many private export and import firms to trade. Generally, the governments use only indirect controls, such as tariffs, quotas, and subsidies, to achieve policy goals. The United States and Europe are examples of this type of trading system.

The Developing Countries have a mixture of trading systems. The large number of Developing Countries and the great diversity of trading systems make difficult any generalizations about the importance of state trading in this group. Therefore, the remainder of this article will only discuss state trading in the Centrally Planned and Developed Countries.

The changing share of world trade for state trading countries is calculated on the basis of gross trade (i. e., imports plus exports). This is a measure of the gross movement of commodities into and out of a country. It enables a convenient way to handle the problem of a country, such as the Soviet Union which switched from a net exporter of wheat in 1958 to a net importer in 1972. We can focus on the relative importance of such a country in world trade without considering whether it is an importer or an exporter.

Wheat

Gross world trade in wheat (imports plus exports) increased from 57.4 to 99.3 million metric tons between 1958 and 1972. Gross trade in wheat by the Centrally Planned Countries went from 10.2 to 13.4 million metric tons, which is from 18 to 13 percent of gross world trade. Thus, the Centrally Planned Countries' share of world trade in wheat actually declined. The big change in these countries was not so much in their total trade, but in changes of the position of individual countries. The major changes were China's growing imports and the Soviet Union's switch from a significant exporter in 1958 (4.9 million metric tons) to an importer (2.9 million metric tons) in 1972.

The wheat trade monopolies of Canada, Australia, and Japan have increased in importance. Their combined share of gross world trade in wheat went from 21 percent in 1958 to 27 percent in 1972.

Together, these two groups of countries had an increase of total gross trade in wheat from 22.5 to 39.9 million metric tons, while their share of world trade changed hardly at all—39 percent in 1958 compared to 40 percent in 1972. Thus, trade in wheat by the principal state trading countries has not increased in relative importance. Yet, they account for 2 out of every 5 tons of wheat traded in world markets.

Coarse grains

In the Centrally Planned Countries, all coarse grains are state traded. Gross trade in coarse grains went from 2 million metric tons in 1958 to 10.1 million metric tons in 1972, while the share of world trade went from 7 to 13 percent. During this period, Eastern Europe and China increased their imports of coarse grains significantly, while the Soviet Union switched from being an exporter to an importer.

Canada's and Australia's[5] share of gross world trade declined slightly.

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[5]Data are for all coarse grains. While barley is the only coarse grain which is state traded in Australia by the Australian Barley Board, it constitutes nearly 80 percent of total coarse grain exports.

from 8 to 7 percent. Although the Food Agency in Japan has a monopoly on barley imports, we are eliminating Japan from our calculation because of the unimportance of barley in Japan's total coarse grain imports in recent years. Barley made up about 50 percent of coarse grain trade in 1958, but dropped to 14 percent in 1972. In 1972, corn made up the bulk of Japan's trade in coarse grains, and corn is not subject to state trading.

The amount of gross world trade in coarse grains accounted for by state trading countries or by those with trade monopolies increased rapidly, as did total world trade. The share of world trade covered by state trading in the Centrally Planned Countries as well as Canada and Australia increased modestly from 15 percent in 1958 to 20 percent in 1972. Thus, unlike wheat, state trading in coarse grains does appear

to have increased in relative importance. The principal state trading nations account for one-fifth of gross world trade.

Soybeans

Soybeans are state traded by the Centrally Planned Countries alone. As a group, their share of gross world trade declined dramatically—from 23 percent in 1958 to 4 percent in 1972. The bulk of this change was accounted for by China, which exported 1.1 million metric tons of soybeans in 1958 and which imported 0.3 million metric tons in 1972. Unlike wheat and coarse grains, the relative importance of state trading countries in soybean trade had declined sharply. Of these, only Eastern Europe has not decreased in importance.

Conclusions

Between 1958 and 1972, world

trade in grains and soybeans increased substantially. World exports of wheat went up by 70 percent; coarse grains increased by 156 percent; and soybeans and soybean products increased by 357 percent. In these commodities there have also been important shifts among countries or regions of the world relative to their importance in world trade.

