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A STUDY OF U.S. EXPORTS OF SOYBEANS AND SOYBEAN MEAL

by

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Soybeans are a major income earner for U.S. farmers. In 1973 and 1974 sales topped $8 billion and are expected to reach about $7 billion for 1975. Returns from soybeans constitute about 20 percent of total cash receipts that farmers receive from sales of all crops.

Close to half of U.S. soybean output is destined for markets overseas. In the 1970's, foreign buyers took two of every five bushels of soybeans and in addition purchased about one-fourth of the soybean meal and 15 percent of the soybean oil produced in the United States. These facts highlight the importance of soybean exports in the agricultural economy of the United States. The export market for U.S. soybean products in the 1970's is reviewed first in this paper then findings of research that analyzed changes in exports of soybeans and soybean meal are reported.

Overview of the Market

Demand for soybeans arises almost entirely out of the demand for the two major soybean products--oil and meal. Food use of whole soybeans is growing, yet remains a small share of total utilization. Soybean oil is used primarily as a food. It is consumed as margarine, shortening, and

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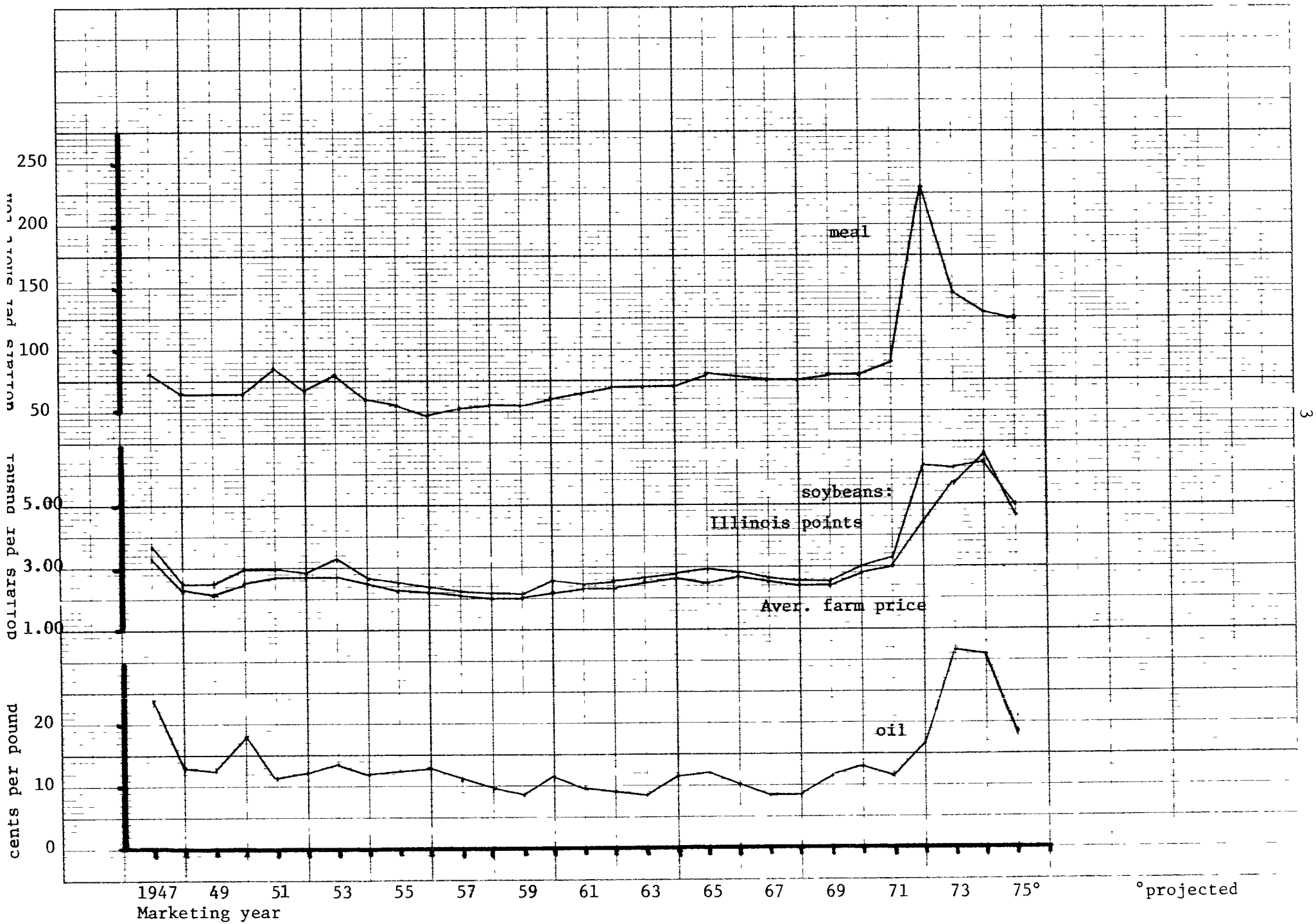
cooking and salad oil. Soybean meal is a high protein supplement used in livestock feed. It contains 45-50 percent high quality vegetable protein. Expanding demand for meat and other livestock products has stimulated the growth and commercialization of animal industries in developed countries. Such modernization involves greater attention to animal nutrition and efficient feeding practices. When these developments occur, demand grows for soybean meal and other sources of protein. Markets for high protein feedstuffs are mainly in developed countries. Oil markets exist in both developed and less developed nations.

Soybean oil and meal are joint products. They are obtained simultaneously and in rather fixed proportions in the processing operation. Each 60-pound bushel of soybeans yields 47 to 48 pounds of meal and 10.5 to 11 pounds of oil. The values of oil and meal in each bushel of soybeans were nearly equal from mid-1972 until mid-1975, differing from the 1960's, when about two-thirds of the value of soybeans was derived from its meal component. In the 1950's nearly equal values had been obtained for oil and meal. Forecasts for the 1975-76 marketing year suggest a return to the two-to-one relationship for the values of meal and oil.

The shifting relative values of the meal and oil components of soybeans stem from changes in the relative prices of meal and oil since the quantities of each are essentially fixed in each soybean. Variations in the relative prices of soybeans, soybean meal and soybean oil indicate that the forces affecting prices in the oil market move differently from their counterparts in the meal market.

Prices of soybeans, soybean meal and soybean oil since World War II are shown in figure 1. The dramatic rise in the 1970's dwarfs earlier price movements. The recent high level was approached only by oil prices

Figure 1. U.S. prices of soybeans, meal and oil, 1947/48-1975/76



shortly after World War II. From 1971 to 1972 bean prices in Illinois rose from $3.24 to $6.22 a bushel as a consequence of skyrocketing meal prices. Meal was $90 per short ton in 1971 compared with $229 in 1972. Meal prices fell the following two years but bean prices were sustained by high oil prices. In the 1975-76 marketing year, oil prices weakened and meal prices changed little, leading to a reduction in the price of beans.

To examine the relationships between the prices of beans and meal and beans and oil, ratios of these two sets of prices were calculated. (The average farm price of beans was used in these calculations.) The ratios are presented in figure 2, together with price ratios of soybeans to corn and soybean meal to fish meal. Figure 2 shows that despite the wide swings in bean and oil prices in the 1970's, the relationships between these two prices did not diverge from the range of the past two decades. In contrast, the relationship between prices of beans and meal fell sharply below the previous range in 1972 then rose to a historical high in 1974. Such rapid changes in the soybean-soybean meal price relationship suggest that unprecedented and extreme conditions existed in oilseed and oilmeal markets in the 1970's. Whatever those conditions were, they did not cause extraordinary variations in the soybean meal-fish meal price relationship. The price ratio of soybean meal and fish meal moved within the same range in the 1970's as it had in earlier years.

The soybean-corn price relationship reveals that soybeans were becoming more expensive relative to corn throughout most of the 20-year period. However, there were substantial changes from one year to the next. Relative prices of soybeans and corn are a consideration for the manufacturer and the user of feed concentrates for livestock since

Figure 2. Price ratios: soybeans to corn, soybean oil and soybean meal and soybean meal to fish meal, 1955/56-1974/75

