A TIME SERIES ANALYSIS OF THE
1983 PIK PROGRAM ON CORN,
EX ANTE AND EX POST

By

John N. Ferris*
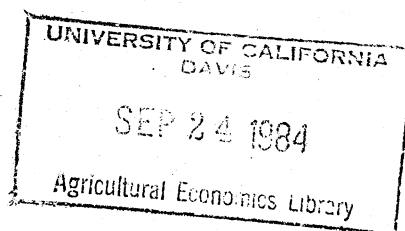
*John N. Ferris is a Professor of Agricultural Economics at Michigan
State University, East Lansing, Michigan.

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A time series supply analysis on corn plantings using annual data for 1960-82 helped predict participation in the 1983 feed grain (PIK) program. Of particular importance in the supply equation was a policy variable which measured both the attractiveness of feed grain programs and the requirements for reducing acreage.

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Recognizing that the previously announced acreage reduction and required land diversion program might not achieve the objectives for bringing supplies in adjustment to demands in 1983, Secretary of Agriculture, John Block, revealed in early November of 1982 that the USDA was seriously considering a payment-in-kind (PIK) program. President Reagan formally announced the PIK program on January 11, 1983. Sign-up began on January 24 with March 11 established as a deadline for both PIK and the acreage reduction and diversion program (ARP-DV). Wheat, corn, grain sorghum, upland cotton and rice were designated for the PIK program.

The program on corn required participants to devote 20 percent of their base to conserving uses. Half of this 20 percent was an Acreage Reduction Program (ARP) and half was a Diversion Program (DV). In addition to receiving direct payments for the DV program, they would be eligible for target prices, regular loans and reserve loans.

The PIK feature was in addition to the basic program. Participants who idled another 10 to 30 percent of their base (in addition to the original ARP-DV 20 percent) were paid 80 percent of their program yield in-kind. Producers could also bid to retire their entire base from corn production (with compensation on their base acreage) up to 80 percent of their program yield. These payments were also in-kind.

Commodities for the PIK program came from the farmer-owned reserve, the regular loan and CCC stocks. The PIK program had the two-fold purpose of encouraging additional acreage cut-back and utilizing excess stocks which were costing the government substantial amounts in storage payments.

To analyze how farmers might respond to this program, some comparison was necessary with farm programs in the past. Such a comparison was, of course, complicated by the fact that the PIK aspect was untried in recent history and the combination of provisions for the total program was unique. To illustrate that useful forecasts can be made in spite of ever changing farm programs, a time series analysis on corn acreage was conducted before the sign-up was known. This provided early insights that participation in the program would be substantial.

Planted Acreage Equation on Corn

Four major factors were believed to affect corn acreage in the past 20 years: (1) expected real profit per acre from corn for nonparticipants (or for all growers in years when there was no program); (2) expected real profit per acre from soybeans; (3) expected advantage to participating versus not participating; and (4) diversion or acreage reduction requirements for participating. As a proxy for (1) and (2), estimates were made of the expected gross margins per acre over the variable costs of production. Lagged farm prices were multiplied by a three-year moving average of yields to generate "expected gross returns." Variable costs per acre were deducted from the "expected gross returns" to calculate the expected gross margins over variable costs which, in turn, were deflated by the Consumer Price Index.

Variable costs of production per acre for 1974-82 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 and USDA data on fertilizer prices and application rates.

The policy 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). Houck and Ryan employed two types of policy

variables. One was an "effective price support," normally calculated by multiplying the loan rate by the maximum proportion of the base acres that could be planted by compliers (100 percent minus the rate for diversion or acreage reduction). The other variable was the effective diversion payment generally calculated by multiplying the diversion or acreage reduction rate by the diversion payment per bushel. The base acre concept was useful for developing a consistent series over time and for comparing compliance with noncompliance.

The base acre concept was retained in computing the advantage to participating versus not participating. For participants, the expected gross return per acre harvested was calculated by multiplying, (1) the higher of lagged corn prices or the price support (loan or target price) announced for the coming crop year by (2) a three-year moving average of corn yields enhanced by a factor representing prospective higher yields on the reduced acreage. Any direct payments (such as diversion payments) in addition to those from the target price feature (deficiency payments) were then added to the gross returns. Variable costs were subtracted from the expected gross returns and the gross margin was then multiplied by the maximum portion of the base that could be planted by compliers. This adjusted the gross margin to the base acre standard. Costs for cover crops on diverted acres were also taken into account.