State trading countries hold significant shares in the world market for wheat and coarse grain trade. Total world wheat trade increased, while the share of state trading countries has remained about constant. For coarse grains, both the level and share of total world trade of state trading nations increased. Only in the case of soybeans and soybean products has state trading declined in importance, and this has been due mainly to decreased exports from China.
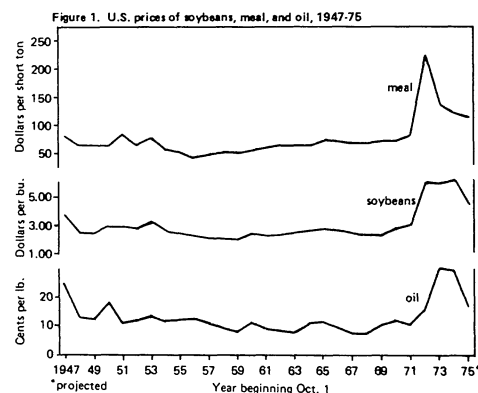

Overview of the market

Demand for soybeans arises almost entirely out of the demand for the two major soybean products—oil and meal. These two commodities are joint products of the processing operation; they are obtained simultaneously and in rather fixed proportions.

Soybean oil is used primarily as a food. It is consumed as margarine, shortening, and cooking and salad oil. Soybean meal is used mainly as a high protein supplement in livestock feed. It contains 45 to 50 percent of high quality vegetable protein.

The expanding demand for meat and other livestock products has stimulated the growth and commercialization of animal industries in developed countries. This, in turn, involves greater attention to animal nutrition and efficient feeding practices. Hence, high protein feeds, such as soybean meal, have experienced extraordinary demand growth. Markets for high protein meal are mainly in developed countries. Oil markets exist in both developed and less developed nations.

Each 60-pound bushel of soybeans yields 47 to 48 pounds of meal and 10.5 to 11 pounds of oil. Because of high oil prices from mid-1972 until mid-1975, the values of the oil and meal components of soybeans were nearly equal. Usually about two-thirds of the value of soybeans is derived from its meal component. Figure 1 shows prices of soybeans, soybean meal, and soybean oil since World War II. The dramatic rise in the 1970s dwarfs earlier price movements. From marketing year[2] 1971 to 1972, soybean prices rose from $3.24 to $6.22 a bushel because meal prices skyrocketed.[3] Meal averaged $90 a ton in 1971, compared with $229 in 1972. Meal prices fell in 1973 and again in 1974, yet soybean prices were sustained by high oil prices, which

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[2]The marketing year for soybeans begins Sept. 1 and ends Aug. 31 the following year. Marketing years for soybean meal and soybean oil run from Oct. 1 to the next Sept. 30.

[3]Fish meal supplies were short, driving up prices for all meals.

Figure 1. U.S. prices of soybeans, meal, and oil, 1947-75

averaged over 30 cents a pound those years. In the marketing year beginning Oct. 1, 1975, oil prices weakened; however, meal prices changed little, leading to a reduction in the price of soybeans.

About 20 percent of U.S. soybean oil exports is in the form of oil. The remaining 80 percent is the oil content of the exported soybeans, themselves. About 30 percent of U. S. meal exports is as meal, and 70 percent is as beans. Table 1 shows the destinations of U.S. soybean and soybean meal exports. Table 2 shows the destination of soybean oil exports. The volume of bean exports

Table 1. Destinations of U.S. soybean and soybean meal exports

	Beans		Meal	
	1966-68	1971-73	1966-68	1971-73
	percent			
Japan	26	23	a	3
European Communityb	37	41	67	58
United Kingdom	2	2	2	1
Denmark	5	3	2	2
Canada	5	3	8	5
Other Western Europe and Australia	14	11	6	8
Eastern Europe	1	3	11	17
Taiwan	5	5	a	a
Israel	3	3	a	a
Others	1	7	4	7
	100%	100%	100%	100%
	Million bushels		Thous. tons	
Volume of exports (annual average)	238	478	2867	4683

aLess than 1 percent.
bBelgium, Luxembourg, France, West Germany, Italy, and the Netherlands.