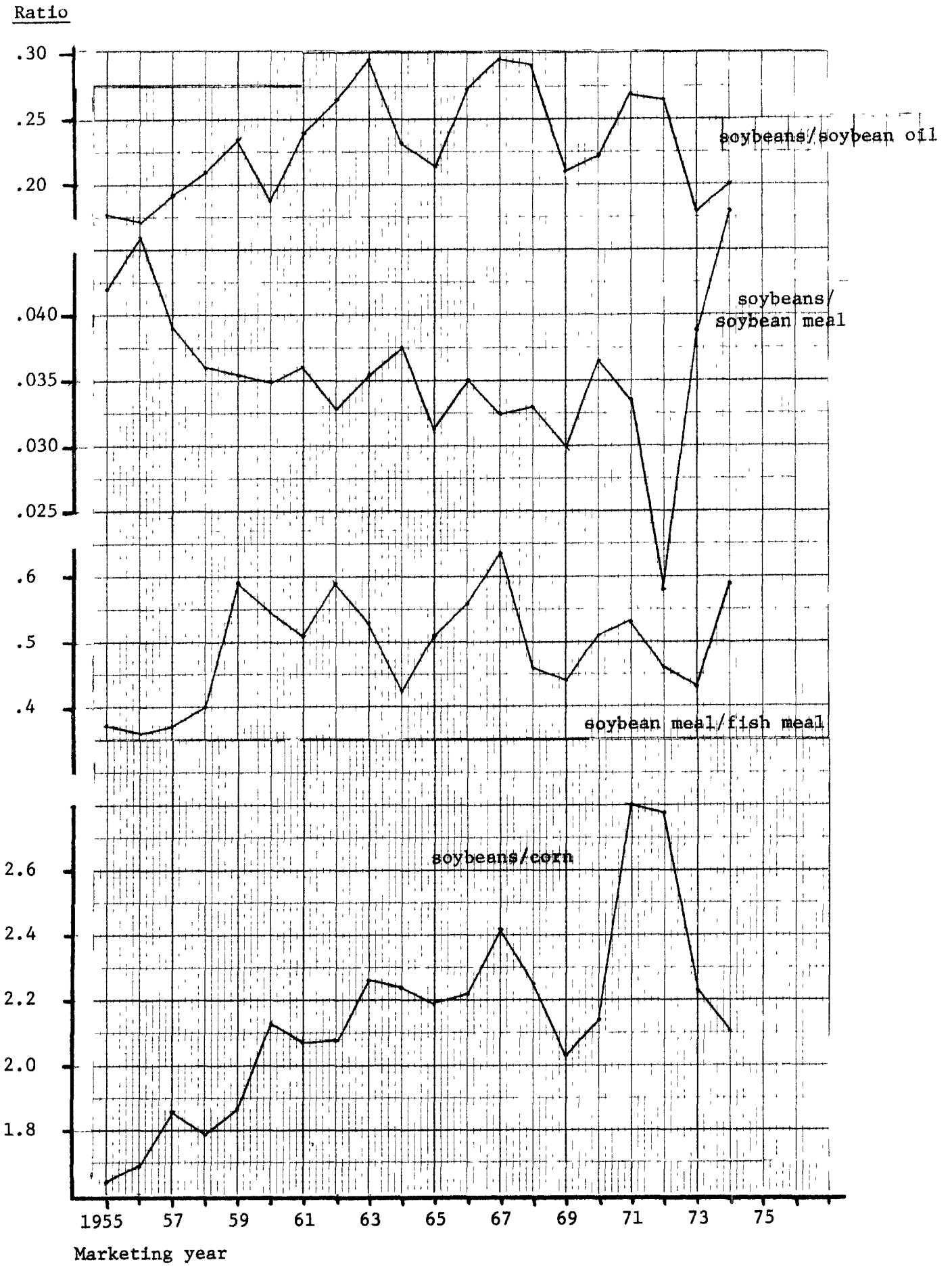


Table 1. Value of U.S. exports of soybeans and soybean products

	Quantity				Price (Illinois)				Value (mil. dol.)			
	72/73	73/74	74/75	75/76[f]	72/73	73/74	74/75	75/76[f]	72/73	73/74	74/75	75/76[f]
Beans, mil. bu.	479.4	539.1	420.7	475-525	$6.22	$6.12	$6.33	$4.95	2981.9	3298.3	2663.0	2350-2600
Oil, mil. lb.	1085	1461	1050	900	.165	.315	.307	.184	179.0	460.2	322	165.60
Meal, thous. short tons	4797	5584	4349	4550	229.0	146.35	130.85	124.60	1098.5	809.9	575.7	566.9
Beans:#												
oil eq., mil. lb.	5273.4	5930.1	4627.7	5225-5775					870.1	1868.0	1420.7	961-1063
meal eq., thous. short tons	11505.6	12383.4	10096.8	11400-12600					2634.8	1812.3	1321.2	1420-1570
Total value of oil exports (oil + oil eq. beans)									1049.1	2328.2	1743	1127-1229
Total value of meal exports (meal + meal eq. beans)									3733.3	2629.5	1897	1987-2137
Percentage value of exports												
oil and oil equivalent of beans									22	47	48	37
meal and meal equivalent of beans									78	53	52	63

f = forecast by USDA.

beans (from line 1) converted to oil and meal equivalents: 1 bu. = 11 lb. oil, 1 bu. = 48 lb. meal. These quantities are then valued according to the prices of oil and meal given in the center portion of the table.

nutritional requirements can be met from various combinations of grains and meals. Substitution takes place when prices change, as users seek the least-cost combination.

Exports of soybeans occur as beans, meal, and oil. Beans are the predominant form. The volume, price, and value of U.S. exports of soybeans and soybean products in recent years are given in table 1. Of the total value of exports, beans constitute from 70 to 75 percent of the value, meal from 15 to 25 percent, and oil from 5 to 10 percent. In the middle portion of table 1, bean exports are converted to oil equivalent and meal equivalent and valued at the prices of oil and meal. In the 1974 marketing year the 420.7 million bushels of beans exported would yield about 4.6 billion pounds of oil and 10.1 million tons of meal. At 30.7 cents a pound for oil and $130.85 a ton for meal, the respective values are $1.4 billion in oil equivalent and $1.3 billion in meal equivalent. The values of the meal and oil components of beans are added to the values of oil and meal exports in the lower portion of the table to give the total value of exports expressed in oil equivalent and meal equivalent. Totals are given in dollars and in percentages. These data show that the total value of meal exports outweigh the total value of oil exports although in 1973 and 1974 the difference was small.

In the early 1970's, about 80 percent of total U.S. soybean oil exports was the oil content of exported soybeans--the remaining 20 percent was exported as oil. This compares to a 75-25 percent relationship in the mid-1960's. About 70 percent of total U.S. soybean meal exports was as beans and 30 percent as meal. These shares have not changed appreciably in the past decade.

Table 2 and figures 3 and 4 show the indicated destinations of U.S. soybean and soybean meal exports. The volume of bean exports doubled

Table 2. Destinations of U.S. soybean and soybean meal exports*

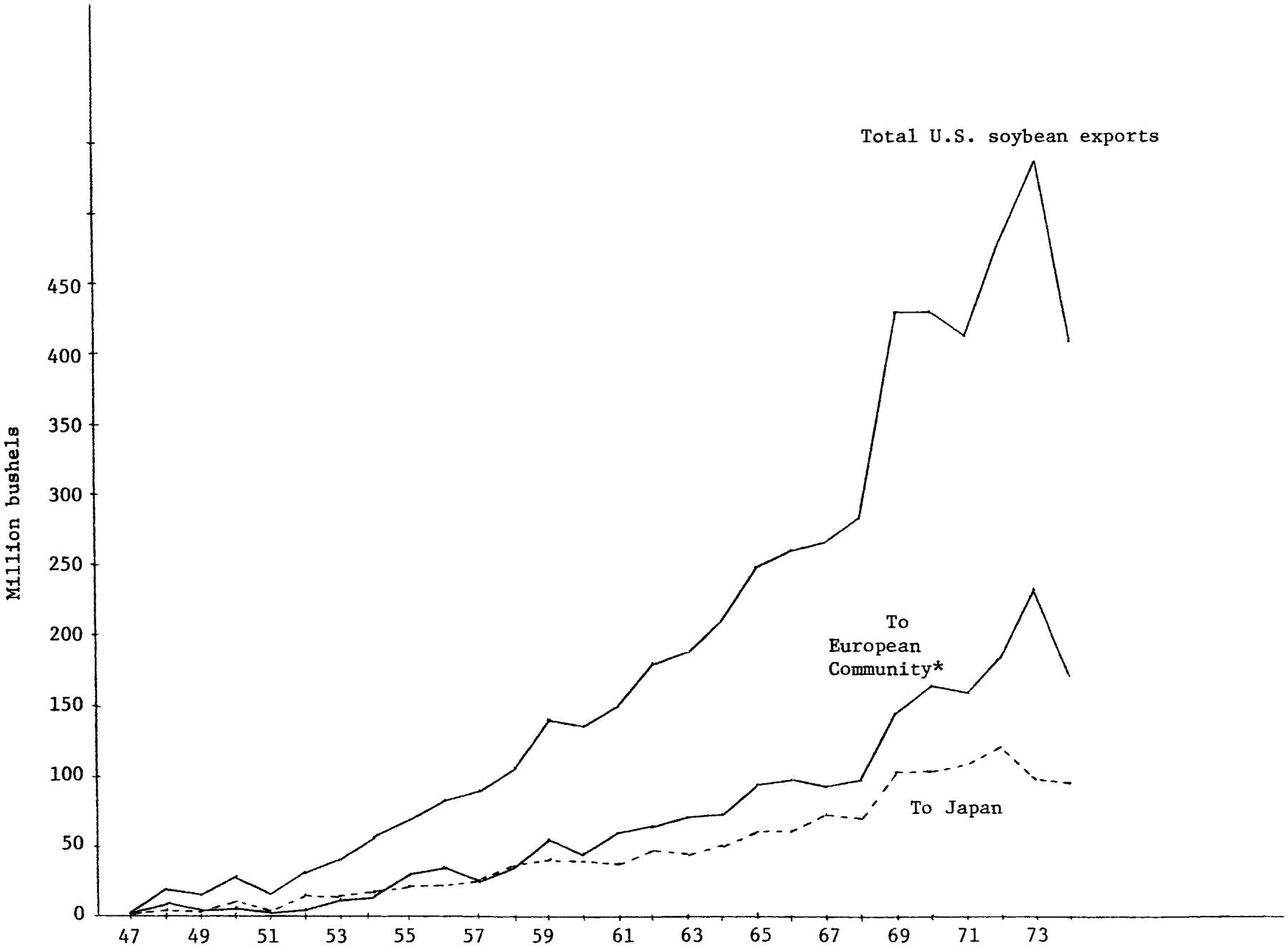
	Beans		Meal	
	1966-68	1971-73	1966-68	1971-73
	percent			
Japan	26	23	a	3
European Community[b]	37	41	67	58
United Kingdom	2	2	2	1
Denmark	5	3	2	2
Canada	5	3	8	5
Other Western Europe and Australia	14	11	6	8
Eastern Europe	1	3	11	17
Taiwan	5	5	a	a
Israel	3	3	a	a
Others	1	7	4	7
	100%	100%	100%	100%
	million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

[a]Less than 1 percent.

[b]Belgium, Luxembourg, France, West Germany, Italy, and the Netherlands.

*Data on destinations of U.S. exports are only approximate because transshipments through Canada, Belgium and the Netherlands are not accounted for (except that transshipments through Canada are omitted from Canadian data). Most transshipments were destined for European countries, thus, their shares would be slightly greater if the data were adjusted.

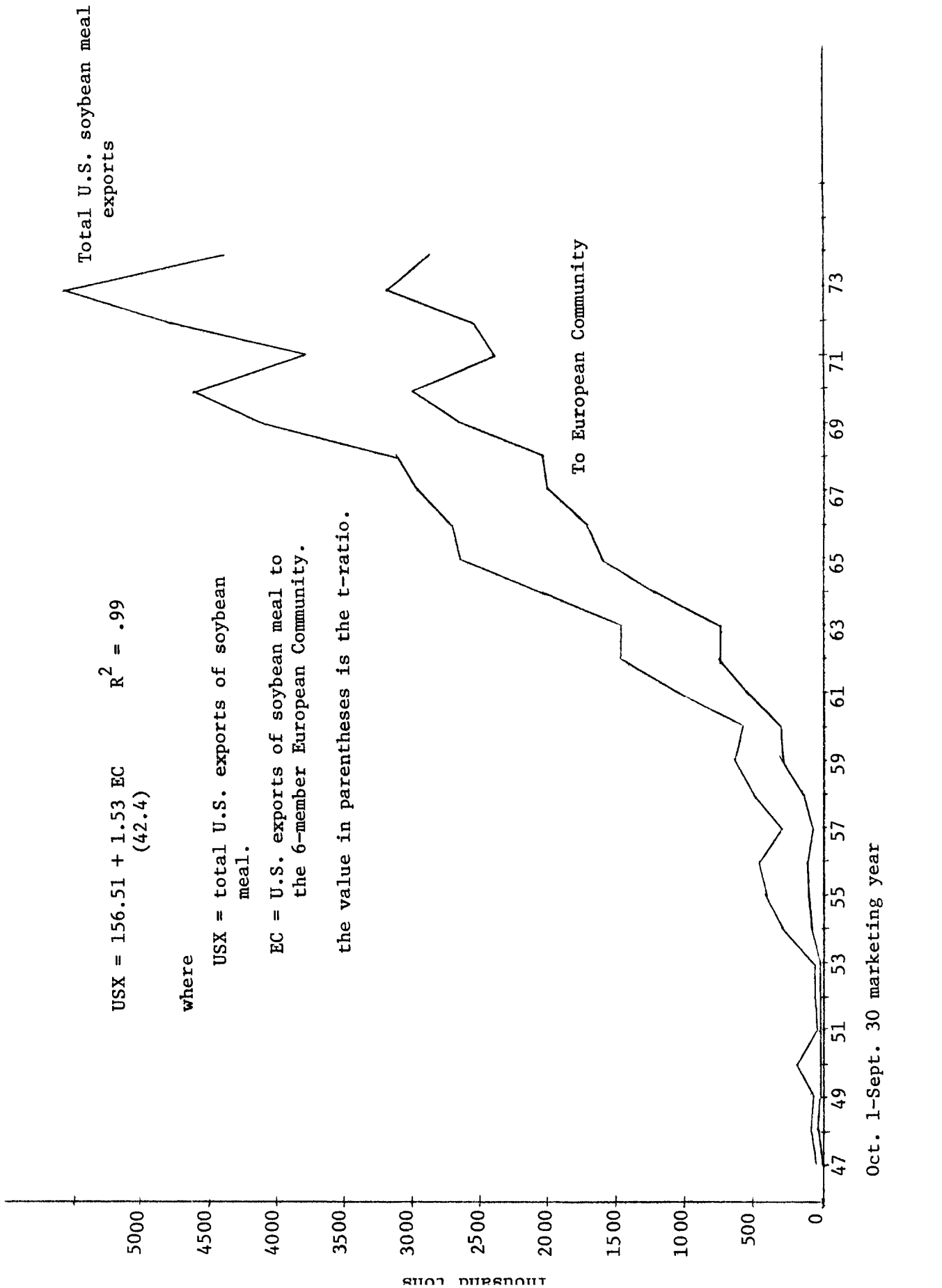
Figure 3. U.S. soybean exports: total and to European Community and Japan



Sept. 1-Aug. 31 marketing year

*Belgium-Luxembourg, W. Germany, France, Italy, and the Netherlands. The data do not include transshipments through Canada.

