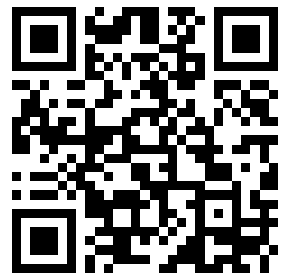

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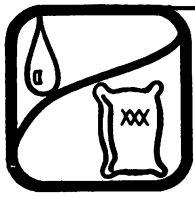
REGIONAL SOYBEAN ACREAGE RESPONSE ANALYSIS AND PROJECTIONS FOR 1974



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APPENDIX*

Calculation of Effective Prices

Soybeans. The effective soybean price (PSE) is the greater of the lagged market price or the announced support rate. Since 1948 soybean market prices have exceeded the support price in all but five years. In 1972 and 1973, PSE in the Corn Belt, Lakes, and Plains regions was adjusted for acreage set-aside provisions. The Agriculture Act of 1970 replaced the corn acreage diversion program with a set-aside program under which participating farmers were required to set-aside to a conserving use an acreage designated by the Secretary of Agriculture. The set-aside requirements were expressed as a percentage of the corn base which was computed as the average acreage planted to corn in 1959-60. In 1971 only corn prices were adjusted for set-aside requirements. In 1972 and 1973 acreage planted to soybeans was considered planted to feed grains. This provision made soybeans much more substitutable for corn. In 1972 and 1973, a farmer with a corn base could, after meeting his set-aside requirements, plant all or none of his corn base to either corn or soybeans and still receive set-aside payments. This feature of the set-aside program necessitated the adjustment in both the soybean and corn price variables in 1972 and 1973.

Decreasing (increasing) set-aside requirements has the effect of increasing (decreasing) the acres available for corn and soybeans. The problem is to determine the effect on corn and soybean acreage of changing the set-aside provisions. The changes in soybean and corn acreage from the previous year (ΔS and ΔC respectively) are directly proportional to the change in set-

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*Appendix not included as part of original article in the Fats and Oils Situation.

aside acreage, ΔSA. The change in set-aside acreage is calculated as:

$$\Delta SA = [SA(-1) - SA]$$

where:

SA(-1) = previous year acreage set-aside

SA = the product of the simple average of the minimum and maximum percentages of the base acreage times base acreage.

To estimate ΔS and ΔC, it is assumed that the percentage of acres in soybeans (SP) and corn (CP) relative to total corn and soybean acreage remains relatively constant from year to year. Given SP and CP, ΔS and ΔC are calculated as:

$$\Delta S = \Delta SA \cdot SP$$

and

$$\Delta C = \Delta SA \cdot CP.$$

The effective soybean price is computed as:

$$PSE = \frac{S(-1) + \Delta S}{S(-1)} \cdot PS(-1)$$

where

S(-1) = lagged soybean acreage, and

PS(-1) = lagged soybean market price.

Corn. Effective corn prices were calculated in a number of ways depending upon the program provisions in effect. For the years 1948 and 1949, 1951-53, 1959-60, PCE is the larger of lagged market price or the announced support rate. During 1950 and 1954-58 acreage allotments were imposed in the commercial corn area and the effective corn price for these years is calculated as:

$$PCE = PC(-1)\left[\frac{A}{B} + Q\right]$$

where

PC(-1) = the lagged market price which exceeded support rates for these years

A = the acreage allotment for the commercial area

B = base acreage (average acreage planted in 1948-49 for 1950; average acreage in 1951-53 for 1954-58)

Q = percent of total corn acreage in the non-commercial area for the base years.

For 1961-70, the lagged market price was taken to be the effective corn price. A dummy variable for the years 1961-70 was employed to account for the effects of the corn acreage diversion program. One factor influencing the level of participation in the diversion program is the expected market price. By including the lagged market prices and the dummy variable, the interaction of market and policy factors is determined. The lagged market price adjusted for acreage set-aside requirements was considered the effective corn price during 1971-73. The effective corn price (PCE) in 1971, 1972, and 1973 is calculated as:

$$PCE = \frac{C(-1) + \Delta C}{\text{Base Acreage}} \cdot PC(-1)$$

where (PC - 1) is the lagged market price and the base acreage is 82.1 million acres.