Table 2. Destinations of U.S. soybean oil exports (total of commercial and P.L. 480 exports)

	1965-66	1971-73
	percent	
Canada	4	3
Latin America	19	20
Western Europe	5	2
Australia & Oceania	1	1
Eastern Europe	7	12
Africa	14	14
Asia	50	49
	100%	100%
P.L. 480 as percentage of total	65%	35%

million pounds (annual average)	1965-66	1971-73	1975
	1.0	1.3	0.9

doubled from 1966-68 to 1971-73, yet the distribution changed little. Europe and Japan were the chief markets. In the same two time periods, meal exports rose more than 60 percent. Again, there was little change in the distribution. The European Community was the predominant meal importer both periods.

Oil exports did not grow as had soybean and meal exports. The volume of soybean oil exports remains at about the same level in the 1970s as in the 1960s. But in the mid-1960s, about two-thirds of soybean oil exports were shipped under P.L. 480 (Food for Peace) programs. By the early 1970s, commercial exports had risen so that

P.L. 480 shipments fell to only one-third of total exports. There was little change among the importing nations. Latin American, Asian, and African nations today continue to be the chief oil importers. They are mostly less developed countries which, for the most part, do not import soybeans from the United States.

Importers who process soybeans into oil and meal must have oilseed crushing facilities. And once they have established a crushing industry, they have an inducement to operate it. Consequently, some bean importers produce oil or meal in excess of their domestic demands, providing a supply for export. Several European importers of soybeans and soybean products do export soybean oil and meal. This suggests that import demand for soybeans in some nations depends, in part, on demand for soybean products in third countries. Thus, factors influencing U.S. exports of soybeans as beans differ somewhat from those influencing the demands for individual soybean products.

A phenomenon of the 1970s is the emergence of Brazil as a major producer-exporter of soybeans and soybean products. The People's Republic of China historically has been a large producer and a periodic exporter. However, exports from China have been inconsequential in recent years, while Brazilian exports are substantial and rising. Exports from these two nations are compared with U.S. exports in figures 2 and 3.
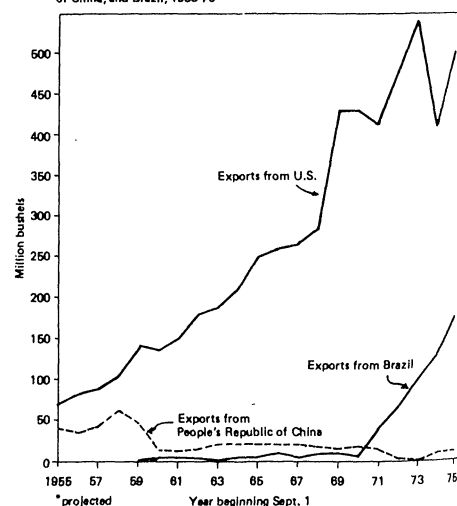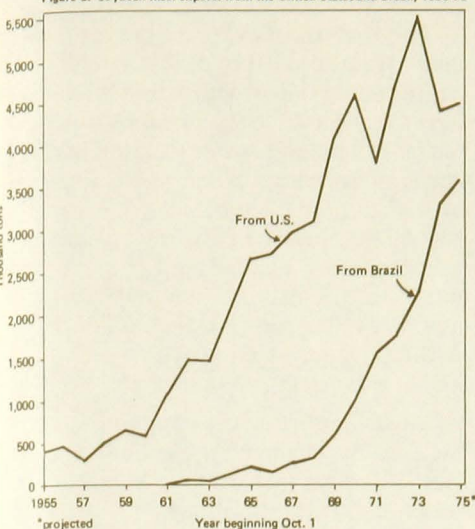

Figure 2. Soybean exports from the United States, The People's Republic of China, and Brazil, 1955-75

Figure 3. Soybean meal exports from the United States and Brazil, 1955-75

From U.S.