The rationale for using the higher of lagged corn prices or the price support was to establish reasonable expectations of market prices versus price supports. When prices have been high relative to supports, farmers' expectations may have been similarly oriented. Such an assumption, however, bears further testing (Lin and Leath).

The expected gross margin per base acre over variable costs from compliance was then divided by the expected gross margin per acre from noncompliance to construct the first policy variable. The second policy variable was simply the required diversion or acreage reduction rate. Using a convention from earlier studies, if two options were available for a diversion level, the mean of the two levels was applied.

The first policy variable established how attractive the program was and the second policy variable determined how much acreage had to be reduced to reap the benefits. In years when there was no program, the value for the first variable was "one" and the value for the second variable was "zero." Both were significantly associated with planted acres in the 1960-82 period of the analysis.

In exploring the combined effect of these two variables, a single policy variable was created by multiplying one by the other. The rationale for combining the policy variables in this manner was the presumption that farmers' acreage response would be based on how attractive the program was and how much acreage would have to be reduced to comply. The statistical properties of the supply equation with the single policy variable were generally improved over the first formulation.

Specifically, the equation and the variables were as follows:

Acreage Planted Equation on Corn Based on Data for 1960-82

$$APCN = 72.3 + \underset{(2.59)}{.1372}\ APCN1 + \underset{(.76)}{.01566}\ EGMVCCND - \underset{(-12.31)}{37.117}\ RPDRCN$$

$$- \underset{(-2.74)}{.07885}\ EGMVCSBD + \underset{(5.02)}{4.517}\ DVCN$$

$$\bar{R}^2 = .979$$

Standard error of the regression = 1.5% of the mean
of the dependent variable

d.w. = 1.745

t values are in parentheses

Code	Unit	Definition
APCN	mil.	Acres planted to corn in year t
APCN1	mil.	Acres planted to corn in year t-1
EGMVCCND	$/acre	Expected gross margin over variable costs per acre on corn divided by the Consumer Price Index (1967 = 1.00)
RPGMVCCN	ratio	Expected gross margin over variable costs per base acre from participating in the feed grain program divided by the expected gross margin over variable costs per base acre from not participating
DRCN	%	Diversion rate (including set asides and reduced acreage) on corn in the feed grain program
RPDRCN	-	RPGMVCN x DRCN
EGMVCSBD	$/acre	Expected gross margin over variable costs per acre on soybeans divided by the Consumer Price Index (1967 = 1.00)
DVCN	no.	Dummy variable which has the value of 0 from 1960-1965 and 1 from 1966 to date

The statistical properties of the equation were satisfactory with one notable exception. The coefficient on EGMVCCND was not significant at the 5 percent level. The effect of the policy variable was particularly strong. The implication is that major changes in corn acreages in the 1960-82 period were due to the feed grain program and not due to responses to strictly market forces. Some type of feed grain program was in effect for 17 of those 23 years. This suggests that efforts to apply time series analysis to forecast how farmers might respond to a "free market" must be supplemented with other information.

The equation was very close in predicting planted acreage of corn in 1982, 81.4 million acres versus the actual 81.6 million. To illustrate the computation of the policy variable, RPGMVCCN was 1.32 indicating a fairly

favorable program. The DRCN (in this year, an acreage reduction program) was a minimum of 10 percent. This resulted in a value for RPDRCN of .132.

Predicting Response to the 1983 Feed Grain (PIK) Program

Calculating the policy variable for the feed grain (PIK) program in 1983 was much more of a challenge because of the various options. At the minimum was a 20 percent acreage reduction of which half qualified for a paid diversion (at $1.50 per bushel on the established yield on the diverted acres). The regular loan was set at $2.65 and the target price was $2.86.

An option in addition to the 20 percent ARP-DV was to place 10 to 30 percent of the base into the PIK program. For this, corn producers were to receive 80 percent of their base yield as PIK grain.