Cotton. The effective cotton price is determined as:

$$PCTE = PCTS \left(\frac{A}{B}\right)$$

where

PCTS = the support price for cotton

A = national cotton acreage allotment

B = historical base acreage (in 1950 the base average equals average cotton acreage in 1948-49; for 1954-1972, the base acreage equals average annual cotton acreage for the years 1951-53).

For the years 1971-73 the national acreage allotment was changed to a domestic allotment and marketing quotas were abolished. The domestic allotment was substantially less than any previous allotment, but acreage planted above the allotment was still eligible for the loan rate of $0.20 per pound. Production within the allotment was supported at a rate of $0.35 per pound. This program presented some problems in constructing the cotton price variable for these years. In a sense cotton acreage was not restricted due to the abolition of the marketing quotas. However, to enter cotton prices in the model under the assumption of no acreage restrictions is equivalent to assuming that producers could adjust acreage upward to the base level in the span of one year. This would entail an increase of 145 percent above the 1970 acreage. An increase of this magnitude was considered unrealistic and cotton acreage was restricted to roughly the 1970 level. The 1970 allotment was 61 percent of the base acreage. The 1971 and 1972 domestic allotments were 41 percent of the base. The 1973 domestic allotment was 35.6 percent of the base acreage. The effective cotton prices for 1971-73 were calculated on the assumption that producers would be unlikely to expand acreage beyond 70 percent of the historical base acreage. The effective cotton prices were calculated as:

$$PCTE = \left[\frac{AD}{B}\right] PCTS + \left[0.70 - \frac{AD}{B}\right] PCT(-1)$$

Where AD is the national domestic allotment. The term in the brackets to the right of the plus sign measures the difference between the upper bound (70 percent of base) and the national domestic allotment. For this acreage the lagged market price, PCT(-1), is used since for these years it exceeded the loan rate. For example the effective price for 1971 is calculated as PCTE = (0.41) (PCTS) + (0.29) PCT(-1).

Oats. The effective oats price (POE) is in all cases the maximum of the lagged market or current support price.

Supply Elasticities

To determine the relative price effects on soybean acreage, the direct and cross price elasticities were computed at the data means. These estimates are given below. Given recent prices relative to past price levels, these elasticities should be used cautiously since the elasticities presented are only applicable at price levels near historical average prices.

Short-run acreage elasticities estimated at data means from regional functions for 1948-72

Region	Price			
	Soybeans	Corn	Cotton	Oats
Corn Belt	0.44	-0.38	---	---
Lakes	0.68	-0.63	---	---
Plains	1.34	-0.87	---	---
Delta	---	---	-0.27	---
Atlantic	0.55	---	---	-0.70
Other	0.66	---	-0.22	-0.46
U.S.	0.46	-0.32	-0.05	-0.07

REGIONAL SOYBEAN ACREAGE RESPONSE ANALYSIS AND PROJECTIONS FOR 1974[1]

by

R. Samuel Evans and David E. Kenyon*

ABSTRACT: Regional acreage response equations were developed to measure the impact of price, government programs, and lagged acreage on harvested soybean acreage. Effective prices for soybeans, corn, cotton, and oats were computed incorporating market prices, support prices and the main supply increasing or decreasing effects of allotments, diversion payments, and set-aside provisions. Special attention was given to the impact on harvested soybean acreage of the Feed Grain Programs of 1961-70. The equations were developed to permit projections of soybean acreage based on data available through March of the current year. For the period 1948 to 1973, the model explains 99 percent of the variation in soybean acreage, and for the period 1966-73, projections averaged within three-fourth million acres of actual harvested acreage.

KEY WORDS: Soybeans, supply functions, supply projections, acreage allotments, acreage diversions, acreage set-asides.

