Forecasting Key Intra-Year Price and Export Patterns for Soybeans and Soybean Products

by

Jim L. Matthews, Roger Hoskin, and Bruce Wendland

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The basic procedural framework for forecasting in the U.S. Department of Agriculture has evolved over many years and is designed primarily for annual forecasts. Such forecasts are quite useful as inputs to decision makers concerned about the formulation and implementation of a broad range of public and private policies. Practical considerations in managing the data requirements and specification needs of a global forecasting process have also been instrumental in the design of the present USDA forecasting system. However, the trend toward more instability and greater deregulation of agricultural markets has raised the level of interest in forecasts for shorter time intervals. Efforts to shift more emphasis to procedures generating quarterly forecasts as opposed to annual, have been quite limited for budgetary and other reasons. Nevertheless, some analytical efforts have been added to our inventory of forecasting tools for quarterly analyses in recent years. (Westcott) A basic theme in this paper is to examine more carefully the possibility of extracting quarterly price information from our annual forecasting process without having to reformulate the whole approach.

The availability of some structural quarterly forecasting procedures also offer the opportunity to examine some of the comparative merits of ultimately merging results from the two alternative approaches. In addition, quarterly structural models which treat exports as a given variable may benefit from seasonal export estimates presented in this paper. The initial sections of this paper are concerned with the statistical estimation of within year price and export patterns based on some alternative approaches. The final portion of the paper will offer some preliminary evaluation and comments on the general accuracy and usefulness of this approach in preparing quarterly forecasts.

Statistical Model

The basic statistical model relies primarily on seasonal adjustment theory and procedures such as those used by the Bureau of Census. The Census seasonal adjustment program basically assumes that a given time series can be represented by a seasonal component, a cyclical component and an irregular component. A trend line (usually a polynomial in time) is first fitted to the data. Seasonal factors are derived by averaging deviations from trend for each of the four quarters. A parallel specification for this paper is to specify a regression relationship incorporating dummy variables for the quarters or seasons and to let the annual price forecast replace the cyclical or trend component. Hence the basic specification for generating quarterly prices or exports from an annual forecast is:

(1) $D_{it} = f\ (QI,\ QII,\ QIII,\ DA_{it})$

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For estimation purposes, the relation fitted was:

(1A) $D_{it} / DA_t = f(Qi's)$

where

D_{it} = Quarterly value of the dependent variable for the commodity in question, for the ith quarter and year t

DA_t = Annual average value for dependent value for the commodity in question in year t

Q1 = First quarter value equals 1; zero otherwise

Q2 = Second quarter value equals 1, zero otherwise

Q3 = Third quarter value equals 1, zero otherwise

An advantage in using a regression approach is the flexibility to test for time dependent changes in the seasonal factors or to test for other structural shifts in the series. Hence, relation (1A) is more generally extended to the following form:

(2) $D_{it} / DA_{it} = f(Qi's, Qi's*DS, Qi's*T)$

where,

DS = Zero/one dummy for short crop year in U.S.

T = Time trend

The actual statistical specification for soybean prices takes advantage of the high co-linearity between soybean prices and soybean product prices while permitting a clear identification of the contribution of individual product market patterns on soybean seasonal price patterns. Hence, the specification for the quarterly soybean price relation is

$PSOY_i = f(PMEAL_i, PSOIL_i, PMEAL_{-1}, PSOIL_{-1}, Qi's, Qi's*DS)$

where,

$PSOY_i$ = Quarterly soybean price divided by annual price in quarter i

$PMEAL_i$ = Quarterly soybean meal price divided by annual price

$PSOIL_i$ = Quarterly soybean oil price divided by annual price

As an alternative to the regression models, time series modeling also offers a way of representing seasonal patterns since current prices can be represented by a series of earlier price observations. The periodicity of within year price changes lends itself to the ARMA/ARIMA (auto-regressive moving average/auto-regressive integrated moving average) modeling approach. In fact, one advantage of this approach is that short-term forecasts can often be easily constructed from recent data minimizing the requirement of estimating forecast values for exogeneous variables. Furthermore, time-series models are flexible enough to represent fairly complex seasonal patterns. A major drawback is that these models say nothing about the structure or relationship among variables that generated the price series.

The first step in time series modeling is to establish the stationarity of the time-series. Weak stationarity presumes that the mean value of the series is constant, i.e. no trend, and the variance of the series is constant. This second requirement is analogous to the homoscedasticity requirement in OLS regression. The time series for both soybean oil and soybean meal prices appears to be stationary. However, modeling on both series was done on transformed quarterly data where the quarterly price was expressed as a percent of the season average price observed over the year. This transformation would eliminate any trend or structural variation so the assumption of a constant mean is met. No formal tests were done to confirm that the variance was constant, although it appeared to be approximately so.