Another option was to reduce planted acres of corn to zero and devote an acreage equal to the base to approved conservation uses. Cooperators were to bid for PIK compensation by specifying the percent of the farm program yield per acre that is acceptable. The maximum percent was 80.

Using the procedure outlined in this paper for calculating expected returns from participating versus not participating, the computation of the expected gross margins per base acre over variable costs was not difficult for each of the options. One exception was that the percent compensation under the "whole base PIK" was not known in advance. A more formidable task was weighting the various options in order to calculate the overall attractiveness of the program and a single value for DRCN.

In a documentation of our thinking in early 1983, we were assuming that 40 percent of the participants would be in the ARP-DV program only and 60 percent of the participants would be in the PIK options (Ferris, Ross and Perraut). If we weighted ARP-DV at .4, the 10-30 percent PIK at .4 and the whole base PIK at .2, we would calculate RPGMVCCN at 1.53. This means that

the "average" participant in the 1983 feed grain program would expect a
53 percent higher gross margin over variable costs per base acre than the
average nonparticipant. The average reduction of acreage (DRCN) would be
about 42 percent. This would mean a RPDRCN of .643 (1.53 x .42).

Applying this value for RPDRCN in the equation resulted in a forecast
of 62.6 million acres planted to corn in 1983. The actual plantings amounted
to about 60.1 million, slightly below the forecast. Based on the actual sign-
up figures, the percentage of participants was higher in the 10-30 percent
PIK option and lower in the ARP-DV option than we had assumed. Using these
final percentages as weights, the forecast of the equation was very close
to the actual.

An Evaluation of the 1983 Feed Grain (PIK) Program

The final weights produced a value for RPGMVCCN of 1.63 which represents,
by far, the most attractive feed grain program in the period examined (since
1960). In the years in which a program was in operation, the average RPGMVCCN
was about 1.10, i.e., a 10 percent "expected" advantage to participating. The
realized returns to participation, of course, were quite different from those
expected in any given year. In the 1960-82 period, realized returns were not
much higher from participating than not participating, but the risks were
much less.

For the 1983 corn crop, yields were much lower than expected due to the
drought. Because of this and the high level of participation in the feed
grain program, farm prices were higher than had been anticipated at sign-up.
The higher prices favored nonparticipants though PIK grain also became more
valuable. The low yields favored participation and particularly made the
"whole base PIK" a very attractive option in retrospect. For the "average"
participant, gross margins over variable costs per acre turned out to be

approximately 50 percent higher than for the average nonparticipant on the base acreage.

In reviewing the separate options, the "whole base PIK" was the most profitable with gross margins per base acre about double the average margins for the nonparticipant. For the participation in the 10-30 percent PIK program, assuming a total reduction in acreage of 35 percent of the base, the advantage was about a third greater than nonparticipating. The PIK corn in both options was priced at the average level of price received by farmers in October 1983 to February 1984. For the participant in the minimum 20 percent ARP-DV option, the gross margin over variable costs per base acre was very close to the gross margins realized by the nonparticipant.

One of the lessons learned from the feed grain program of 1983 was the value of the program in reducing yield risks in addition to price risks. The drought-reduced national yield of 81 bushels per acre was at least 25 bushels under the trend and even more considering the productivity of the reduced acres. The "whole base PIK" option carried higher price risks than the other two options since PIK grain was not eligible for regular or reserve loans nor target prices. However, the yield risk was eliminated. The combination of the drought and the relatively high market prices provided the "whole base PIK" with its strong advantage over the other options.

At sign-up, it was clear that participation would likely pay and that the 10-30 percent PIK option was more attractive than the minimal 20 percent ARP-DV level. But of course, at the time, yields were expected to average in the 105-115 per bushel range and farm prices were expected to remain below $3.00 per bushel. The whole base PIK option appeared attractive under these circumstances if bids of 65 percent or more would be accepted. The average bids turned out to be above this level, but this was not known at sign-up.

The conclusion of this analysis is that farmers responded to the feed grain program in 1983 in a reasonably predictable fashion. Time series analysis can be used to assist in predicting plantings even from such a complex program as PIK. Some difficulty, however, may be encountered in generating a scenario of how corn producers might respond to economic incentives in a relatively free market.

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