The recent high prices for soybeans, soybean meal, and soybean oil have increased pressure to accurately predict future supplies and prices. To help meet this need, we developed and analyzed regional acreage supply functions for soybeans for 1948-73. Particular attention is given to the measurement and analysis of the effects of government commodity price—support programs on harvested soybean acreage. Detailed attention was given to the effect of the feed grain programs of the 1960's and the set—aside programs of 1971-73 on soybean acreage harvested. The supply model used to determine the regional acreage response equations is briefly presented. The main emphasis is placed on the results obtained and the ability of the model to project harvested acreage 6 to 9 months in advance.

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The Supply Model

Several recent studies of acreage supply response (1 through 6)[2] have included the impact of government programs on acreage response either independently or jointly with price variables. This study follows a similar procedure. Soybeans, unlike the other major grain and oilseed crops, have not been tied to acreage restrictions of any kind. However, soybean production is affected by acreage restricting programs applied to competing crops such as corn and cotton. Although soybeans have not been permitted on diverted acreage, soybeans competed effectively with other crops for the remaining non-restricted acreage. Consideration of these program provisions led to the calculation of effective support prices for those crop prices included in the regional functions.

The general form of each regional acreage supply function for soybeans is:

$$A = f(PSE, PCE, DV, A(-1))$$

where

A = harvested acreage of soybeans
PSE = effective price of soybeans
PCE = effective price of competing crop in the region

[2]Numbers in parentheses are references listed at the end of this paper.

DV = 0-1 dummy variable to determine the effect of the feed grain acreage diversion program in 1961-70

A(-1)= harvested acreage of soybeans last year.

Effective Prices

The relevant effective price for each crop considered is generally the higher of the adjusted lagged market price or the current support rate. Market prices for each crop were adjusted on the basis of applicable support rates, allotments, diversions payments and set-aside provisions. For example, the effective price of cotton (PCTE) is determined as:

$$PCTE = PCTS\left(\frac{A}{B}\right)$$

where

PCTS = the support price for cotton

A = national cotton acreage allotment

B = historical base acreage.

Since the national cotton acreage allotment (A) was less than the historical base acreage (B), the impact of including these program provisions in the calculation of the effective price of cotton is to reduce the price. At the lower price, less cotton is supplied, generating exactly the effect the government program was designed to accomplish. Similar procedures were used to compute effective prices for the other crops.[3]

Diversion Payments

Increases or decreases in the quantity of feed grain acreage diverted under the 1961-70 Feed Grain Programs should have little direct effect on soybean acreage since soybean production was not permitted on diverted acreage. When acreage was taken out of diversion and made eligible for production, soybeans were not substituted for corn since price support payments were not made on that portion of the feed grain base devoted to soybeans. However, by restricting corn acreage, the diversion payment program had the indirect effect of making soybeans more competitive with the other feed grains, cotton and hay. In other words, this program stimulated the expansion of soybean production on land that might have otherwise been planted primarily to corn. A 0-1 dummy variable was included in the model to determine the impact on soybean acreage of the feed grain programs of 1961-70.

Lagged Soybean Acreage

A 1-year lag in acreage is included in each equation in recognition of rigidities in the system that normally restrict rapid adjustment. On a regional basis, fixed machinery complements, land restrictions, management expertise, and market considerations restrict the amount of yearly adjustment in response to relative price changes. Thus, lagged acreage is a good indication of short-run changes in acreage. Both 1-year and 2-year lags on harvested acreage were included in each equation. The 2-year lag variable was significant only in the Corn Belt Region.

Statistical Results

The results of estimating the regional supply equations are in table 21. The most significant variable in terms of affecting acres of soybeans harvested was the lagged acreage variable in each equation. The effective price of soybeans had the expected positive sign in all regions and was statistically significant at the 5 percent level in all equations except the Delta. The effective price of cotton as defined determines soybean acreage in the Delta Region rather than the price of soybeans.