Since the series is stationary, differencing is not necessary. Therefore, the final model will be a form of ARMA where the integrating term is not necessary. The identification phase suggests the appropriate combination of auto-regressive and/or moving average terms that are necessary to include. Several configurations of ARMA model appeared best by the criteria of small standard errors, with a minimum number of variables. Adding variables, i.e. "overfitting" the equation produced negligible improvement in the standard error. Furthermore, the autocorrelation function of the residuals of both the soybean oil and soybean meal models suggested that the error terms were reasonably close to "white noise" (i.e. E(e) = 0, cov (ei, ej) = 0 and var(e) is finite and constant).

Statistical Estimation Results and Findings

Time Series Modeling Fits. The time series models estimated are presented below:

i) $PMEAL_t = 100.065 - .41175\ MA(2) - .13139\ AR(1) - .26365\ AR(8)$
(-2.56) (-0.1478) (-2.83)

Adj $R^2 = .20$

S.E. = 8.71 Mean = 100.0

where,

MA(2) = moving average, order two
AR(1) = auto regression, first order
AR(8) = auto regression, order eight

ii) $PSOIL_t = 99.896 - .1933\ MA(1) - .6177\ MA(2) + .4347\ MA(4) - 0.3546\ AR(8)$
(-1.19) (-3.91) (2.76) (-4.82)

Adj $R^2 = .52$

S.E. = 7.63 Mean = 100.0

where,

MA(1) = moving average, order one
MA(2) = moving average, order two
MA(4) = moving average, order four
AR(8) = auto regression, order eight

The two models as estimated suggest that about half of the within year price variance for oil can be accounted for by recurring seasonal or cyclical factors and only about a fifth of similar within year price variance for soybean meal can be so accounted for. The remainder of the variance is irregular intra-year changes in prices. The inter-year price changes (and perhaps some of the intra year change) were filtered-out by transforming the quarterly prices to a percentage of the season average price.

By taking the estimated percentages obtained from the model and multiplying by the actual observed season average price we obtain a new series of estimated season average prices. Actual quarterly prices are regressed on fitted quarterly prices. The results are as follows:

1.) Meal Price Actual = −12.161 + 1.072*Meal Price Fitted
(−.869) (13.487)

Adj $R^2 = 0.81$

S.E. = 14.77

Avg. Meal Price = 174.26

2.) Soybean Oil Price Actual = −1.587 + 1.067*Oil Price Fitted
(−1.15) (19.38)

Adj $R^2 = 0.90$

S.E. = 1.74

Average Oil Price = 24.79

The forecasting process can now be undertaken using the season average price for both oil and meal as projected by the Inter-Agency Estimates Committee as exogeneous information. The fitted ARMA models can be used to distill a quarterly price estimate. Once the season average price is known, the model can be updated, and forecasts for the following season prepared.

Plots of the actual quarterly prices and fitted prices show that the models track fairly well (Figures 1 and 2). The soybean meal model works better in later periods than in earlier ones where it missed six turning points out of the first eight. The soybean oil price model tracks the actual much better. This suggests possible areas for future research, a point returned to in the summary.

Regression Model Fits. A summary of results, based on regression analyses is shown in Tables 1 through 6. Results for the soybean price relation suggest that around 80 percent of the variation is explained by seasonal price changes for soybean meal and oil prices and by sorting of years according to short or normal crop years. A short crop year is defined as one where yields fall by 2 standard errors below trend. Years qualifying as short crop years included 1974/75, 1976/77, 1980/81, 1983/84 and 1984/85. The pattern of coefficients for short crop years suggest that soybean prices relative to product prices are more depressed early in the marketing year than in years of more normal supply availabilities. This does not contradict the observation that seasonal price patterns are usually reversed in short crop years as we will see in the results for soybean meal and oil price relationships. Overall, the estimation results were quite encouraging for soybean prices as can be seen from Figure 3.

The regression results for soybean meal and oil were generally encouraging, though the best regression fits using the basic model generally accounted for only around 50 percent of the intra-year variance. Some improvement in these regression fits could be obtained by the addition of key exogenous variables that are known to influence annual price adjustments. Interest rates (R) along with supplies of meal and vegetable oils in major exporting and importing countries added significantly in some cases to the R^2 for these price equations. One possible explanation for the significance of these factors is that they are part of the irregular component in a seasonal adjustment modeling context.