From Brazil

1955 57 59 61 63 65 67 69 71 73 75*
*projected   Year beginning Oct. 1

U.S. government trade policies can also influence exports. For a discussion of recent policy controversies and alternative export strategies for soybeans and grains, see the October 1975 *Minnesota Agricultural Economist*.

Research results

Statistical methods were used to explain changes in exports of U.S. soybeans and soybean meal.[4] By identifying and measuring major factors that affected U.S. soybean exports in the past, we can build a useful framework for estimating the level of exports in the future. Also, information from this research can be combined with other information about domestic soybean utilization and production to evaluate the U.S. soybean market and its implications for the soybean industry.

The first step was to identify the major forces affecting soybean and soybean meal exports. From the preceding description of the soybean market, we knew we had to consider importing nations' livestock production and food oil consumption. Alternative food oils and high protein feeds competing with soybeans were studied also. By

[4]Because somewhat distinct markets apparently existed for soybeans and soybean meal, each was considered separately. Exports of U.S. soybean oil as oil are being examined as part of a larger study of world trade in fats and oils.

systematically examining the historical data, a few factors emerged as the principal determinants of changes in U.S. exports of soybeans and soybean meal. These factors are discussed here. Other factors that might influence exports were not found to add significantly to an explanation of changes in export levels during the study period.

Soybean exports

Our analysis of soybean exports covered 15 years—marketing years 1960 through 1974. Six factors were discovered to be the major forces affecting exports of U.S. soybeans. They are: prices of soybeans; prices of soybean meal; prices of soybean oil; prices of corn; production of oilseed and fish meals in other nations; incomes in importing nations.

Using statistics, we estimated how much impact that changes in each of the six factors had on changes in U.S. exports of soybeans for each year. We then summed up the six impacts to estimate the bushels of soybeans exported each year. Next, we compared our estimates with the actual values of soybean exports each year of the study period; we did this to see how well our historical estimates matched actual values. When they matched quite closely and if we expected the future to be determined by the same factors as in the past, we had a good means to estimate the future.

Example 1 shows how we calculated our 1974 estimate. (Values for each of the other years were calculated in the same manner, using appropriate data for each year.) In

the left column are listed the six factors that were found to affect soybean exports.

In the second column are changes in actual values for each of the six factors from marketing year 1973-1974. For example, the price of soybeans was $5.68 a bushel in 1973 and $6.25 in 1974—a change of + 57 cents. The values for this column would be different for other years in the study period or for estimating future exports.

The multipliers in the third column were estimated by statistics. These values are constant for all years. The actual values in the first column are multiplied by the multipliers to obtain the impact of each factor on soybean exports. Each multiplier translates the change which occurred in the factor into its estimated impact on soybean exports. For example, the value −91 after the price of soybeans means that a $1 increase in the price of soybeans would cause exports to decrease 91 million bushels. To find the effect of a 57 cent increase in the price per bushel of soybeans, +.57 is multiplied by −91, giving −52. That value appears in the right column, which is the impact on soybean exports for 1974. The meaning of the values in the third column and the computation of the values in the right column are similar for each of the other factors.

The last step is to sum the values in the right column to obtain the estimate of U.S. soybean exports for 1974, calculated by our statistical method. In the example, our estimate is 112 million bushels less than
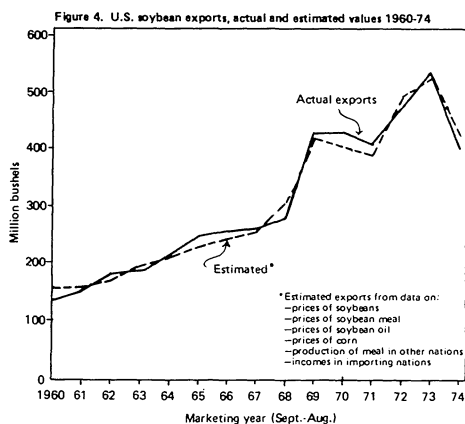
Example 1. How to calculate estimates of soybean exports