The effective price of corn had a significant impact in the Corn Belt, Lakes, and Plains regions. Increases in effective corn prices produced significant reductions in soybean acreage harvested. In the Atlantic and other regions, the effective price of oats entered the model as the crop affecting the acreage of soybeans harvested. An analysis of acreage trends in these two regions revealed that the expansion of soybean acreage has come almost entirely at the expense of oat acreage.

The diversion payment dummy variable was statistically significant at the 5 percent level in the Corn Belt and Plains regions and entered the Lakes Region equation as an important variable. This is consistent with the hypothesis that soybean acreage expanded as a result of restricted corn acreage. The diversion payment dummy variable was not significant in those regions where the effective corn price did not enter the equation as a competitive crop with soybeans. The absolute impact on soybean acreage harvested in a given year is relatively small compared with the effects of the other variables. However, due to the lagged acreage variable, the aggregate impact of the Feed Grain Programs during 1961-70 was to increase soybean acreage by approximately 10 million acres. This is approximately one-half of the total increase in soybean acreage from 1960 to 1970.

A U.S. aggregate model was obtained by horizontally summing the regional supply functions. The aggregate model explains approximately 99 percent of the variation in total soybean acreage.[4]

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[3]The procedures used in developing effective prices may be obtained on request from the authors.

[4]This estimate was computed by weighting the R^2's for each region by the proportion of that region's acreage variance to the total acreage variance.

Table 21.--Regional acreage response equation for soybeans (dependent variable is A), based on 1948-73 data

Region	PSE	PCE	POE	PCTE	DV	A(-1)	A(-2)	Constant	R^2	D.W.	S.E.
											Acres
Corn Belt	2644	-4856			496	0.5483	0.2978	2181	0.995	2.26	446,400
(t)	10.9	-7.6			2.1	4.2	2.4	2.5			
Lakes	735	-1411			206	0.6596		820	0.954	1.87	269,600
(t)	6.4	-4.8			1.5	8.0		1.9			
Plains	707	-954			283	0.5917		-123	0.960	2.35	175,900
(t)	8.8	-5.5			2.8	6.7		-0.5			
Delta				-5217		0.9668		1553	0.987	2.21	347,600
(t)				-2.9		32.2		3.4			
Atlantic	374		-1769			0.8518		632	0.985	2.23	119,100
(t)	4.4		-3.5			16.2		2.3			
Others	425		-1089	-1695		0.9573		258	0.989	1.76	156,600
(t)	3.5		-1.7	-1.6		20.5		0.9			

A = Harvested soybean acreage, thousands of acres.
PSE = Effective soybean price, $/bu.
PCE = Effective corn price, $/bu.
POE = Effective oats price, $/bu.
PCTE = Effective cotton price, $/lb.
DV = Dummy variable for feed grain acreage diversion program (1961-70 = 1, otherwise = 0).
A(-1) = Harvested acreage last year, thousands of acres.
A(-2) = Harvested acreage two years previous, thousands of acres.
t = t test value.
Corn Belt = Ohio, Indiana, Illinois, Iowa, Missouri.
Lakes = Michigan, Minnesota, Wisconsin.
Plains = Kansas, Nebraska, North Dakota, South Dakota.
Atlantic = Virginia, Maryland, Delaware, North Carolina, South Carolina.
Delta = Arkansas, Mississippi, Louisiana.
Other = Georgia, Kentucky, Tennessee, Alabama, New York, New Jersey, West Virginia, Texas, Oklahoma, Florida, Pennsylvania.

The effect of a $0.10 increase in effective prices on U.S. harvested soybean acreage was:

Effective soybean price:	488,500 acres
Effective corn price:	-722,100 acres
Effective cotton price:	-691,200 acres
Effective oats price:	-285,800 acres

The average aggregate effect of the Feed Grain Program during 1961-70 was to add 985,000 acres to U.S. harvested soybean acreage per year, or 9,850,000 acres over the life of the program.