Figure 4. U.S. soybean meal exports: total and to European Community



from 1966-68 to 1971-73 yet the distribution changed little. Europe and Japan are the chief markets. In the same two time periods, meal exports rose more than 60 percent. Again, there was little change in the distribution; most noteworthy were a 9 percentage point drop for the European Community (EC) and a 6 percentage point rise for Eastern Europe. Nonetheless, the EC was the predominant meal importer in both time periods. To investigate the relationship between meal exports to the EC and total meal exports, the equation shown on figure 4 was computed. It indicates that 99 percent of the variation in total U.S. meal exports is associated with exports to the EC.

Table 3 gives the destination of U.S. soybean oil exports in 1965-66 and 1971-73.[1/] Oil exports did not grow as bean and meal exports had. The volume of soybean oil exports remained at about the same level in the 1970's as in the 1960's. But in the mid-1960's about two-thirds of soybean oil exports were shipped under P.L. 480 (Food for Peace) programs, whereas by the early 1970's 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 were the chief oil importers in both periods. Oil importing nations are mostly less developed countries and with few exceptions do not import soybeans from the United States.

A phenomenon of the 1970's is the emergence of Brazil as a major producer-exporter of soybeans and soybean meal. The People's Republic

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[1/] Although exports of soybean oil were not included in the statistical analysis of this study, they are briefly discussed here because of their influence on the soybean market. An analysis of U.S. soybean oil exports is currently underway as part of a broader study of world fats and oils trade.

Table 3. Destination 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%	
Volume of exports in million pounds (annual average)	1965-66	1971-73	1975
	1.0	1.3	0.9

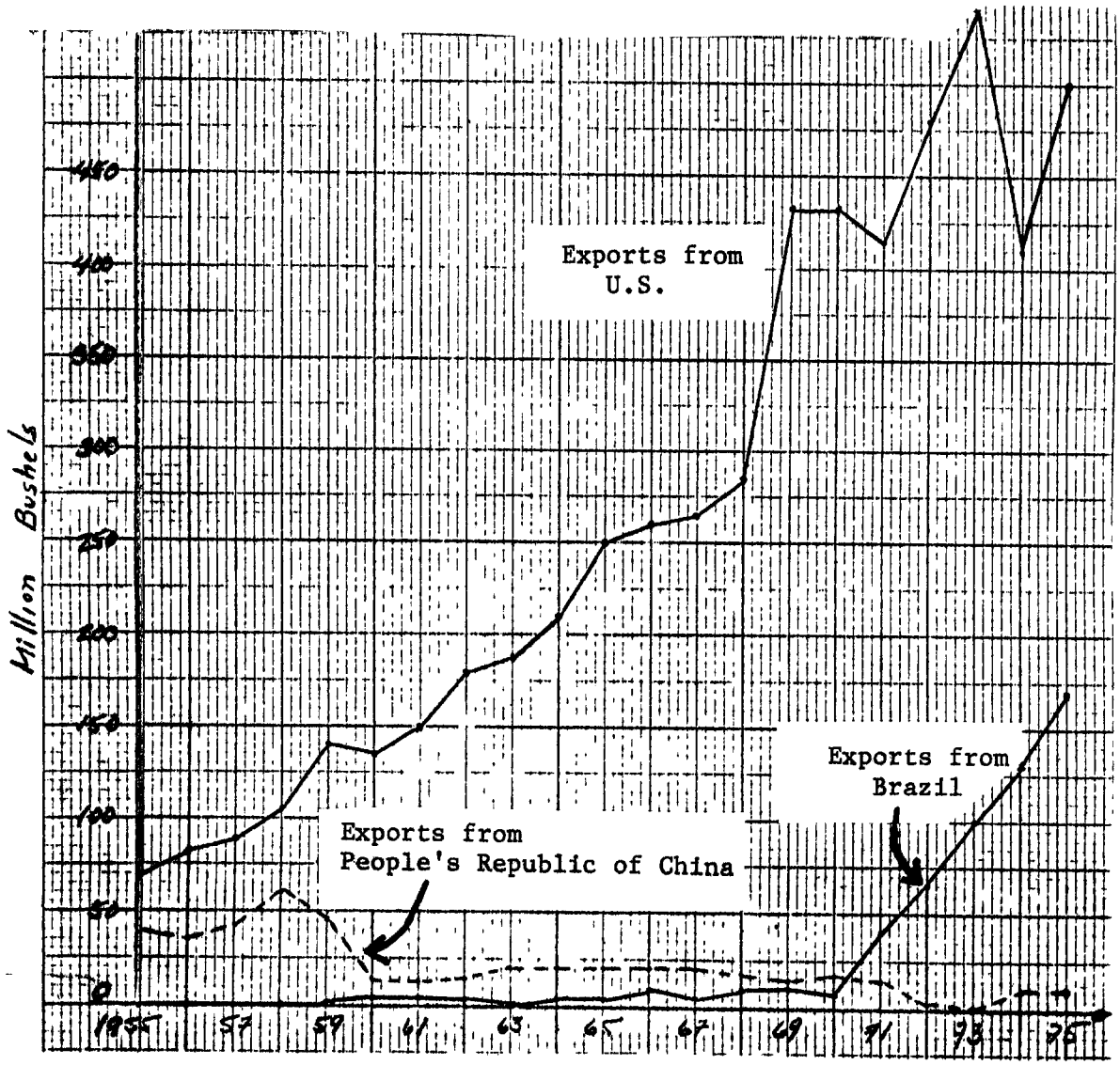
of China historically has been a large producer and a periodic exporter. Exports from China have been inconsequential in recent years, but Brazilian exports are substantial and rising. Exports from these two nations are compared with U.S. exports in figures 5 and 6.

Importers of soybeans not to be used as food must have oilseed crushing facilities to process the beans into meal and oil. And once they have established a crushing industry they have an inducement to operate it. Consequently, bean importers may produce oil or meal in excess of their domestic demand so many export some meal and oil.

Table 4 lists the major exporters of soybean meal and oil in 1970-73. Of the countries listed, only the United States and Brazil produce exportable surpluses of soybeans; exports of oil and meal from the remaining nations are obtained from crushing imported beans. Each of the five nonproducing meal exporters also imported soybean meal. In fact, their imports exceeded their exports. Apparently they exported soybean meal to achieve an intertemporal balance of supplies. A different situation exists for the European soybean oil exporters. Some of these nations do import soybean oil as well as export it, but in all cases, exports exceeded imports. Their exports of oil chiefly reflect excess supplies of fats and oils.

This discussion of oil and meal exports by soybean importers suggests that import demand for soybeans in these countries depends in part on demand for soybean products in third countries. And thus, factors influencing import demand for soybeans as beans differ to some extent from those influencing the demands for individual soybean products.

Figure 5. Soybean exports from the United States, The People's Republic of China and Brazil, 1955-75



Year beginning September 1

°projected

Figure 6. Soybean meal exports from the United States, and Brazil, 1955-75

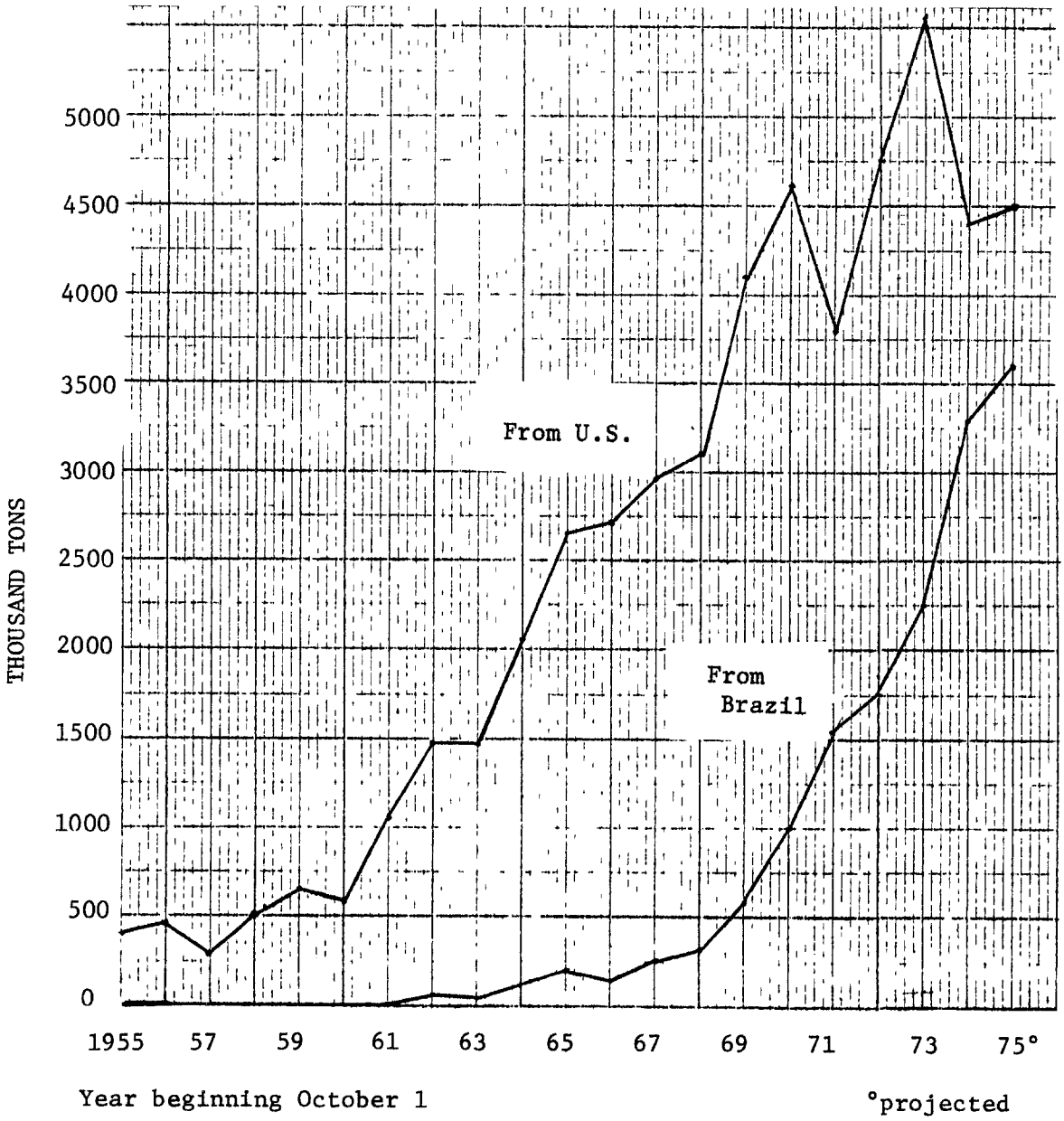


Table 4. Exporters of soybean meal and oil, 1970-73

	Meal
U.S.	60%
Brazil	17
Netherlands	7
West Germany	7
Belgium-Luxembourg	2
Denmark	2
Canada	2
All others	3
	100%
	Oil
U.S.	54%
Netherlands	8
West Germany	8
Spain	7
Brazil	4
Denmark	4
France	4
Belgium-Luxembourg	3
All others	8
	100%

