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Forecasting Corn Producers' Response to the 1986 Feed Grain Program

by

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Abstract

A time series supply equation on corn found four factors to "explain" 90 percent of the variation in planted acreage - expected net returns from corn, soybeans, and the corn program per base acre, and land retirement requirements. This equation was applied to the Feed Grain Program to forecast 1986 acreage.

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In the past 25 years, some type of feed grain program with acreage adjustment features has been offered to farmers in all but 7 years. Details of the program change from period to period but the non-recourse loan, an income-transfer instrument (such as deficiency payments based on target prices), and acreage adjustment have been common provisions throughout. The challenge to commodity analysts has been to take the complexities of the program into account and develop a set of consistent variables over time to monitor how farmers respond both when the program is available and when it is not.

The Food Security Act of 1985 passed by Congress and signed by the President in December 1985 freezes the target price for corn at existing 1985 levels ($3.03 per bushel) for 1986 and 1987 followed by reductions of 2 percent, 3 percent and 5 percent in the subsequent years. While target prices will change only modestly, the Secretary of Agriculture was given substantial authority to lower the loan. This he did, from $2.55 per bushel in 1985 to $1.92 in 1986. This is a 25 percent reduction, the largest year to year change ever made in the loan rate--up or down.

These efforts to lower prices and make U.S. corn more competitive in world markets will result in increased deficiency payments and encourage more farmers to comply with the program. They will be required to place 20 percent of their base acres into conserving uses. Part of this 20 percent (2.5 percent of the base) will be a paid diversion at the rate of $.73 per bushel times the program yield.

Under the Act, the "statutory" loan rate was set at $2.40 per bushel. However, the Findley Amendment requires a 10 percent reduction from this level in 1986 and allows an additional 10 percent reduction at the discretion of the Secretary. The Secretary made full use of this allowance. While a $50,000 upper limit on government payments was provided in the Act, payments resulting from a season average farm price below $2.40 are not subject to the limitation. However, the drop in the statutory loan from $2.55 to $2.40 will mean that more farmers will be subject to the upper limit.

Another change from previous Feed Grain Programs was the formula for calculating base acres and base yields. According to the Act, acreage bases will be the planted and considered planted acreage in the five previous years rather than the previous two years. For 1986 and 1987, program yields are frozen at the average of 1981-85 levels disregarding high and low years. In 1988-90, the Secretary has discretion to phase in actual yields for the most recent crop in calculating a five-year average of program and actual yields.

A major uncertainty is the implementation of the Gramm-Rudman-Hollings Act to reduce the federal deficit. Likely, direct payments will be pared back.

Clearly, while some of the same tools will be employed in the 1986 Feed Grain Program as in the past, the program has unique features and some major adjustments are in the offing. The task is to glean information from how farmers have responded in the past in order to establish a perspective on likely developments in 1986.

The model used to forecast this response has been kept relatively simple and on a national basis. This was done for ease of updating and modification--a convenience as a part of a comprehensive agricultural sector model.

The Model

The analysis is based on annual time series for 1960-85. An equation on acreage planted to corn was formulated in a manner similar to a partial budgeting approach familiar to many farmers. In recent years, the Cooperative Extension Service, the U.S. Department of Agriculture and farmer advisory services have published budget sheets and have developed microcomputer software comparing the alternatives of participating or not participating in government programs.

The key independent variables are: (1) expected net returns from corn over variable production costs per acre outside the government program; (2) expected net returns from soybeans over variable production costs per acre; (3) expected net returns on corn over variable costs per base acre for participants in the Feed Grain Program (including direct payments); and (4) percent of base acres that must be put into conserving uses in order to be in compliance.

The expected net returns from corn over variable production costs per acre outside the government program was calculated by multiplying the farm prices for the previous season's crop, or the current year's loan rate whichever is higher, by expected yield and then deducting variable costs per acre from the gross return. The higher of the lagged price or current loan represents expected market price. The lagged price was calculated using monthly prices from the beginning of the previous season to planting of the current crop, i.e. October to April. The period was shortened to October to March (end of sign-up period) since 1984 when penalties were imposed on those who signed up but didn't comply.