Evaluation of the Model

Figure 1 compares actual and predicted (fitted) harvested soybean acreage for 1948-73. In addition, for 1966 through 1974, harvested acreage is projected based on the information available up through March of the preceding crop year. In other words, the equation estimated from data available from October 1948 to March 1965 is used to project 1966 harvested acreage, whereas the prediction of 1966 soybean acreage is based on the soybean supply response equation estimated from data covering the time period October 1948 to March 1973. Actual, predicted, and projected soybean acreages are compared in Figure 2 for the period 1966 to 1974. Overall, the model is quite accurate in projecting U.S. harvested soybean acreage 6 months in advance. During 1966-73, on the average the model missed U.S. soybean acreage by 747,630 acres with the largest error being 1,148,000 acres and the smallest error being 342,000 acres.

Estimates for 1974

With enactment of the Agricultural and Consumer Protection Act of 1973, the concept of target or guaranteed prices was implemented. For 1974, the Secretary of Agriculture has removed all acreage restrictions for all crops considered in the regional supply functions, and the average market prices through mid-February 1974 exceeded all target and support price levels. Therefore, the effective price for all crops was the average market price from October 1973 to mid-February 1974. The average prices used in projecting 1974 soybean acreage are:

a) soybeans, $5.69/bu.
b) corn, $2.48/bu.
c) oats, $1.26/bu. and,
d) cotton, $0.54/lb.

The effective price of cotton was adjusted to prohibit a 145 percent increase in acreage above 1970 acreage. Given these price estimates and 1973 soybean acreage, the following projections of regional and U.S. harvested soybean acreage for 1974 were obtained:

Region	*Acres*
Corn Belt	28,627,000
Lakes	5,035,000
Plains	3,687,000
Delta	8,398,000
Atlantic	3,533,000
Others	5,298,000
U.S.	54,578,000

The model projects a harvested soybean acreage of approximately 54½ million acres in 1974. On March 1 farmers indicated to the USDA they intend to plant 55 million acres of soybeans this spring, down 2.3 million from 1973. Based on the historical ratio of 0.979 harvested to planted acres, this converts to about 54 million harvested acres. The American Soybean Association survey of planting intentions reported in the January 1974 *Soybean Digest* indicates farmers will plant 51.4 million acres or harvest about 50.3 million acres. The *Farm Journal*, based on 8,000 responses from farmers in states representing 95 percent of 1973 soybean acreage, predicts a 2 percent drop in planted acreage compared to 1973, or 56.1 million planted acres and 54.9 million harvested acres in 1974. These various estimates indicate harvested soybean acreage in 1974 may total approximately 54 million acres.

Although the model coefficients were estimated to make projections in March of each year, it can be used earlier for preliminary projections. For example, in January 1974 the model projected a harvested soybean acreage of 54.9 million acres. The current projection of 54.6 million acres is based on data through mid-February 1974, a decline of 0.5 percent from the January forecast. Earlier projections could be made based on preliminary harvested acres, expected prices of the relevant crops, and anticipated government programs. For example, 1975 harvested acreage could be projected based on data available through mid-August 1974. However, the accuracy of the model to make projections this far in advance has not been evaluated.

Three characteristics of the acreage response model indicate that the 1974 harvested acreage estimate may be a little high. First, the current high wheat prices are not accounted for in the model. Previous wheat price levels did not enter significantly into any of the equations, but some farmers may substitute wheat for soybeans at current price levels. Second, restricting cotton acreage to 70 percent of historical base acreage may be unrealistic given the tremendous rise in cotton prices in recent months. And third, since the lagged acreage response variable is the major determinant of projected acreage, any time a large increment in acreage from one year to the next occurs like from 1972 to 1973, very large changes in the relative prices of the competing