FIGURE 1

SOYBEAN MEAL PRICES – DECATUR

Percentage converted back to raw prices

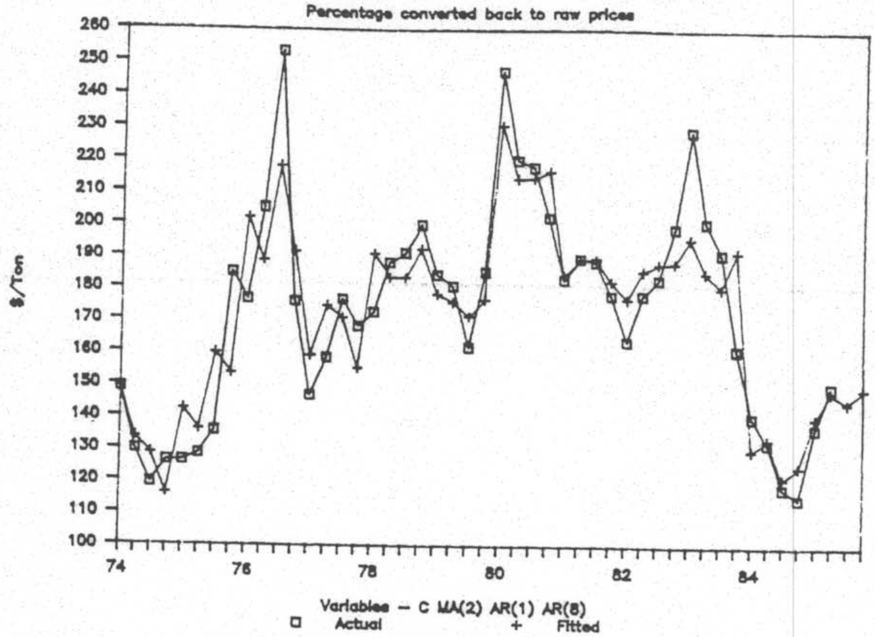

FIGURE 2

SOYBEAN OIL PRICES – DECATUR

Percentage converted back to raw prices

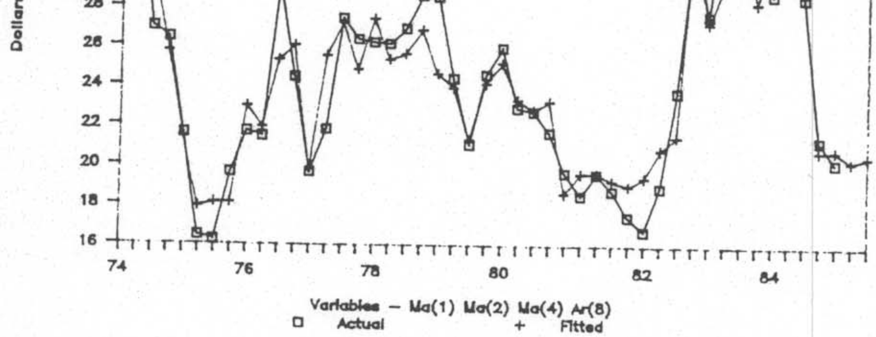

Table 1. Soybean Quarterly Price Relationships 1974/75 to 1984/85 Fit

Dependent Variable	Constant Term	Soybean Meal	Product Meal Lag	Prices Oil	Quarterly Dummies			Short Crop Dummies			R^2
		PMEAL	PMEAL-1	PSOIL	QI	QII	QIII	DS*QI	DS*QII	DS*QIII	
		--- Independent Variables ---									
PSOY	-0.057	0.4243	0.4055	0.2361	0.0153	0.0213	0.0208	-0.077	-0.0596	-0.1537	0.79
(t)		(4.27)	(4.96)	(2.70)	(0.58)	(0.81)	(0.82)	(-2.04)	(-1.73)	(-1.51)	

Table 2. Soybean Meal Quarterly Price Relationships 1974/75 to 1984/85 Fit

Dependent Variable	Constant Term	3rd Quarter Dummy	Quarter Before Short Crop	Short Crop Dummies				U.S. Export Market Share for Soymeal			R^2
		QIII	D4	DS	DS*QI	DS*QII	DS*QIII	QI*SH	QII*SH	QIII*SH	
PMEAL	1.0330	-0.4191	0.1173	-0.1760	0.3273	0.2107	0.2296	-0.1309	-0.0919	0.5518	0.455
(t)		(-1.10)	(1.86)	(-2.92)	(4.18)	(2.69)	(2.54)	(-1.56)	(-1.09)	(1.04)	

Table 2a. Soybean Meal Quarterly Price Relationships 1974/75 to 1984/85 Fit

Dependent Variable	Constant Term	Quarterly Dummies		Quarter Before Short Crop	Short Crop Dummies				Time	Time Dummies		R^2
		QI	QII	D4	DS	DS*QI	DS*QII	DS*QIII	T	T*QI	T*QII	
PMEAL	1.396	-0.864	-0.675	0.146	-0.152	0.308	0.190	0.161	-.0027	0.0057	0.0045	0.52
(t)		(-2.46)	(-1.91)	(2.81)	(-3.19)	(4.28)	(2.64)	(2.82)	(-1.89)	(2.27)	(1.80)	