Expected yield was based on a moving average of the 5 previous years adjusted upward by 3 times the average annual increase over the 1960-85 period. Variable costs of production for 1974-85 were obtained from the USDA cost estimates mandated by the Agriculture and Consumer Protection Act of 1973 (Gustafson). Estimates prior to 1974 were generated from selected budget studies. Variable costs include cash variable costs plus an allowance for labor and interest on operating capital.

The expected net returns from soybeans over variable production costs were estimated in a manner similar to corn.

The other two variables represent modifications of earlier efforts to measure the effects of the Feed Grain Program on corn acreages (Houck and Ryan; Ryan and Abel; McKeon). They generated two types of policy variables, an "effective price support" and an "effective diversion payment." The effective price support was normally calculated by multiplying the loan rate by the maximum proportion of the base acres that could be planted by compliers. The effective diversion payment was generally calculated by multiplying the diversion or acreage reduction rate by the diversion payment per bushel.

While this approach worked well for the period analyzed, the developments of the 1970s rendered their models inadequate. Market prices rose above the loan rate in several years reducing the effect of the loan on price expectations. Spiraling fertilizer and energy costs required special attention to production costs. Because soybeans need relatively little fertilizer, the impact affected corn costs more than soybeans. On the other hand, yields on corn had been increasing more, percentagewise, than on soybeans, so yields represented another factor which needed to be included in any supply analysis on corn.

The "expected net returns on corn over variable costs per base acre for participants in the Feed Grain Program" is a rather complex measurement designed to overcome some of the deficiencies of the "effective price support." This was calculated by multiplying: (1) the higher of lagged corn prices or the loan rate announced for the current year by (2) the 5-year moving average of corn yields mentioned earlier enhanced by a factor representing prospective higher yields on the reduced acreage. The product of (1) and (2) represents the expected gross return from the corn on acreage planted. To convert to a base acre standard, this product is multiplied by the maximum proportion of base acres that could be planted and still be in compliance.

Diversion payments are calculated by multiplying the payment rate by the program yield by the percent of base eligible. While diversion payments are known in advance, deficiency payments are based on program yields times the difference between the target price and the average farm price with the maximum of the difference between the target price and the loan rate. The expected deficiency payment was calculated using the expected farm price discussed earlier. The expected payment per planted acre was converted to the base acre standard.

Variable costs per planted acre were also reduced by the acreage adjustment requirements. Costs were added for maintaining a cover crop on the acreage devoted to conserving uses.

To illustrate the computation of the net return per base acre for participants and net per acre for non-participants, Table 1 portrays a scenario for 1986-90. This scenario assumes no change in the program from 1986 on and that corn prices rise from $2.00 to $2.50 over this period. The advantage to participation is substantial in this example until the end of the decade.

Table 1

Prospective Returns to Participation in the Feed Grain Program in 1986-90 Under Assumed Conditions[a]