Research Results

The above review of export market conditions provided insights for developing the models to estimate export relations for soybeans and soybean meal. Separate equations were estimated for each because somewhat distinct markets appeared to exist for soybeans, and soybean meal. The following general models were a basis for estimation and analysis.[2/]

(1) The bean model: $QSX = f(PS, X, I, Z)$

where

QSX = the quantity of U.S. soybeans exported

PS = the U.S. price of soybeans

X = the effects of competitive products (prices or quantities)

I = population and income changes

Z = other factors

(2) The meal model: $QMX = f(PM, L, Y, F, Z)$

[2/] The general economic relationship investigated can be expressed as

$$QX = f(P, X, Y)$$

where QX is the quantity exported, P is the price, X represents a collection of demand shifters in the importing nations (such as prices or quantities of available substitutes, incomes, tastes and preferences), and Y represents a collection of supply shifters in importing nations (such as prices or quantities of alternative products and factors of production, technology, etc.). The relationship derives from an aggregated import demand relationship for countries deficit in the commodity investigated and where import demand and exports are equated. See chapter 2 in E. E. Leamer and R. M. Stern, Quantitative International Economics (Boston: Allyn and Bacon, 1970) for a development of import demand relationships.

where

QMX = the quantity of U.S. soybean meal exported

PM = the U.S. price of soybean meal

L = the size and composition of the relevant livestock inventory

F = effects of competitive products (prices or quantities of other high-protein products)

Z = other factors

Statistical estimates of these economic models were obtained by ordinary least squares regression (OLS).

Soybean exports

Several estimates of U.S. soybean exports are given in tables 5 and 6. Correlation coefficients and definitions of the variables appear in tables 7 and 8 respectively. The equations differ by specification and by study period. Estimates employing FMPD and BRAZQSX begin with the 1960 marketing year because the FMPD data series began that year and because preliminary analysis beginning earlier did not produce statistically significant results for BRAZQSX. (Exports from Brazil began in 1960.) The most recent observation available for EC9+J was 1973, hence, most study periods terminate then. However, because of the unusual market conditions in 1974 that affected price relationships, it was decided to assume a value for EC9+J and add 1974 to the study period for some estimations.

All specifications include the price of soybeans, PS, a variable reflecting income and population in importing nations, EC9+J, and several variables measuring competitive effects. All equations account for 95 to 99 percent of the variation in U.S. soybean exports in the respective

Table 5. Estimates of U.S. soybean exports, regression coefficients and t-values

Eqn. no.	Time period	Constant	PS/PO	PS/PC	PS/PM	EC9+J	FMPD	BRAZQSX	S	$\bar{R}^2$	D.W.
5-1	1955-73	39.94	-393.66 (3.0)	-66.08 (2.5)	-1402.25 (1.4)	6.41 (24.7)			16.19	.99	2.02
5-2	1960-73	28.94	-447.89 (2.8)	-60.89 (1.9)	- 955.72 (0.8)	6.38 (20.3)			18.25	.98	1.90
5-3	1960-74	169.45	-480.81 (1.9)	-54.66 (1.1)	-4054.72 (2.6)	5.84 (13.1)			28.73	.95	2.35
5-4	1960-73	41.13	-411.42 (2.2)	-66.20 (1.8)	-1029.86 (0.8)	6.28 (14.8)		.13 (0.4)	19.18	.98	1.95
5-5	1960-74	72.09	-620.57 (2.4)	-34.77 (0.7)	-2711.83 (1.5)	6.45 (10.7)		-.52 (1.4)	27.33	.96	2.26
5-6	1960-73	75.48	-331.11 (1.8)	-60.16 (1.9)	- 800.39 (0.6)	7.84 (6.4)	- 8.88 (1.2)		17.74	.98	1.92
5-7	1960-74	201.57	-204.26 (0.9)	-56.20 (1.4)	-2133.80 (1.5)	9.36 (7.0)	-19.76 (2.7)		22.39	.97	1.79

Dependent variable = QSX

Table 6. Estimates of U.S. soybean exports, regression coefficients and t-values

Eqn. no.	Time period	Constant	PS	PO	PC	PM	EC9+J	S	$\bar{R}^2$	D.W.
6-1	1955-73	-233.48	- 95.12	6.98	108.58	.43	6.32	18.71	.98	1.88
			(3.2)	(1.8)	(1.6)	(1.7)	(17.4)			
6-2	1960-73	-233.43	-111.03	7.54	136.65	.52	6.27	20.58	.98	1.89
			(3.0)	(1.7)	(1.6)	(1.7)	(14.6)			
6-3	1960-74	-171.18	-126.82	14.59	33.85	.73	6.34	25.82	.96	1.85
			(2.7)	(3.3)	(0.4)	(2.0)	(11.8)			

Dependent variable = QSX

Table 7. Correlation coefficients (r) for variables employed in analysis of soybean exports

	1955-73							
	PS	PO	PM	PC	PS/PO	PS/PM	PS/PC	EC9+J
QSX	.78	.58	.73	.56	.22	-.53	.69	.98
PS		.90	.82	.90	-.12	.15	.37	.75
PO			.58	.97	-.43	.36	.10	.49
PM				.59	.20	-.70	.68	.73
PC					-.34	.41	.05	.48
PS/PO						-.54	.64	.35
PS/PM							-.70	-.58
PS/PC								.78

Table 7. (continued)

	1960-73									
	PS	PO	PM	PC	PS/PO	PS/PM	PS/PC	FMPD	BRAZQSX	EC9+J
QSX	.76	.68	.67	.68	-.23	-.29	.42	.91	.78	.98
PS		.93	.79	.95	-.29	-.12	.39	.61	.97	.73
PO			.60	.98	-.58	.10	.11	.68	.90	.60
PM				.62	-.04	-.68	.62	.67	.80	.69
PC					-.45	.09	.08	.68	.89	.60
PS/PO						-.26	.42	-.23	-.29	-.06
PS/PM							-.53	-.29	-.19	-.34
PS/PC								.42	.46	.56
FMPD									.65	.97
BRAZQSX										.76

Table 7. (continued)

	1960-74									
	PS	PO	PM	PC	PS/PO	PS/PM	PS/PC	FMPD	BRAZQSX	EC9+J
QSX	.69	.65	.69	.60	-.28	-.08	.37	.88	.69	.97
PS		.96	.72	.97	-.40	.37	.16	.73	.98	.74
PO			59	98	-.61	.47	-.03	.63	.94	.66
PM				57	-.10	-.36	.55	.62	.71	.71
PC					-.50	.53	-.08	.65	.95	.64
PS/PO						-.37	.44	-.08	-.40	-.16
PS/PM							-.50	.10	.36	-.01
PS/PC								.42	.19	.45
FMPD									.76	.96
BRAZQSX										.76

Table 8. Variable identification for analysis of soybean exports

QSX = total U.S. exports of soybeans, million bushels, Sept.-Aug.

PS = U.S. farm price of soybeans, dollars per bushel, Sept.-Aug.

PM = price of soybean meal, 44% protein Decatur, dollars per short ton, Oct.-Sept.

PO = price of soybean oil (crude, Decatur, tank cars) cents per pound, Oct.-Sept.

PC = U.S. farm price of corn, dollars per bushel, Oct.-Sept.

FMPD = foreign production of oil meals and meal equivalent of oilseeds, converted to soybean meal equivalent, million metric tons (For. Ag. Service series reported in FOP series of Foreign Agr. Circulars.)

BRAZQSX = exports of soybeans from Brazil, million bushels, calendar year 1961 data matched with U.S. crop year 1960.

EC9+J = GDP volume index for EC9 (9 member nations of the European Community) and GNP index for Japan, 1970=100. Weights: EC9= .67, Japan = .33, based on approximate relative shares of U.S. soybean exports in 1971-73. Data for calendar years matched with the previous marketing year, e.g. 1956 with 1955.

S = standard error of the estimate

$\bar{R}^2$ = coefficient of multiple correlation, squared, adjusted for degrees of freedom.

D.W. = Durbin-Watson statistic

t-values are in parentheses

All data are USDA except the EC9 GDP index from official EC statistics and the GNP index for Japan was calculated by ERS from official Japanese statistics. The data are given in the Appendix.

study periods. Actual and estimated values based on equations 5-1 and 5-7 are shown in figures 7 and 8. The statistical and graphic results indicate that these equations successfully portray the major historical changes in U.S. soybean exports.

The net relationship between the price of soybeans and soybean exports is negative. Importers buy fewer U.S. soybeans at high prices than at low prices, if no change occurs in the other variables. Three sets of elasticities were calculated to express the relationship in terms of percentage change.[3/] They are

	Elasticity of PS
Based on average for entire study period	-.81 to -1.27
3 years, 1971-73	-.53 to -1.01
3 years, 1972-74	-.65 to -1.45

Thus, a 10 percent change in the price of soybeans is associated with an opposite change in the volume of exports of 5 to 14 percent. (When PS appears in the numerator of more than one ratio, the elasticity is calculated as the sum of the elasticities of the ratios.) The response of exports to price changes was slightly greater when estimates were based on study periods including 1974.

Fairly significant positive relationships were found between the prices of soybean products, oil and meal, and exports of soybeans. It is

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[3/] It is recognized that the estimated regression coefficients and elasticities presented here may not be good estimates of the "true" values of those parameters because the single equation models do not allow for the simultaneity that exists in reality among prices of soybeans, soybean meal, soybean oil, and corn. Nevertheless, previous experience has shown that OLS results are useful and often do not differ greatly from results obtained from more complex estimating procedures.