Table 3. Soybean Oil Quarterly Price Relationships 1974/75 to 1984/85 Fit

Dependent Variable	Constant Term	Quarterly Dummies			Quarter Before Short Crop	Short Crop Dummies				Major Exporters	Major Importers	R^2
		QI	QII	QIII	D4	DS	DS*QI	DS*QII	DS*QIII	XVEGX	IMP	
PSOIL (t)	0.989	0.0056 (0.05)	-0.0704 (-0.64)	-0.0339 (-0.31)	0.2224 (2.16)	-0.1410 (-1.37)	0.1717 (1.23)	0.2033 (1.45)	0.2768 (1.98)	—	—	0.50
PSOIL (t)	1.265	-0.1158 (-1.04)	-.2202 (-1.55)	-.0619 (-0.69)	0.2856 (2.87)	-0.0795 (-0.92)	0.1193 (1.03)	0.0753 (0.61)	0.2398 (2.11)	-0.0158 (-1.76)	0.7401 (2.14)	0.72

Table 4. Corn Quarterly Price Relationships 1974/75 to 1984/85 Fit

Dependent Variable	Constant Term	Quarterly Dummies			Quarter Before Short Crop	Short Crop Dummies				Interest Rates	R^2
		QI	QII	QIII	D4	DS	DS*QI	DS*QII	DS*QIII	R	
PCORN (t)	105.494	-0.14526 (-3.58)	-10.2144 (-2.52)	-2.9316 (-0.72)	6.2294 (1.45)	-10.1241 (-2.47)	23.7359 (4.24)	16.9513 (3.03)	8.1910 (1.47)	—	0.51
PCORN (t)	83.017	-0.15007 (-3.99)	-10.9172 (-2.90)	-3.594 (-0.96)	6.5797 (1.66)	-11.3329 (-2.97)	23.7233 (4.59)	19.6421 (3.73)	10.4692 (2.00)	0.2290 (2.63)	0.59

Table 5. Soybean Meal Equivalent Exports; U.S. and South American 1974/75 to 1984 Period of Fit

Dependent Variable	Constant Term	Quarterly Dummies			Short Crop Dummies			R^2
		QI	QII	QIII	DS*QI	DS*QII	DS*QIII	
XSMUS	16.293	13.487	12.212	8.484	1.171	2.956	-2.633	0.874
(t)		(11.16)	(10.11)	(7.02)	(0.78)	(1.96)	(-1.75)	
XSMSA	37.008	-19.734	-24.179	-3.755				0.878
(t)		(-11.52)	(-14.12)	(-2.19)				

Table 6. Vegetable Oil Exports of Major Competitors Includes Oil Equivalent of Soybean Exports

Dependent Variable	Constant Term	Quarterly Dummies			R^2
		QI	QII	QIII	
XVEGX	33.278	-11.633	-16.863	-4.615	0.867
(t)		(-7.25)	(-10.52)	(-2.88)	
XSOSA	36.972	-21.791	-25.811	-0.288	0.763
(t)		(-5.18)	(-6.14)	(-0.07)	