	Unit	Years 1986	1987	1988	1989	1990
Participant						
Gross from the market						
Price of corn (or loan)[b]	$/bu.	2.00	2.00	2.10	2.25	2.50
x yield	bu.	115	117	119	121	123
x (1 - % AR + DV)[c]		.80	.80	.80	.80	.80
= gross per base acre	$	184	187	200	218	246
Diversion payment						
Payment rate	$/bu.	.73	.73	.73	.73	.73
x program yield	bu.	106	106	108	110	112
x % DV		.025	.025	.025	.025	.025
= gross per base acre	$	2	2	2	2	2
Deficiency payment						
Target price	$/bu.	3.03	3.03	2.97	2.88	2.75
- price of corn (or loan)[b]	$/bu.	2.00	2.00	2.10	2.25	2.50
= deficiency payment rate	$/bu.	1.03	1.03	.87	.63	.25
x program yield	bu.	106	106	108	110	112
x (1 - % AR + DV)		.80	.80	.80	.80	.80
= gross per base acre	$	87	87	75	55	22
Total gross per base acre	$	273	276	277	275	270
Variable costs						
Per planted acre	$	148	144	141	147	153
x (1 - % AR + DV)		.80	.80	.80	.80	.80
= per base acre	$	118	115	113	118	122
Per conserving use acre	$	10	10	10	10	10
x (% AR + DV)		.20	.20	.20	.20	.20
= per base acre	$	2	2	2	2	2
Total		120	117	115	120	124
Net returns per base acre over variable costs	$	153	159	162	155	146
Non-Participant						
Price of corn	$/bu.	2.00	2.00	2.10	2.25	2.50
x yield	bu.	111	113	115	117	119
= gross per acre	$	222	226	241	263	298
- variable costs	$	148	144	141	147	153
= net return per acre	$	74	82	100	116	145

[a] Effect of Gramm-Rudman-Hollings not included.

[b] Whichever is higher.

[c] AR = % of base in acreage reduction; DV = % of base in paid diversion.

In the planted acreage equation, the three net returns per acre variables were all deflated by the Consumer Price Index (1967=100%). The fourth variable is the required percentage of the base to be put to conserving uses. In some years, a minimum is established with additional retirement of land as an option. Using a convention from earlier studies, if two or more options were available, a mean between the minimum and the maximum was applied. A weighted average of several alternatives was used in 1983, the year of the major PIK program (Ferris).

The rationale for the acreage retirement variable is that, given two years in which the expected advantages from participating in the program are equal, more acreage would be retired in the year that the diversion or set-aside requirement was the higher.

The Statistical Results

The statistical properties of the model are presented in Table 2 and Figure 1. The coefficients have the correct signs and are significant except that the expected net revenue per acre on corn is marginally insignificant at the 95 percent confidence level. The coefficient on acreage retirement, on the other hand, is highly significant. The Durbin-Watson statistic, at 1.596, is evaluated as inconclusive at the 5 percent significance level.

A major discrepancy between the actual and fitted values is noted in Figure 1 for 1973, a year of considerable uncertainty following substantial disruption in world grain and soybean markets. Another phenomenon was the three years in 1978 to 1981 in which planted acreage was above the fitted values by more than the standard error of the regression. This may be attributed to the pervasive optimism in the late 1970s concerning the longer term outlook for the domestic and export demand for feed grains.

Table 2. Planted Acreage Supply Equation on Corn with Forecasts for 1985 and 1986 [a/]