Factors influencing soybean exports	Change from 1973 to 1974 $\times$	Estimated multiplier (constant for all years)* $=$	Impact on soybean exports for 1974
Price of soybeans ($bu.)	+ $0.57	− 91	— 52 mil. bu.
	− $16.35	.35	— 6 mil. bu.
Price of soybean oil (¢lb.)	− 0.8¢	7	— 6 mil. bu.
Price of corn ($bu.)	+ $0.40	70	+ 28 mil. bu.
Foreign production of oil meal (mil. tons)	+ 4.1 mil. tons	− 18.6	— 76 mil. bu.
Income index for Europe and Japan (1970 = 100)	0	9.65	0 mil. bu
Total estimated change from 1973 to 1974			− 112 mil. bu

*The multipliers, appearing in the screened area, were estimated from statistics.

—7—

for 1973. Estimated exports in 1973 were 531 million bushels, so our estimate for 1974 is 531 minus 112, or 419 million bushels. Actual exports in 1974 were 421 million bushels—our estimate for 1974 was accurate. Estimates for each of the other 14 years in the study period were also calculated. All 15 estimates are portrayed in figure 4, which also shows actual values for comparison. Actual and estimated values appear to be fairly close for most years. Over the 15-year period, the six factors together accounted for 98 percent of the variation in U.S. soybean exports.

Now presented in more detail are the six elements that affect U.S. soybean exports.

Figure 4. U.S. soybean exports, actual and estimated values 1960-74

*Estimated exports from data on:
—prices of soybeans
—prices of soybean meal
—prices of soybean oil
—prices of corn
—production of meal in other nations
—incomes in importing nations

Marketing year (Sept.-Aug.)

The price of soybeans. The minus signs appearing in columns three and four after the prices of soybeans mean that, as the price of soybeans goes up, the quantity of soybeans exported from the United States goes down, providing no changes occur in the other five factors. On the average for 1960-74, a 10 percent increase in the price of soybeans is associated with an 8 percent decrease in the quantity of U.S. soybeans exported.

Prices of soybean meal and soybean oil. Positive relationships were found between the prices of soybean oil and soybean meal and exports of soybeans. Price increases for soybean products increase exports of soybeans. A possible explanation is that, as the prices of soybean meal and soybean oil rise relative to the price of soybeans, importers shift from meal and oil imports to soybean imports. It is

cheaper for them to get their meal and oil from beans than to buy already processed oil and meal.

The price of corn. Corn also appears in a competitive relationship with U.S. soybean exports. As U.S. price of corn rises, soybean exports also rise. This relationship reflects substitution that is possible between oil meal and grains in feed concentrates for livestock. When corn becomes relatively more expensive, feed manufacturers reduce the quantity of corn in rations and increase soybean meal.

Foreign production of oil meal. The fifth element used to estimate U.S. exports of soybeans was a measure of foreign production of oilseed and fish meals. Foreign production of these meals nearly doubled in the 15-year period. Forty-two percent of that increase was accounted for by expansion of soybean output in Brazil. A second major foreign source of meal is fish. The relationship between world fish meal production and U.S. soybean exports warrants particular attention because fish meal output varies considerably from year to year. For example, fish meal output in 1969 and 1973 was low. Those low supplies were largely responsible for reductions those years in total foreign supplies of oil meal. In turn, foreign shortages led to sharp increases in demand for U.S. soybean meal and soybeans.

Incomes in importing nations. The sixth element used to estimate demand for U.S. soybean exports was a variable to reflect income in Japan and in the nine nations in the European Community. These ten nations are the chief customers for U.S. soybeans. About 7 of every 10 bushels of soybeans exported from the United States are destined for these countries. As populations and incomes grow in these countries, import demand for U.S. soybeans also grows. More people and higher incomes mean greater demand for vegetable oils and for livestock products. And when income growth slows, as it did in Europe and Japan in 1974 and 1975, these nations cut back on their imports of U.S. soybeans. In our estimate of U.S. soybean exports for marketing year 1974, we assumed no growth in income from the previous year. That is indicated by the 0 in column 2 of the example.