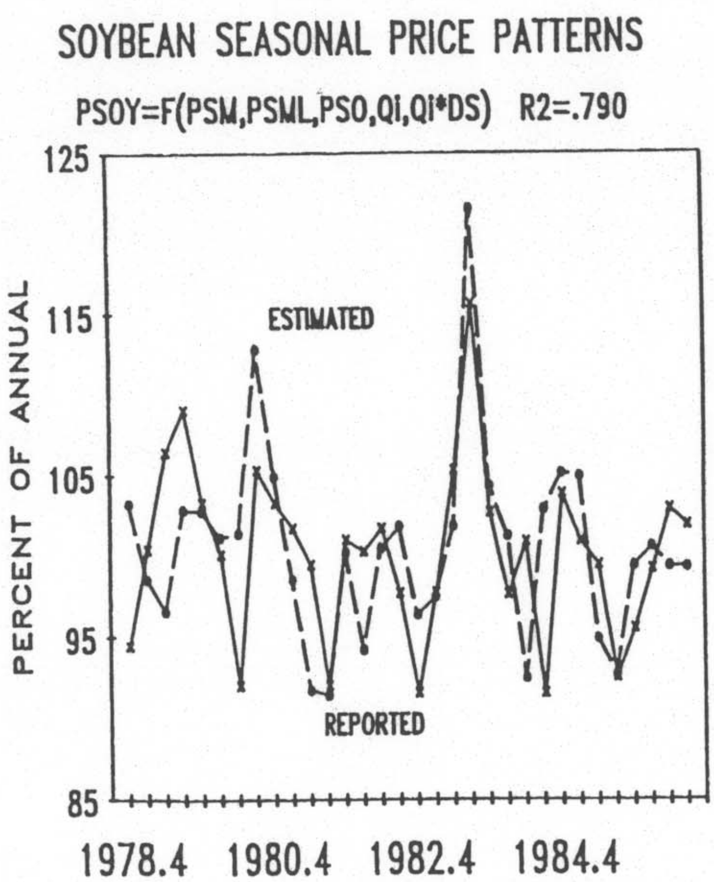

FIGURE 3

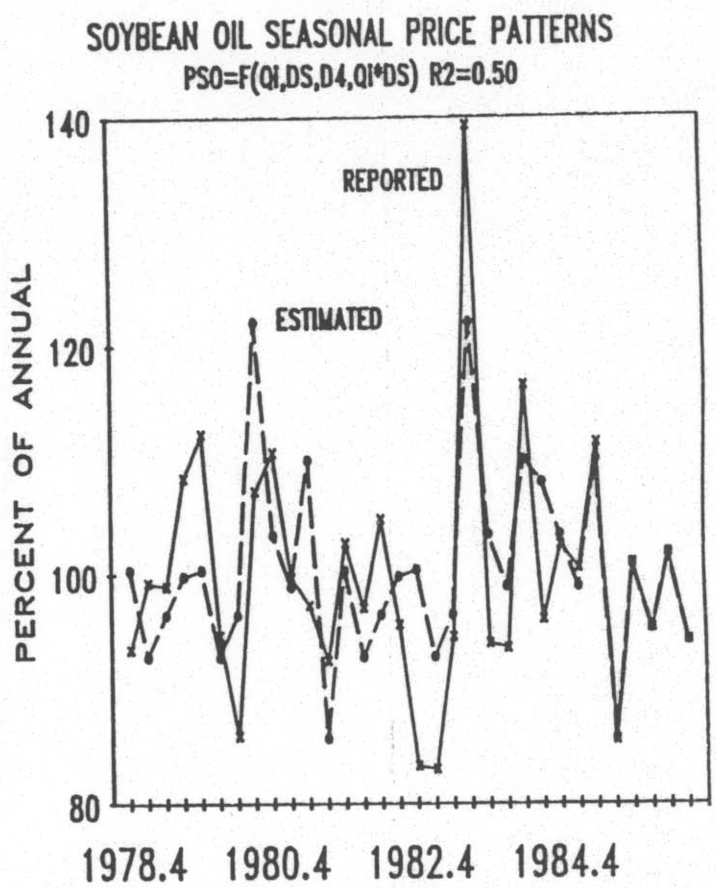

FIGURE 4

In the soybean meal price relationship, there are strong indications that the seasonal price pattern has been changing over time and is altered significantly by crop shortfalls in the United States. The time influence on seasonal price patterns is probably due mostly to the rise in South American supply competition since the mid-1970's. Hence, a soybean meal export market share variable was used in lieu of time trend in one specification of the meal price relation and was found to be highly significant. The desirability this variable has over the time trend variable is generally unknown, but application in a forecast mode may offer some clues later. In Figures 5 and 6, application of these equations to the forecast period 1985/86 suggests significantly different possibilities for quarterly meal price changes.

For the soybean oil price relation, no significant change in seasonal patterns over time were identified. Results were encouraging as can be seen in Figure 4. Short crop years had a significant impact on the seasonal price pattern shifting the seasonal highs to early in the year in contrast to the normal lows for prices. Short crops also were found to impact significantly the quarter preceding the short crop year, denoted D4 in the analysis. This was true for meal as well. Extension of the oil price relation to include some structural variables indicated that imports by selected major countries could add significantly to the R^2 for the soybean oil price relation. The addition of exports by major exporters did not add that much. The reason may be that such exports are highly collinear with the seasonal dummies, while imports are not highly collinear and are probably a part of the irregular portion of the seasonal adjustment approach.

Estimates of U.S. and major competitor seasonal export patterns were surprisingly good with high R^2's for both soybean meal and vegetable oils (Tables 5 and 6). Only seasonal dummy shifters were required with no evidence of a shift in patterns over time.

Some Evaluation Comments

Quarterly forecasts for soybeans and soybean oil prices are shown in Tables 7 and 8 for 1984/85 and for 1985/86. Annual forecasts are those published monthly by the U.S. Department of Agriculture (USDA). Only selected months paralleling a quarterly sequence of reporting are used beginning in August, 1984 through April, 1985. Annual forecasts published on those dates are used to derive quarterly estimates based on the quarterly allocation relationships derived from regression models (discussed in the previous section). Absolute percentage errors in the forecasts are shown to give some notion about the pattern of errors in the procedure for this short forecast time interval. In addition, results from a quarterly forecasting model housed in the Economic Research Service are shown for the same dates to provide a benchmark. Hopefully, the comparative remarks may offer some insights into the merits of each approach as well as to point up areas where parts of alternative forecasting approaches may be beneficially merged.

For the forecast period examined, the following comments and observations are offered.

(1) Early soybean forecasts (as of August) for the full year published by USDA were generally better than results from the quarterly model.