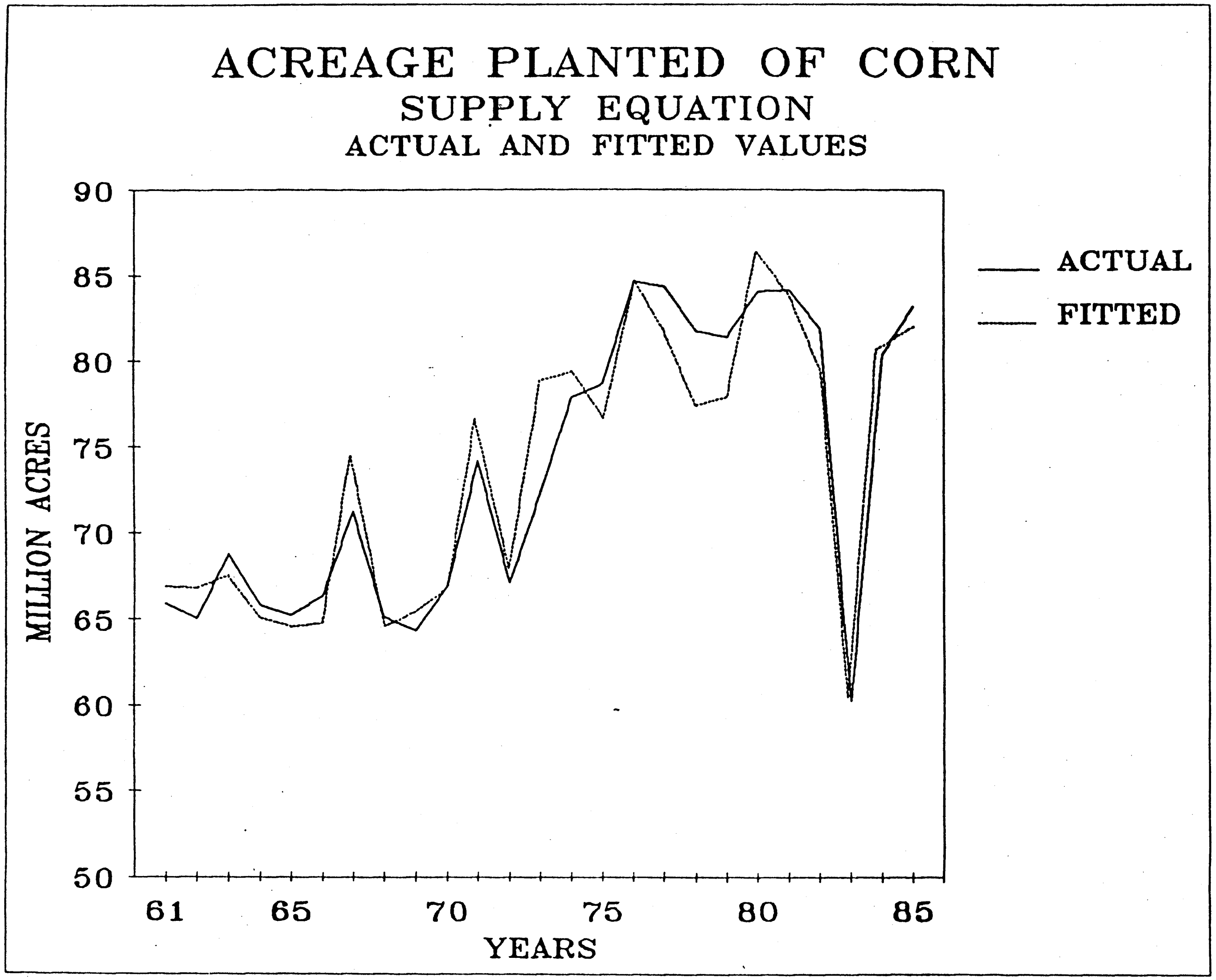
Indepdent Variables	Unit	Coefficient		1985 Forecast		1986 Forecast			
						Lagged Prices		December Futures in Late February Less Normal Basis [b/]	
		Estimate	t Statistic	Value of Variable	Product	Value of Variable	Product	Value of Variable	Product
Constant		97.95	29.14		97.95		97.95		97.95
Expected net revenue per acre over variable costs on corn deflated by CPI (1967=1.00)	$	.1234	1.71	39.21	4.84	30.41	3.75	18.45	2.28
Expected net revenue per acre over variable costs on soybeans deflated by CPI (1967=1.00)	$	-.1412	-2.51	31.42	-4.44	24.69	-3.49	23.76	-3.35
Expected net revenue for participants per base acre over variable costs on corn deflated by CPI (1967=1.00)	$	-.2063	-2.60	49.22	-10.15	46.30	-9.55	45.46	-9.38
Percent of base devoted to conserving uses	%/100	-62.27	-14.28	.10	-6.23	.20	-12.45	.20	-12.45
Dependent Variable									
Acres planted to corn									
Estimated	mil				81.97		76.21		75.05
Actual	mil				83.20				
Residual (actual less estimated)	mil				1.23				

Standard error of the regression = 2.50 (2.4% of mean of dependent variable).
R-squared = .922; Adjusted R-squared = .906
Durbin-Watson = 1.595
Turning point errors = 4/24

a/ Based on annual data for 1961-85. Effect of Gramm-Rudman-Hollings is not included.

b/ November futures on soybeans.