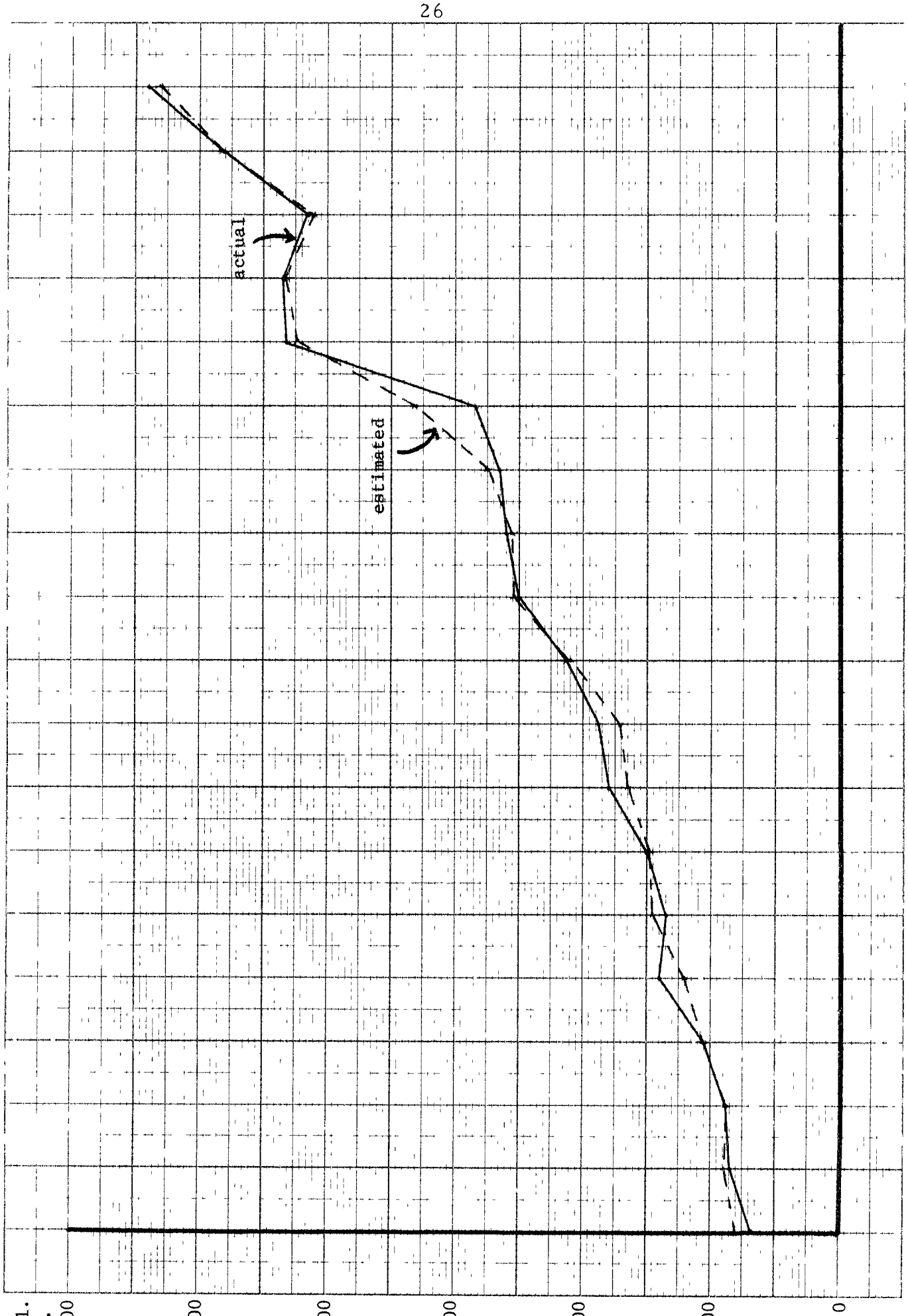

Figure 7. U.S. soybean exports, actual and estimated values 1955-73 (equation 5-1)

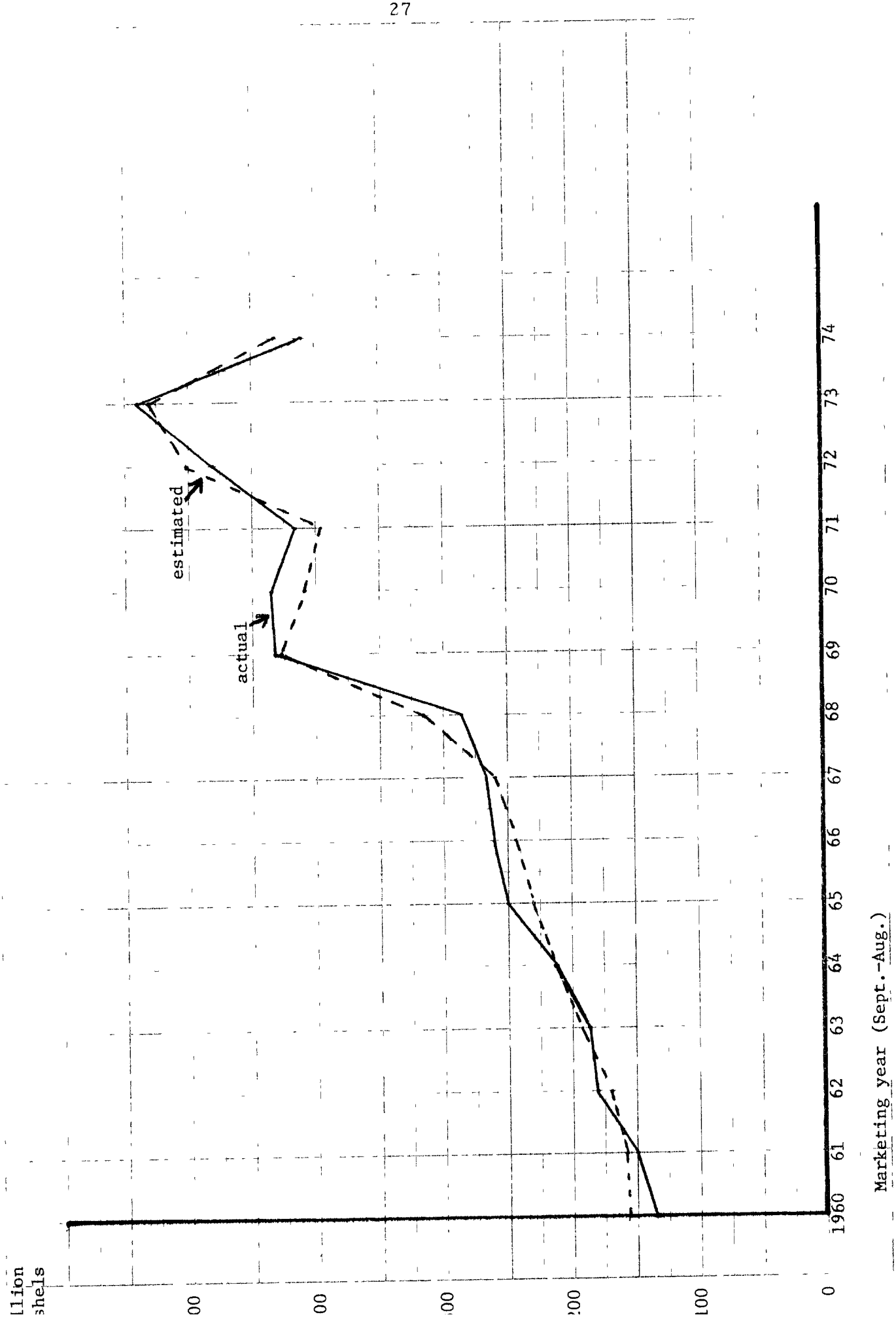

Figure 8. U.S. soybean exports, actual and estimated values 1960-74 (equation 5-7)

plausible to presume that as the prices of soybean meal and soybean oil rise, relative to the price of soybeans, importers who export soybean products import more soybeans to gain from the price increase of their export products. Also, those who import soybeans as well as soybean oil and soybean meal find soybeans a relatively cheaper source of meal or oil when meal and oil prices rise relative to the price of soybeans. Cross price elasticities are

	PO	PM
Based on average for entire study period	.16 to .64	.09 to .45
3 years, 1971-73	.15 to .31	.05 to .17
3 years, 1972-74	.09 to .80	.16 to .30

These estimates are consistent with expectations that own-price elasticity, or effects, generally are greater than cross-price elasticities. The meaning in this context is that a one percent change in the price of meal or oil has less effect on soybean exports than an equivalent percentage change in the price of soybeans. These estimates also indicate that in most specifications, price changes for oil tend to have a greater impact on soybean exports, in percentage terms, than meal price changes. This result also is reasonable since there is a greater variety of substitutes for soybean oil than for soybean meal. Thus, oil importers can readily switch to an alternative source of oil. As was true for the price elasticity of soybeans, elasticities for oil and meal prices were somewhat larger when 1974 was included in the study period.

The competitive relationship between corn and soybeans also was captured by the equations presented. Cross price elasticities fall within the range of .15 to .57, well below the elasticities estimated for PS. The addition of 1974 to the estimation period reduced the size of the regression coefficient, its significance and the elasticity of PC--just the opposite of the results obtained for PS, PM, and PO in most specifications.

These statistical findings support the observation made earlier that recent changes in oilseed markets were extraordinary. The question of why 1974 makes such a difference cannot be answered by an examination of the correlation coefficients (r) for the price variables examined, see table 7. The differences were small between correlation coefficients for the three study periods. It is not apparent at present whether estimates based on a data series ending with 1973 or one ending with 1974 will be better predictors of the future. Some experience with these estimates will be needed to make that judgement.

The correlation coefficients between soybean products generated in this study differ to some extent from those obtained by Houck, et. al. for 1951-67. They are compared in the accompanying tabulation.

	Correlation coefficients	
	Houck, et. al.	Table 7
PS and PO	.35	.90 to .96
PS and PM	.83	.72 to .82
PO and PM	.03	.58 to .60

Oil prices were correlated with meal and bean prices much less in the earlier study.

The variables FMPD and BRAZQSX are additional measures of competition with U.S. soybean exports. Only Brazilian exports of soybeans are accounted for by the variable BRAZQSX; all foreign production of oil meals is included in FMPD. Foreign production of oilseed and fish meals nearly doubled from 1960 to 1974. Forty-two percent of that increase occurred in Brazil where soybean output expanded. Fish meal is the second major component of foreign meal production. It is mainly responsible for large annual fluctuations in foreign supplies of oil meal. For example, the chief cause of dips in foreign meal output in 1969 and 1973 was short supplies of fish meal. Including either FMPD or BRAZQSX in the estimate of U.S. soybean exports improves the explanatory power of the equations--especially those estimated through 1974 (compare equation 5-3 with 5-5 and 5-7). Not surprisingly, the significance of the oil and meal price variables is reduced by including the additional variables measuring competition. Undoubtedly, PO and PM partially reflect the effects of other competitive products when the latter are not explicitly included in the equation.

The income variable, EC9+J, directly measures the effect on U.S. soybean exports of changes in real aggregate income in Japan and the nine nations comprising 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 one of these countries. As populations and incomes in these countries grow, import demand for U.S. soybeans also grows. As mentioned, the demand for soybeans derives from the demand for oil to produce margarine, salad oils and other products, and for meal to be fed to livestock. Rising demands for vegetable oils and for livestock products are characteristic of nations where incomes are relatively high and growing.