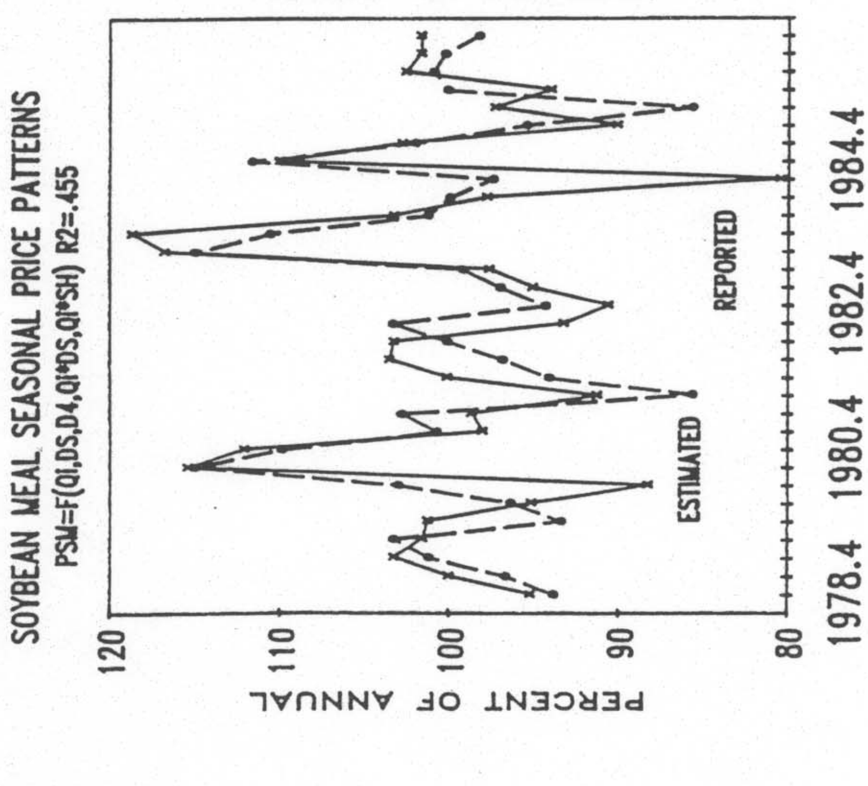

FIGURE 5

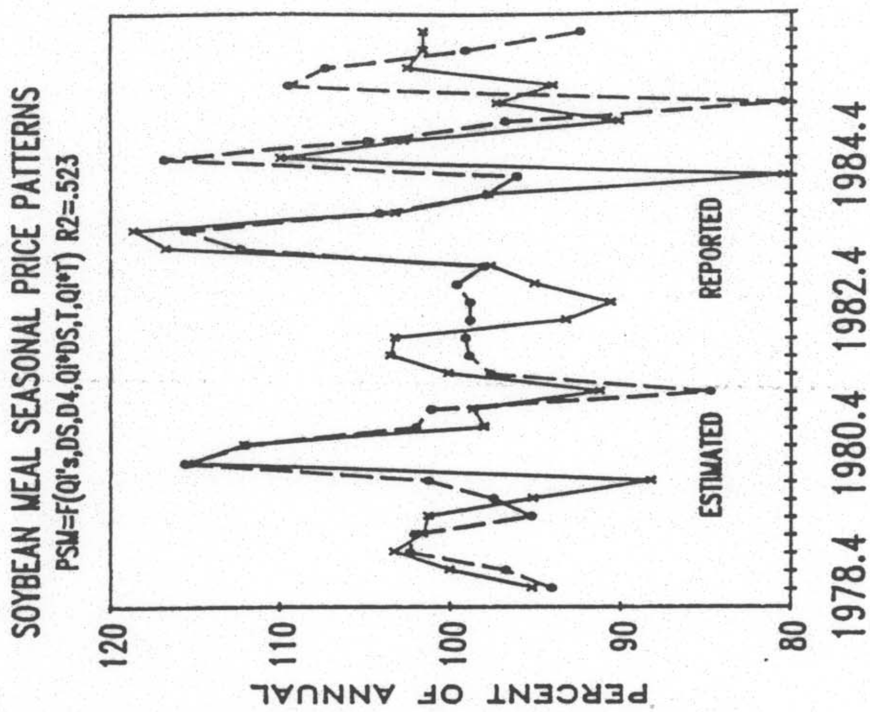

FIGURE 6

(2) Later forecasts for the year from the two alternative approaches were much closer together.

(3) USDA published estimates are a consensus forecast as opposed to a single forecast from the model. The USDA forecast, however, gives some weight to the modeling result.

(4) The larger annual soybean price forecast errors in the quarterly model appear to be traceable more to errors in soybean oil prices rather than meal, particularly in 1985/86 (Table 8). Consequently, improvement in the soybean oil portion of the model may offer significant improvement in forecast performance.

(5) When annual forecast errors are similar for the two approaches, errors for individual quarters tend to be smaller for the nearby quarters for the structural model whereas errors for the later quarters are generally smaller using the quarterly allocation approach.

(6) Improvement in annual forecasts at later forecast dates were markedly better for soybean oil using the annual forecast approach and applying the seasonal allocation method. However, the poorer performing structural model still frequently did better in the nearby quarter. This suggests that use of time series models discussed earlier may have merit on forecasting the nearby quarters. Unfortunately, time did not permit testing this notion.

(7) Strong seasonal behavior observed for exports of competitors has strong implications for improving the quarterly forecasts based on use of seasonal allocation approaches.