Figure 1


ACREAGE PLANTED OF CORN
SUPPLY EQUATION
ACTUAL AND FITTED VALUES
MILLION ACRES
90
85
80
75
70
65
60
55
50
61
65
70
75
80
85
YEARS
ACTUAL
FITTED

Four relatively minor turning point errors are observed in Figure 1. Residuals have been less than the standard error in recent years. The predicted acreage in 1985 was about 82 million as compared to the actual 83.2 million.

From the "t" values on the coefficients of the expected net revenue per base acre for participants and the required land retirement, the planted acres equation indicates that the Feed Grain Program has been a predominant factor in the variation in acreage in the past 25 years. Observations are limited on adjustments to strictly market price and cost considerations.

Forecast for 1986

The model generated price expectations on both corn and soybeans by using the higher of lagged price or the loan rate. While this technique has been a standard procedure in econometric analysis, questions are being raised about whether farmers really do base their expectations on past prices or whether they understand markets well enough to make their own forecasts independent of what has happened in the recent past. A number of analysts have explored this alternative known as the rational expectations hypothesis (Muth; Fisher; Goodwin; Shonkwiler and Emerson; Love, Rausser and Freebairn).

While no attempt was made to apply a full scale rational expectations model, at least the loan rate was used in deriving expectations. Also, an additional regression equation was computed using December corn futures and November soybean futures at planting time substituted for lagged prices. An estimate of normal "basis" (difference between futures and farm prices at harvest) was deducted.

The equation from this approach to expectations was not satisfactory. This formulation resulted in a negative sign on expected net revenue over variable costs on corn and insignificant "t" values on expected net revenue from soybeans and participation in the program. Other statistical properties were comparable with the original equation.

Even so, with the loan rate in 1986 so much lower than in 1985 and also so much lower than farm prices averaged on the 1985 crop, farmers may be influenced more than in the past by the loan and the outlook. Futures prices in late February reflected the outlook. For this reason, two forecasts for 1986 were made, one with lagged prices and one with December 1986 corn futures and November 1986 soybean futures. The average harvest basis for the two crops over the past 3 years was subtracted. The same equation as shown in Table 2 was used for both forecasts.

<u>Forecasts for 1986</u>

Based on lagged prices, the forecast for 1986 is 76.21 million acres, down about 5.8 million acres from 1985. The lagged price on corn was $2.24 per bu. and on soybeans, $4.99 per bu. Futures prices in late February translated into about $1.88 on corn and $4.89 on soybeans. Using these prices based on futures, the equation generated plantings of 75.05 million acres in 1986, down about 6.9 million acres from 1985.

Note the effect of the independent variables as reflected in their products with their respective coefficients. The increase in the acreage retirement requirement from 10 percent to 20 percent of the base accounts for most of the adjustment. While the effect of Gramm-Rudman-Hollings was not included in this analysis, some idea of its possible impact could be derived from the equation.

If the Gramm-Rudman-Hollings Act results in a cut-back of 4.3 percent in direct payments exclusive of the portion of the payments that will be in kind, a reduction of \$3-4 per base acre would result. Deflating this number by the CPI, the estimate would be close to \$1 in real terms. A \$1 reduction in the expected net revenue per base acre would increase the planted acres by about .2 million (\$-1 x -.2063). While minor in 1986, the projected reduction in direct payments in 1987 could be substantial and could have a more noticeable effect on acreages. However, the conclusion remains that participation for nearly all producers will be more profitable than not participating, even with the application of Gramm-Rudman-Hollings.

Other refinements could be made in generating acreage forecasts for 1986 including the effect of the \$50,000 limitation. One of the advantages of a model of this type is that it can accommodate a variety of provisions in farm programs and changes in these programs over time.

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