An income measure encompassing more countries might provide equivalent or superior statistical results but the variable employed is highly significant and has the advantage of simplicity. The data are readily available and can be updated easily. Nonetheless, the variable may require future modification if the composition of the foreign market for U.S. soybeans should change appreciably.

In the equations spanning 1960-1974, EC9+J for 1974 (calendar year 1975) was assumed to equal its value for 1973. In other words, no aggregate economic growth in importing nations was assumed. In an alternative set of estimates EC9+J was assumed to decrease one percent in 1975. The resulting estimates differed only slightly from those reported. If neither of the assumptions accurately reflect actual economic conditions in 1975, the reported estimates are invalid.

In sum, this analysis suggests that U.S. exports of soybeans are highly dependent upon economic conditions in importing nations and foreign supplies of oilseeds and fish meal.

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. About 3 of every 5 tons of soybean meal exported from the United States is shipped to the European Community and, as mentioned, changes in their demand from year to year accounted for virtually all of the variation in U.S. exports between 1955 and 1974. Hence, livestock feeding in the European Community was the focal point of this part of the research.

Most of the 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 supplied 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.

Until 1963 the United States was the world's sole net exporter of soybean meal. Since then Brazil has become a strong competitor. As shown in figure 6, meal exports from Brazil were about 80 percent as large as U.S. exports in 1974 and 1975.

Fish meal is another source of competition because fish meal and soybean meal are close substitutes in many feed products. The European soybean meal importers have traditionally been major consumers of fish meal. When fish meal supplies are temporarily short they can quickly meet their need for high protein meal by turning to imports of soybean meal.

These considerations led to the specification of the equations in table 9. Actual and estimated values of exports based on equation 9-1 are depicted in figure 9. Correlation coefficients are given in table 10. All variables are defined in table 11.

The prices of soybean meal, soybeans and fish meal, the numbers of hogs and poultry in the six original member nations of the European Community, and exports of soybean meal from Brazil appear in all equations reported. The equations differ by time period and by the form in which prices were entered. In two equations the prices of soybean meal and soybeans are in ratio form.

U.S. exports of soybean meal fall as the price of soybean meal rises if no changes occur in the other factors. Over the 20 year period, a

Table 9. Estimates of U.S. soybean meal exports, regression coefficients and t-values

Eqn. no.	Time period	Constant	PM	PM/PS	PS	PFM	ECPIGS	ECHENS	BRAZQMX	S	$\bar{R}^2$	D.W.
9-1	1955-74	- 8,005.10		-44.49		6.10	.17	3.15	-.64	267.18	.98	2.16
				(2.4)		(4.0)	(5.3)	(2.9)	(3.1)			
9-2	1960-74	-11,009.37		-31.02		5.11	.15	5.62	-.70	236.01	.97	2.83
				(1.5)		(3.0)	(4.7)	(3.8)	(3.6)			
9-3	1955-74	- 9,024.75	-13.91		277.80	7.76	.17	3.00	-.62	272.67	.97	2.15
			(1.9)		(1.0)	(2.5)	(3.3)	(1.7)	(1.3)			
9-4	1960-74	-11,958.83	- 6.38		356.57	4.67	.17	4.74	-.97	235.09	.98	2.80
			(0.8)		(1.4)	(1.4)	(3.8)	(2.7)	(2.2)			

Dependent variable = QMX

Table 10. Correlation coefficients (r) for variables employed in analysis of soybean meal exports

	1955-74						
	PM	PS	PM/PS	PFM	ECPIGS	ECHENS	BRAZQMX
QMX	.73	.73	.36	.65	.97	.96	.78
PM		.76	.67	.96	.69	.66	.74
PS			.06	.69	.73	.72	.95
PM/PS				.66	.31	.30	.09
PFM					.59	.53	.64
ECPIGS						.95	.83
ECHENS							.75

	1960-74						
	PM	PS	PM/PS	PFM	ECPIGS	ECHENS	BRAZQMX
QMX	.66	.69	.20	.67	.95	.96	.77
PM		.72	.63	.98	.61	.60	.69
PS			-.07	.66	.70	.76	.94
PM/PS				.66	.11	.04	-.04
PFM					.58	.57	.61
ECPIGS						.93	.85
ECHENS							.83

Table 11. Variable identification for analysis of soybean meal exports.

QMX = U.S. exports of soybean meal to all destinations, thousand short tons (Oct.-Sept.)

PM = price of soybean meal, 44% protein Decatur, dollars per short ton (Oct.-Sept.)

PS = U.S. farm price of soybeans, dollars per bushel (Sept.-Aug.)

PFM = price of fish meal, European ports, 65% protein, dollars per short ton, reported by the USDA as adjusted for variations in exchange rates, calendar year data, aligned with previous marketing year

ECPIGS = number of hogs in the EC6, in thousands, December census

ECHENS = number of poultry in the EC6, expressed in thousands of animal units (1 head of poultry = .004 animal unit), December census

BRAZQMX = exports of soybean meal from Brazil, thousand metric tons, calendar year data aligned with previous marketing year

S = standard error of the estimate

$\bar{R}^2$ = coefficient of multiple correlation, squared, adjusted for degrees of freedom

D.W. = Durbin-Watson statistic

t-values are in parentheses.

All data are from USDA sources.

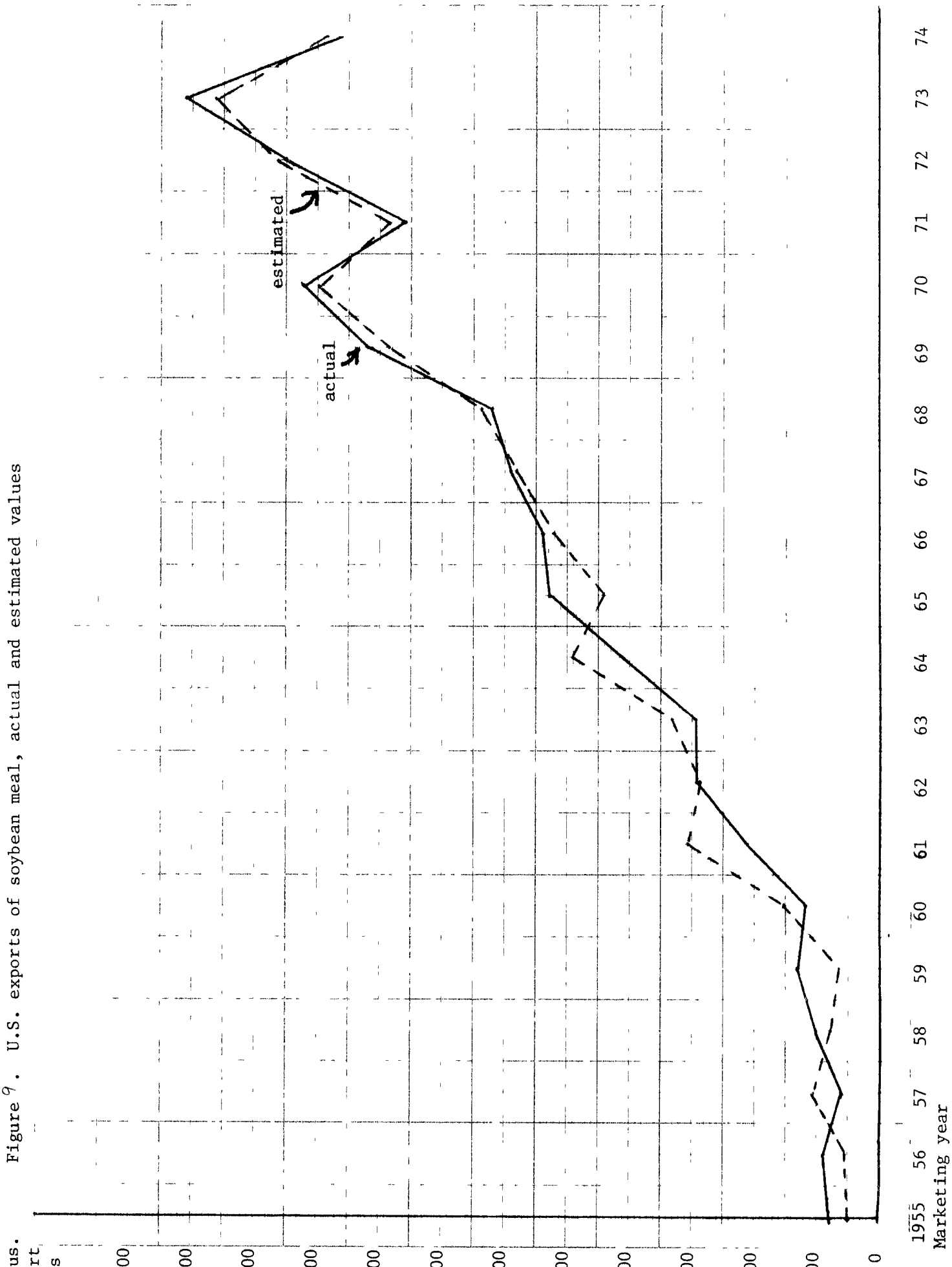

Figure 9. U.S. exports of soybean meal, actual and estimated values

10 percent increase in the price of soybean meal was associated with a 2 to 5 percent decrease in meal exports. Competitive relationships with soybeans and fish meal were accounted for by including the U.S. price of soybeans and the European price of fish meal in the estimation. The findings indicate that U.S. soybean meal exports grew 3 to 5 percent when soybean prices advanced 10 percent or when the price of fish meal rose 10 percent.

The estimated price and cross-price elasticities calculated from the results reported in table 9 are

	Elasticities of		
	PM	PS	PFM
Based on average for			
entire study period	-.20 to -.54	.31 to .54	.29 to .56
3 years, 1972-74	-.17 to -.48	.17 to .46	.34 to .56

There is no substantial difference in price responsiveness between the early 1970s and the average of the past 20 years. Also, own price and cross-price responsiveness are approximately of the same magnitude, suggesting that U.S. soybean meal exports are affected about the same by competing product price changes as by soybean meal price changes. However the regression coefficients for the price variables reported in table 9 and hence the elasticities, must be interpreted somewhat cautiously because they are not highly significant (also see footnote 3). High intercorrelation between PM and PFM (r = .96 to .98) and PS and BRAZQMX (r = .94 to .95)

contribute to estimation difficulties. Despite these statistical problems, the price response results are reasonable and are potentially useful for prediction. The estimates based on the longer time period are slightly more significant and thereby may be somewhat more reliable than those obtained from equations 9-2 and 9-4.

Competition between U.S. and Brazilian soybean meal exports was captured by these equations. For each one ton increase in meal exports from Brazil, U.S. exports fall from two-thirds to one ton.

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.

Both hog and poultry numbers trended upward during the study period so they are highly correlated ($r = .93$ to $.95$). Nevertheless, annual variations in each differed sufficiently to permit strong, separate relationships with QMX to emerge. The responsiveness of U.S. soybean meal exports to changes in hen numbers is greater for the 1960-74 time period than when the earlier years are included. These statistical results are compatible with changes that occurred in the European poultry sector in the past 10 to 15 years. During that period commercial broiler and egg industries were developed that utilized more high protein meals than the former form of production which relied more on nonspecialized operations.