(8) Updating of quarterly forecasts based on the allocation method as one proceeds through the season can provide good insight about final season average prices. Given reported first quarter results, application of seasonals to refine annual forecasts appears to be a good use of seasonals. However, a mid-season revision in the annual price estimate due to a shift in market environmental factors poses some difficulty in deriving remaining quarterly estimates and refining the annual average price forecast.

Some implications that follow from the previous comments are:

(1) Preparation of quarterly estimates can probably benefit by giving weight to both approaches. Nearby quarterly forecasts could give more weight to quarterly modeling results or to results based on ARMA models while an allocation procedure could be given greater weight in later quarters.

(2) Forecasts based on quarterly models might benefit by using consensus annual forecasts for soybean oil exports combined with a seasonal allocation approach to determine values for exogenously treated exports. This should be empirically testable at some future date.

(3) For the quarterly allocation model, relying on the first quarter reported soybean prices in 1984/85 and 1985/86 would have improved the annual forecast much more quickly than was the case. Note, that as of

TABLE 7. SOYBEAN PRICE FORECASTS BASED ON ALTERNATIVE PROCEDUAL APPROACHES. FORECASTS MADE AS OF DATE INDICATED IN LEFT MARGIN OF TABLE

SOYBEAN PRICES

	ANNUAL/QUARTERLY ALLOCATION METHOD					QUARTERLY ECONOMETRIC MODEL				
1984/85	I	II	III	IV	YEAR	I	II	III	IV	YEAR
AUGUST	$6.94	$6.92	$6.26	$6.11	$6.60	$6.96	$7.10	$7.03	$7.17	$7.05
% ERROR	14.3%	17.3%	7.6%	13.0%	12.8%	14.7%	20.3%	20.8%	32.5%	20.5%
NOVEMBER	$6.94	$6.92	$6.26	$6.11	$6.60	$6.27	$6.49	$6.58	$6.82	$6.50
% ERROR	14.3%	17.3%	7.6%	13.0%	12.8%	3.3%	10.0%	13.1%	26.1%	11.1%
FEBRUARY	$6.41	$6.40	$5.79	$5.65	$6.10	$6.07	$6.55	$6.77	$7.03	$6.50
% ERROR	5.6%	8.4%	0.6%	4.4%	4.3%	0.0%	11.0%	16.3%	29.9%	11.2%
MAY	$6.20	$6.19	$5.60	$5.46	$5.90	$6.07	$5.82	$6.11	$6.20	$6.05
% ERROR	2.1%	4.9%	3.8%	1.0%	0.9%	0.0%	1.4%	5.0%	14.6%	3.4%
FINAL EST	$6.15	$6.14	$5.55	$5.42	$5.85					
% ERROR	1.3%	4.0%	4.6%	0.2%	0.0%					
REPORTED	$6.07	$5.90	$5.82	$5.41	$5.85	$6.07	$5.90	$5.82	$5.41	$5.85
1985/86	I	II	III	IV	YEAR	I	II	III	IV	YEAR
AUGUST	$5.27	$5.33	$5.27	$5.26	$5.30	$5.23	$5.45	$5.62	$5.88	$5.48
% ERROR	7.1%	4.3%	2.3%	2.2%	5.0%	6.3%	6.7%	9.1%	14.2%	8.4%
NOVEMBER	$5.12	$5.18	$5.12	$5.11	$5.15	$5.04	$5.19	$5.26	$5.47	$5.20
% ERROR	4.1%	1.4%	0.6%	0.7%	2.0%	2.4%	1.6%	2.1%	6.2%	2.9%
FEBRUARY	$5.17	$5.23	$5.17	$5.16	$5.20	$4.92	$5.25	$5.31	$5.46	$5.18
% ERROR	5.1%	2.3%	0.3%	0.3%	3.0%	0.0%	2.7%	3.1%	6.0%	2.4%
APRIL	$5.07	$5.13	$5.07	$5.07	$5.10	$4.92	$5.11	$5.35	$5.49	$5.15
% ERROR	3.0%	0.4%	1.6%	1.6%	1.0%	0.0%	0.0%	3.9%	6.6%	2.0%
FINAL EST	$4.97	$5.03	$4.97	$4.97	$5.00					
ALT I	$5.12	$5.18	$5.12	$5.11	$5.15					
REPORTED	$4.92	$5.11	$5.15_P/	$5.15_P/	$5.05_P/	$4.92	$5.11	$5.15_P/	$5.15_P/	$5.05_P/

_P/ Preliminary

TABLE 8. SOYBEAN OIL PRICE FORECASTS BASED ON ALTERNATIVE PROCEDUAL APPROACHES.
FORECASTS MADE AS OF DATE INDICATED IN LEFT MARGIN OF TABLE