Soybean meal exports

The analysis of exports of soybean meal from the United States concentrated on those factors that affect livestock production in importing nations. The European Community accounts for about 3 of every 5 tons of soybean meal exported; yet year-to-year changes in their demand accounted for virtually all the variation in U.S. exports between 1960 and 1974. Hence, livestock feeding in the European Community was the key in this part of the research.

Most importing nations import meal to supplement meal obtained from crushing imported soybeans or other oilseeds. In many of these nations, demand for meal exceeds demand for the oil that would be produced if all meal needs were met from crushing oilseeds. Moreover, the importation of meal provides flexibility to accommodate rapid shifts in demand for meal that may result from sudden expansion or contraction in livestock numbers, from short term changes in livestock feeding practices, or from other causes. The European meal importers traditionally have been major users of fish meal. When fish meal supplies are temporarily short, these importers can quickly meet their need for high protein meal by turning to imports of soybean meal. Importing unprocessed oilseeds that require crushing would require more time.

Our statistical analysis revealed that satisfactory estimates of soybean meal exports could be made from six factors—the price of U.S. soybean meal; the price of U.S. soybeans; the price of fish meal in Europe; the number of hogs in the European Community; the number of poultry in the European Community; and exports of soybean meal from Brazil.

Example 2 shows how we calculated our 1974 estimate. The computation and interpretation of these values are analogous to those given in example 1.

The example shows that estimated exports of soybean meal in 1974 are 923,678 tons below the 1973 exports. Estimated exports for 1973 were 5,348,000 tons, so our estimate for 1974 is 5,348,000 minus 923,678, or 4,424,322. Actual exports in 1974 were 4,300,000 tons.

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Example 2. How to calculate estimates of soybean meal exports

Factors influencing soybean meal exports	Change from 1973 to 1974 ×	Estimated multiplier (constant for all years) =	Impact on soybean meal exports for 1974
Price of soybean meal ($ton)	− $ 16.35	− 13,906	+ 227,363
Price of fish meal ($ton)	− $119.00	7,759	− 923,321
Price of soybeans ($bu.)	+ $ 0.57	277,798	+ 158,345
Exports of soybean meal from Brazil (tons)	+ 979,000 tons	− 0.618	− 605,020
No. of hogs in the European Community (thous.)	+ 1,327	165	+ 218,955
No. of Poultry in the European Community (thous.)	0	12	0
Total estimated change from 1973 to 1974			− 923,678

Figure 5. U.S. exports of soybean meal, actual and estimated values

*Estimated exports from data on:
—price of U.S. soybean meal
—price of U.S. soybeans
—price of fish meal in Europe
—exports from Brazil
—number of hogs in the European Community
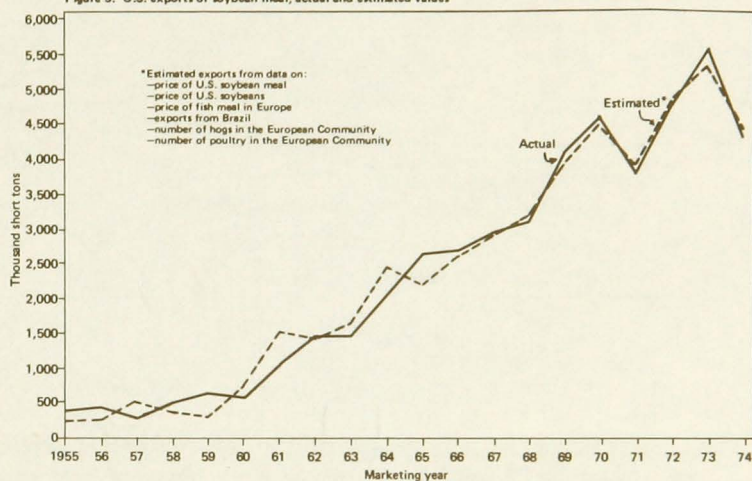—number of poultry in the European Community

Figure 5 illustrates actual and estimated exports of soybean meal from the United States for the 20-year period from 1955 through 1974, based on the six factors cited. These factors accounted for 98 percent of the variation in U.S. meal exports during that period.