Over the study periods, 97 to 98 percent of the variation in U.S. exports of soybean meal was accounted for by the variables discussed. As was true for soybean exports, U.S. meal exports depend almost entirely upon conditions abroad.

Concluding Comments

The prime intent of this analysis of U.S. soybean and soybean meal exports was to develop reasonably simple models for predicting future levels of exports. To test in part how successful we were, export levels of soybeans were calculated for marketing years 1974 and 1975 from several equations in table 5 and appendix table B-1.[4/] They are

Equation no.	Estimate for 1974	1975
	million bushels	
5-1	495	547
5-3*	429	508
5-5*	417	449
5-6	478	511
5-7*	411	451
B-1	492	504
B-4	429	440
B-5*	410	424

*These four equations were estimated through 1974 using preliminary 1974 data. The regression coefficients generated by those data were then applied to revised 1974 data to obtain the estimates of exports in 1974 presented here. The other four equations were estimated through 1973; 1974 estimates of exports were calculated from the revised 1974 data. Estimates for 1975 for all equations employed projected data for the independent variables.

[4/] Estimations reported in appendix table B-1 employed wholesale prices of soybeans in lieu of prices at the farm level. The purpose and results of this exercise are discussed in appendix B.

Actual soybean exports in 1974 were 421 million bushels. The lowest estimate, 410 million bushels, is 3 percent too low; the highest is 18 percent too high. Most equations indicate a modest rise in exports for marketing year 1975. The official USDA estimate of exports for 1975 is 525 million bushels.

Four estimates of U.S. soybean meal exports in 1974 and 1975 were also calculated. They are

Equation no.	Estimate for 1974	Estimate for 1975
	thousand short tons	
9-1	4417	4470
9-2	4384	4476
B-9	4448	4230
B-10	4386	4497

Actual 1974 meal exports were 4299 thousand tons. These estimates are within 3 percent of actual exports. Three equations indicate a 1 to 2 percent rise in meal exports in 1975/76, based on projected data for the independent variables. Equation B-9 indicates a small contraction. Together they suggest little or no change for 1975. The official USDA estimate is 4,500,000 tons for 1975.

One limitation of this study is that effects of changes in the exchange rate of the dollar vis-a-vis other currencies have not been explicitly accounted for. Since 1971 no fixed rate of exchange has existed between the United States and many of its major trading partners. Fluctuations in exchange rates introduce a new source of variation into relationships between prices of commodities exported from the United States and those in other nations. This problem has been reduced by employing ratios of U.S. prices

in most specifications. (All estimates for 1974 and 1975 were based on equations which had prices in ratio form.) The impact of changes in the value of the dollar applies equally to all U.S. prices and hence relative prices of U.S. products are not affected by variations in exchange rates.

Appendix Table A

DATA FOR ANALYSIS OF SOYBEAN AND SOYBEAN MEAL EXPORTS, 1955-74[a]

MKTG YEAR	QSX	QMX	PS	PM	PO	PC	PFM[c]	FMPD	EC9+J[c]	ECPIGS[d]	ECHENS[d]	BRAZQMX	BRAZQSX	PSI
	MBU	TST	$/BU	$/ST	C/LB	$/BU	$/ST	MMT				TMT	MBU	$/BU
55.	68.6	400.4	2.22	52.55	12.5	1.35	142.0	b	43.3	30118.	1099.	0	0	2.51
56.	83.7	443.2	2.18	47.45	12.7	1.29	132.4	b	45.7	30033.	1104.	0	0	2.33
57.	88.4	300.0	2.07	53.40	10.8	1.11	145.7	b	46.9	31731.	1127.	0	0	2.20
58.	105.0	512.2	2.00	55.80	9.5	1.12	140.2	b	49.7	31102.	1156.	0	0	2.12
59.	139.9	648.7	1.96	55.55	8.3	1.05	93.8	b	54.0	32009.	1185.	0	0	2.07
60.	134.7	589.7	2.13	60.60	11.3	1.00	111.2	17.9	58.0	33357.	1219.	0	2.6806	2.53
61.	149.4	1063.7	2.28	65.60	9.5	1.10	124.0	18.8	60.9	36095.	1289.	0	3.5588	2.41
62.	180.5	1475.5	2.34	71.30	8.9	1.12	120.9	19.9	64.3	35772.	1331.	62	1.2479	2.50
63.	187.2	1478.4	2.51	71.00	8.5	1.11	134.1	20.0	69.3	35328.	1365.	44	0	2.59
64.	212.2	2059.1	2.62	70.20	11.3	1.17	165.0	20.9	72.4	37979.	1410.	105	2.7731	2.81
65.	250.0	2656.1	2.54	81.50	11.8	1.16	159.0	22.7	76.1	38127.	1430.	185	4.4369	2.91
66.	261.6	2705.3	2.75	78.80	10.1	1.24	140.0	23.1	80.5	39138.	1476.	125	11.1848	2.86
67.	266.6	2959.8	2.49	76.90	8.4	1.03	121.0	24.8	86.8	42971.	1468.	235	2.4030	2.61
68.	286.8	3099.9	2.43	74.10	8.4	1.08	161.0	25.6	93.6	43058.	1471.	295	11.4158	2.54
69.	432.6	4102.1	2.35	78.40	11.2	1.16	178.0	24.8	100.0	47319.	1542.	525	10.6301	2.53
70.	453.8	4620.6	2.85	78.50	12.8	1.33	155.0	26.8	104.7	51470.	1541.	911	7.8571	3.00
71.	416.8	3805.0	3.03	90.20	11.3	1.08	169.0	28.1	110.5	49810.	1556.	1405	38.1298	3.24
72.	479.5	4745.0	4.37	229.00	16.5	1.57	497.0	28.1	118.3	49868.	1556.	1581	65.6295	6.22
73.	539.1	5548.0	5.68	146.35	31.5	2.55	338.0	27.3	119.1	51365.	1659.	2021	100.3390	6.12
74.	410.0	4400.0	6.25	130.00	30.7	2.95	219.0	31.4	119.1[e]	52692.	1659.[e]	3000	131.7210	6.36

[a]Variables are described in tables 8 and 11, except PSI, which is soybean price, no. 1 yellow, Illinois points.

[b]Data series began in 1960.

[c]Calendar year data matched with previous marketing year, e.g. 1956 calendar year matched with 1955 marketing year.

[d]Census data from December or January each year.

[e]Calendar year 1975 value assumed unchanged from 1974.

APPENDIX B

Estimates of soybean exports reported in tables 5 and 6 and soybean meal exports in table 9 employed average farm prices for soybeans and corn because those are the prices that enter into the USDA model of the U.S. soybean economy. Alternative estimates were also made in which wholesale prices for soybeans and corn were utilized. These alternative estimates are presented and discussed in this appendix.

The purposes of investigating wholesale prices of corn and soybeans were: (1) they are one step closer to the point of export and thereby more likely to represent prices viewed by importers, and (2) they are obtained from a similar level in the marketing system as that from which the prices of soybean meal and soybean oil were taken, thus making all prices more comparable.

Annual wholesale prices of soybeans (PSI) and farm prices are closely related, as shown in figure 1 in the first section of this paper. The simple correlation coefficient (r) is .96. But 1972 and 1974 reveal unusual circumstances. The gap between average annual wholesale prices in 1972 and farm prices was exceptionally large. Then, in 1974 farm prices averaged higher than wholesale prices ($6.64 and $6.33, respectively).* To examine these situations, monthly prices were graphed in figure B.

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*These are revised data. A preliminary farm price of $6.25, given in table A, entered into the estimates presented in this paper unless it is stated that revised 1974 data were used.

Figure B. Monthly soybean prices, average U.S. farm price and wholesale price at Illinois points, Oct. 1971-Sept. 1975

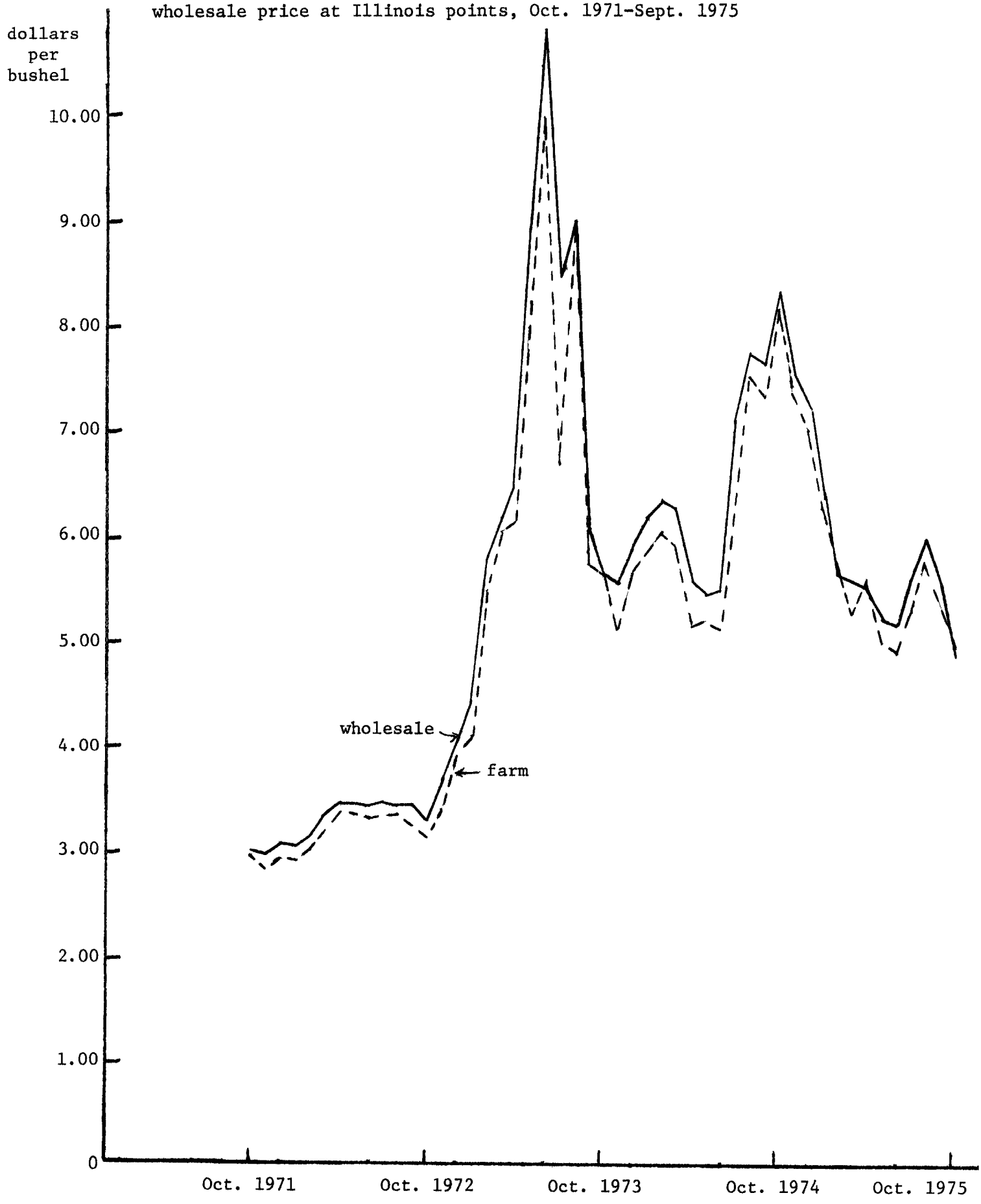

Figure B shows that monthly prices in the two locations were parallel. This suggested that the divergent picture of annual prices resulted from the pattern of marketings. In 1972 apparently farmers sold more of their beans at the lower prices early in the marketing year. And the opposite situation must have prevailed in 1974 when heavy early marketings by farmers yielded a higher average annual farm price than the 12-month average wholesale price. (The farm price series, PS, is weighted by farm marketings. The wholesale series, PSI, is a simple average of monthly prices.)