SOYBEAN OIL PRICES

	ANNUAL/QUARTERLY ALLOCATION METHOD					QUARTERLY ECONOMETRIC MODEL				
1984/85	I	II	III	IV	YEAR	I	II	III	IV	YEAR
AUGUST	29.0	27.7	30.8	24.0	28.0	28.2	27.3	26.8	27.9	27.5
% ERROR	4.1%	6.8%	6.4%	4.8%	5.1%	6.8%	7.9%	18.5%	10.5%	6.7%
NOVEMBER	30.0	28.7	31.9	24.9	29.0	26.7	26.0	25.2	27.7	26.4
% ERROR	0.7%	3.4%	3.0%	1.4%	1.7%	11.6%	12.6%	23.4%	9.8%	10.6%
FEBRUARY	30.0	28.7	31.9	24.9	29.0	28.5	27.4	26.5	29.0	27.8
% ERROR	0.7%	3.4%	3.0%	1.4%	1.7%	5.6%	7.9%	19.5%	15.0%	5.7%
MAY	32.1	30.7	34.1	26.6	31.0	28.5	29.5	30.6	31.9	30.1
% ERROR	6.2%	3.2%	3.6%	5.4%	5.1%	5.6%	0.7%	7.0%	26.4%	2.1%
FINAL EST	30.5	29.2	32.5	25.3	29.5					
% ERROR	1.0%	1.8%	1.4%	0.3%	0.0%					
REPORTED	30.2	29.7	32.9	25.2	29.5	30.2	29.7	32.9	25.2	29.5
1985/86	I	II	III	IV	YEAR	I	II	III	IV	YEAR
AUGUST	26.8	25.2	27.0	25.0	26.5	27.9	27.2	26.6	29.0	27.7
% ERROR	28.0%	34.9%	58.8%	61.0%	47.0%	33.5%	45.5%	56.5%	87.1%	53.5%
NOVEMBER	22.2	20.9	22.4	20.7	22.0	25.1	24.8	24.3	26.8	25.3
% ERROR	6.3%	12.0%	31.8%	33.7%	22.1%	20.1%	32.6%	42.9%	72.9%	40.1%
FEBRUARY	18.7	17.6	18.8	17.4	18.5	20.7	20.2	21.0	22.4	21.1
% ERROR	10.6%	5.8%	10.8%	12.4%	2.6%	1.0%	8.0%	23.5%	44.5%	16.9%
APRIL	18.2	17.1	18.3	17.0	18.0	20.7	20.3	21.1	22.5	21.2
% ERROR	13.0%	8.3%	7.8%	9.4%	0.1%	1.0%	8.6%	24.1%	45.2%	17.3%
FINAL EST	20.7	19.5	20.9	19.3	20.5					
ALT.I	16.7	15.7	16.8	15.5	16.5					
REPORTED	20.9	18.7	17.0_P/	15.5_P/	18.0_P/	20.9	18.7	17.0_P/	15.5_P/	18.0_P/

_P/ Preliminary

February, 1985, the annual allocation approach called for a $6.41 per bushel quarterly soybean price for 1984/85 when the reported price was $6.07. This would have suggested a full year price of slightly less than the $5.85 finally reported as opposed to the $6.10 forecast in February.

(4) A change in the annual forecast due to a change in the economic/policy environment will result in a change for all quarterly estimates. Only unreported quarters appear to be adjusted to the new annual estimate but some judgment is still required in this situation to arrive at a set of quarterly estimates consistent with the annual.

(5) For the remainder of 1985/86, the soybean seasonal adjustment procedure indicates that soybean prices will likely remain near or slightly below levels reached in the spring. A slight decline in soybean meal along with oil is indicated, but oil could show some increase in the early summer before resuming its downtrend.

Summary Remarks

The overall results were encouraging but the procedure needs much more testing and evaluation before its reliability can be determined in a forecast mode. Time series models which were estimated were not evaluated in this exercise but may provide beneficial price forecasting help, particularly for the nearby quarters. If the final evaluation of these quarterly allocation approaches prove to be worthwhile, a next step would be to attempt a similar process with monthly prices. Seasonal effects would likely be more pronounced in the monthly series and better intra-seasonal fits might be obtained, particularly with the ARMA/ARIMA models.

Some further study of the price adjustment mechanism might suggest other variables which could be included as independent variables. The independent variables could be modeled in the quarterly regression equations or in the ARMA context as a mixed model or transfer function model. Stock or stock adjustment variables could be a useful source of potential variables. Interest rates have been significant variables in some specifications of the regression model. As with all variables, problems with collinearity have to be considered as well as the major stumbling block of estimating future values of independent variables in the forecast mode. One of the most important issues is dealing with exogenous shocks to the system which cause departures from regular season pricing patterns, e.g. large or earlier than usual purchases of soybeans by the Soviet Union as occurred this year or the big year-over-year decline in U.S. production that occurred in 1983 as a result of major drought. These shocks are usually modeled as dummy variables which act as equation shifters; the real trick is not just to model the shock, but to model the shock's impact on the seasonal pricing pattern. Answering these questions suggest a lot of work which will not be done quickly, but the results should meaningfully enhance our outlook work.

REFERENCE

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