The price of soybean meal. The analysis revealed that U.S. exports of soybean meal fall as the price of soybean meal rises, if no change occurs in the other five factors. Over the 20-year period, a 10 percent increase in the price of soybean meal was associated with a 5 percent decrease in meal exports.

The prices of fish meal and soybeans. Those competitive relationships were accounted for by including the European price of fish meal and the U.S. price of soybeans in the estimation. As the price of fish meal rose, U.S. exports of soybean meal rose. For the 20-year period, a 10 percent increase in fish meal prices resulted in a 5 percent increase in U.S. soybean meal exports.

As mentioned in the discussion of soybean exports, soybean meal can be imported as meal or as beans to be processed into meal. Our findings indicate that U.S. meal exports grow by 3 percent when soybean prices advance by 10 percent.

Brazilian soybean meal. U.S. soybean meal also competes with soybean meal exported from Brazil. For each one-ton increase in Brazilian meal exports, U.S. meal exports fall about two-thirds of a ton.

No. of hogs and poultry. Changes in the numbers of hogs and poultry in the European Community were also found to be closely related to exports of soybean meal from the United States. Production of poultry and pork can be adjusted rather quickly when profitability changes. When livestock producers are expanding or contracting their inventories of hogs and poultry, they adjust their purchases of livestock feed accordingly. Such changes are rather quickly felt by the feed industry. The feed industry then increases or decreases its orders for soybean meal to meet the new market conditions.

Concluding comments

This study suggests that exports of U.S. soybeans and soybean meal are highly dependent upon economic conditions in importing nations and on foreign supplies of high protein meals. These factors are virtually beyond the scope of U.S. policy. Nevertheless, we can make several sets of assumptions about foreign conditions and then estimate U.S. exports to match each set of assumptions. Such estimates can guide the U.S. soybean industry in its production, marketing, and storage decisions.

By employing the multipliers generated from this research and by using estimates of the major factors influencing exports, we forecast soybean and soybean meal exports for the 1975/76 marketing year. Soybean exports are forecast to be about 5 percent greater than for last year, while soybean meal exports may rise little if at all above the year-earlier level. If the assumptions we made about the factors influencing exports are wrong, these estimates will be wrong. That is the hazard of forecasting.

MINNESOTA'S AGRICULTURAL EXPORTS
Value for year ending June 30, 1976

Commodity	Million dollars
Wheat & products	168.3
Feedgrains & products	298.2
Soybeans & products	245.5
Flaxseed & products	1.2
Fruits & preparations	.2
Vegetables & preparations	13.3
Dairy products	21.9
Meats & products (excluding poultry)	30.5
Hides & skins	37.4
Poultry products	9.1
Lard & tallow	13.9
Other	75.2
All commodities	$914.7
Total U.S. agricultural exports	$22,146.9

NOTE: Minnesota ranked eighth among states in terms of value of agricultural exports in fiscal year 1976. Minnesota was exceeded only by Illinois ($2,405.0 million), Iowa ($1,752.0 million), Texas ($1,541.2 million), California ($1,466.6 million), Kansas ($1,312.3 million), Nebraska ($1,138.7 million), and Indiana ($1,134.7 million).

Source—U.S. Department of Agriculture

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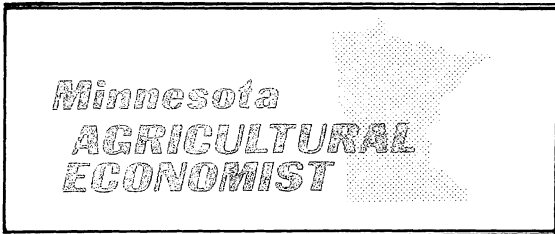
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NO. 582   AUG.-SEPT. 1976

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Roland H. Abraham, Director

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