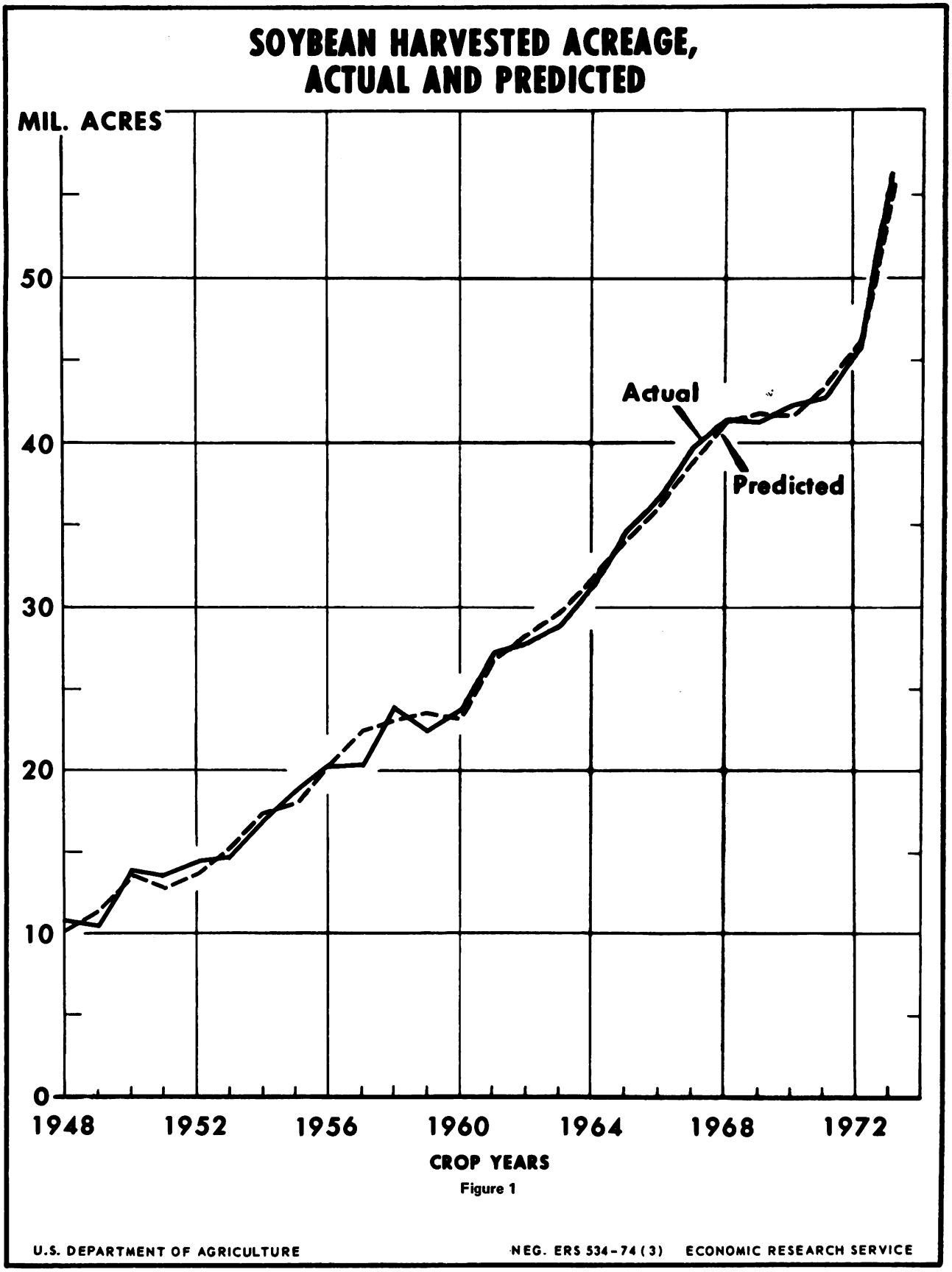

Figure 1

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SOYBEAN HARVESTED ACREAGE, ACTUAL, PREDICTED AND PROJECTED

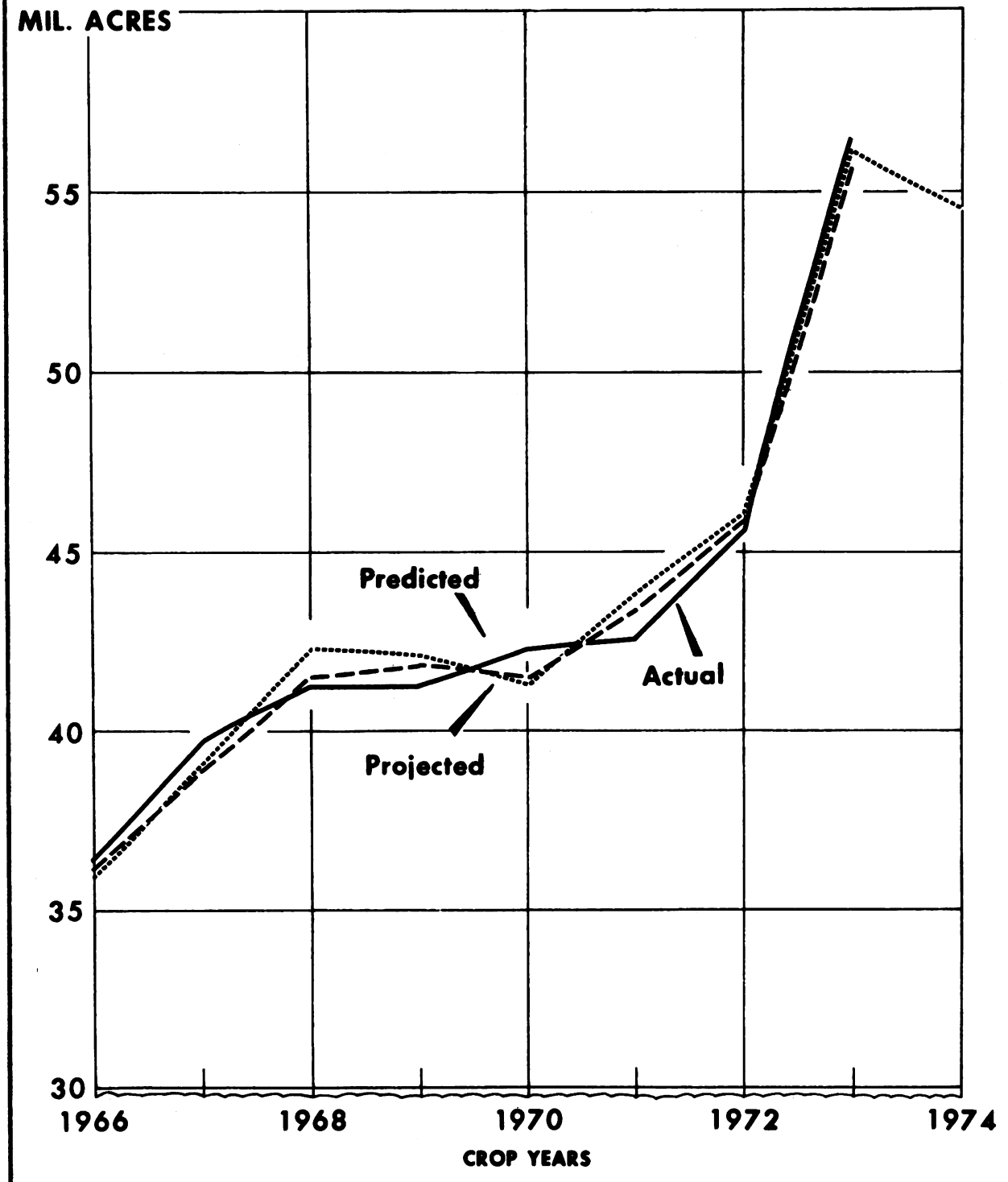

Figure 2

U.S. DEPARTMENT OF AGRICULTURE NEG ERS 533-74 (3) ECONOMIC RESEARCH SERVICE

crops are necessary to offset this effect. Consideration of these factors indicates that the projection of 1974 harvested soybean acreage may be overestimated. In addition planting decisions are not yet complete, and the effects of weather conditions this spring, fertilizer supplies, and the energy shortage may alter the amount of soybeans planted and harvested in 1974.

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