Soybean Exports

To facilitate direct comparison between estimates employing the farm price series and those employing the wholesale price series, the same set of equations in tables 5 and 6 was reestimated with wholesale prices. First, the wholesale price of soybeans (PSI) was substituted for PS. Then, retaining PSI, the wholesale price of corn (PCO) was substituted for PC. When PSI was entered in combination with either corn price, no significant relationship was found between the corn price variable and the dependent variable, U.S. soybean exports. Because of its lack of significance, the price of corn was deleted from the specifications and the set of ten equations estimated once more. The results from this final set are presented in appendix table B-1. Correlation coefficients involving the wholesale prices of soybeans and corn are given in table B-4; elasticities generated from these specifications are summarized in table B-3.

In general the results in table B-1 are slightly superior to those

in tables 5 and 6 for explaining historical movements in exports of U.S. soybeans. In all cases estimated or predicted exports for marketing year 1974 are closer to actual exports and the $\bar{R}^2$'s are the same or larger. In most cases the standard errors of the estimates (S) are smaller.

The substitution of the wholesale price for the farm price of soybeans resulted in greater responsiveness of exports to prices of soybeans, soybean meal and soybean oil. The pattern persisted that price responsiveness was greater when 1974 was included in the estimation period than when 1973 was the final year.

Competitive relationships were not established between U.S. soybean exports and corn or between exports of soybeans from the United States and Brazil. (The measure of Brazilian-U.S. competition obtained in equation 5-5 was not highly significant. The t-ratio was 1.4.) However, when Brazilian soybean exports are not singled out but included as a component of FMPD (foreign meal production, expressed in soybean meal equivalent) strong substitution is captured. The significance of FMPD is greater in table B-1 than in table 5 and the difference between the specification based on 1960-73 and on 1960-74 is reduced. Hence, the regression coefficients here are likely to be more reliable.

The variable measuring income in importing nations, EC9+J, was also affected by the change from farm level to wholesale prices for soybeans. The estimated regression coefficients for equations B-1 to B-3 and B-5 to B-8 are somewhat smaller than their counterparts in tables 5 and 6. An opposite change occurred in equation B-4 where the size increased. In all cases the significance of the income variable rose. As was true for

FMPD, the difference between B-4 (ending with 1973) and B-5 (ending with 1974) was reduced, again indicating that these estimates are probably more reliable.

Soybean Meal Exports

The four equations from table 9 were reestimated, substituting PSI for PS. Results are given in table B-2.

This substitution had less overall effect on soybean meal export estimates than in the case of soybean exports. Regression coefficients and elasticities of PM and PSI are somewhat greater in table B-2 than those reported in table 9. Changes in the other variables were small.

Correlations (r) involving PSI are

	1955-74		1960-74	
	PSI	PM/PSI	PSI	PM/PSI
QMX	.73	.38	.70	.15
PM	.90	.49	.88	.39
PFM	.84	.44	.83	.43
ECPIGS	.72	.33	.69	.05
ECHENS	.69	.38	.71	.01
BRAZQMX	.91	-.02	.90	-.23

As expected, correlations between PSI and PM and between PSI and PFM are larger than parallel correlations with PS (see table 10).

Conclusion

Estimates based on wholesale soybean prices (PSI) have slightly superior statistical properties than those employing farm prices. Therefore, equations from tables B-1 and B-2 are preferable as single equation estimators of U.S. exports. Nevertheless, because of compatibility

with the USDA soybean model, equations containing the farm price may be more useful to incorporate into that simultaneous system.

Appendix Table B-1. Estimates of U.S. soybean exports, regression coefficients and t-values

Eqn. no.	Time period	Constant	PSI/PO	PSI/PM	PSI	PO	PM	EC9+J	FMPD	S	$\bar{R}^2$	D.W.
B-1	1955-73	95.73	-682.94 (4.5)	-3353.84 (2.1)				5.93 (28.2)		18.05	.98	1.96
B-2	1960-73	162.57	-739.36 (4.0)	-4986.35 (2.1)				6.02 (21.6)		19.31	.98	1.60
B-3	1960-74	364.41	-914.07 (4.7)	-8634.92 (4.6)				5.71 (21.4)		21.97	.97	1.67
B-4	1960-73	276.82	-650.68 (4.3)	-5033.01 (2.7)				8.33 (9.4)	-14.45 (2.7)	15.16	.99	1.82
B-5	1960-74	342.49	-675.31 (4.7)	-5915.55 (4.1)				8.60 (10.9)	-16.63 (3.8)	14.83	.99	1.77
B-6	1955-73	-174.41			-143.36 (4.1)	17.29 (5.1)	2.59 (3.8)	5.64 (24.6)		16.33	.99	1.76
B-7	1960-73	-168.98			-154.27 (3.4)	18.55 (4.2)	2.79 (3.2)	5.59 (15.7)		18.47	.98	1.56
B-8	1960-74	-153.25			-187.35 (6.4)	21.30 (6.2)	3.46 (6.2)	5.54 (15.8)		18.43	.98	1.48

Dependent variable = QSX

All variables are identified in table 8 except PSI, which is the wholesale price of No. 1 soybeans at Illinois points.

Appendix Table B-2. Estimates of U.S. soybean meal exports, regression coefficients and t-values

Eqn. no.	Time period	Constant	PM	PM/PSI	PSI	PFM	ECPIGS	ECHENS	BRAZQMX	S	$\bar{R}^2$	D.W.
B-9	1955-74	- 7,994.27		-60.08		4.82	.16	3.57	-.64	277.29	.97	2.12
				(2.1)		(3.9)	(5.0)	(3.1)	(2.8)			
B-10	1960-74	-11,303.32		-56.12		4.62	.15	6.29	-.79	224.44	.98	2.92
				(1.8)		(3.9)	(5.1)	(4.7)	(3.8)			
B-11	1955-74	- 9,232.52	-17.81		319.82	7.61	.16	3.33	-.60	271.64	.97	2.16
			(2.4)		(1.1)	(2.5)	(3.5)	(2.2)	(1.4)			
B-12	1960-74	-12,832.64	-11.11		539.96	3.47	.18	5.08	-1.15	215.86	.98	2.91
			(1.5)		(2.0)	(1.0)	(4.6)	(3.6)	(2.8)			

Dependent variable = QMX

All variables are identified in table 11.

Appendix Table B-3. Price elasticities and cross-price elasticities generated in the analysis of U.S. exports of soybeans

Elasticity of PSI	
Based on average for	
entire study period	-1.18 to -2.07
3 years, 1971-73	- .66 to -1.67
3 years, 1972-74	- .86 to -2.45
Elasticity of PO	
Based on average for	
entire study period	.58 to .93
3 years, 1971-73	.39 to .77
3 years, 1972-74	.37 to 1.22
Elasticity of PM	
Based on average for	
entire study period	.51 to 1.04
3 years, 1971-73	.25 to .91
3 years, 1972-74	.49 to 1.17

Appendix Table B-4. Correlations coefficients between wholesale price variables and other variables in soybean analysis

	PSI	PSI/PO	PSI/PM	PSI/PC	PSI/PCO	PCO
			1955-73			
QSX	.75	.34	-.54	.62	.50	.67
EC9+J	.72	.46	-.60	.69	.57	.60
PO	.82	-.27	.18	.23	.18	.97
PM	.94	-.10	.04	.86	.21	.67
PC	.82	-.20	.15	.18	-	-
PSI		.30	-.29	.70	.66	.87
PSI/PO			-.82	.75	.74	-.10
PSI/PM				-.66	-.62	.04
PSI/PCO						.21
			1960-73			
QSX	.73	-.02	-.27	.41	.23	.75
EC9+J	.71	-.13	-.35	.50	.30	.69
BRAZQSX	.94	-.02	-.04	.51	.43	.92
FMPD	.60	.22	-.41	.48	.27	.56
PO	.84	-.37	.27	.20	.15	.97
PM	.93	.44	-.50	.83	.77	.67
PC	.84	-.29	.20	.16	-	-
PSI		.15	-.19	.66	.60	.88
PSI/PO			-.78	.66	.64	-.22
PSI/PM				-.58	-.49	.12
PSI/PCO						.15
			1960-74			
QSX	.71	-.09	-.06	.35	.18	.65
EC9+J	.76	-.01	.01	.37	.21	.72
BRAZQSX	.94	-.25	.45	.20	.17	.96
FMPD	.71	.00	.08	.30	.13	.71
PO	.89	-.49	.58	.02	-.01	.98
PM	.88	.32	-.21	.75	.70	.62
PC	.88	-.43	.60	-.05	-	-
PSI		-.06	.25	.43	.39	.91
PSI/PO			-.77	.68	.65	-.39
PSI/PM				-.56	-.48	.53
PSI/PCO						-.02

- indicates that no correlation was calculated.

All variables are defined in table 8 except PSI, which is the wholesale price of No. 1 soybeans at Illinois points, and PCO, which is the wholesale price of No. 2 corn at Omaha.

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Houck, J. P., M. Ryan, and A. Subotnik, Soybeans and Their Products, Minneapolis, Univ. of Minnesota Press, 1972.

Jones, James R., and W. R. Morrison, Import Demand for Soybeans and Soybean Products in Eastern Europe, Agr. Experiment Station Bulletin No. 803, Fayetteville, Univ. of Arkansas, March 1976.

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(For earlier work see citations in the above publications.)

Supplement

1. The data listed below were used to calculate the estimates of U.S. soybean and soymeal exports for 1974 and 1975 presented on pages 39 and 40 of the staff paper.

	1974 (revised)	1975
QSX	421.0	525.0
QMX	4299.0	4500.0
PS	6.64	4.63
PSI	6.33	4.95
PM	130.85	124.60
PO	30.7	18.4
PC	3.02	2.44
PFM	219.0	280.0
FMPD	31.4	33.3
EC9+J	118.1	122.3
ECPIGS	52692.0	53219.0
ECHENS	1659.0	1676.0
BRAZQMX	3000.0	3300.0
BRAZQSX	131.72	171.0

2. Equation B-5 can be modestly improved by the addition of the variables ECPIGS and ECHENS. The $\bar{R}^2$ is raised from .9871 to .9886; the Durbin-Watson statistic is increased from 1.77 to 1.98; and the standard error of the estimate is reduced from 14.83 to 13.94. The equation containing those two variables is not reported because the t-values of ECPIGS and ECHENS are less than 2.0 and the estimate for 1975 is very close to that obtained from equation B-5.