Evaluation of Extension and USDA Price and Production Forecasts

by

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This study evaluates Extension forecasting accuracy in an analysis of responses to the Annual Outlook Survey conducted by the American Agricultural Economics Association from 1983 through 1995. Representative and composite production and price forecasts for several commodities are examined. Extension forecasts are compared with USDA, naive, and futures-based forecasts. Relationships between forecast/forecaster features and accuracy are examined in a regression framework. Composite forecasts are more accurate than representative forecasts. Generally, Extension forecasts are less accurate than USDA forecasts for crops, but more accurate for beef production and price. Forecasters who rely more heavily on formal econometric models are slightly more accurate than those who do not.

Forecasting has been an integral part of agricultural economics since the discipline's inception. The USDA, in particular, has routinely provided both quantity and price forecasts of agricultural commodities for many years. These forecasts are intended to assist agricultural industry participants in making informed production, marketing, processing, and retailing decisions. For over 70 years applied university agricultural economists, or simply *Extension*, have bridged the gap between the USDA and industry participants by providing regular real-time forecasts of their own.

Fundamentally important to Extension forecasters and forecast users, is whether such "extending upon" USDA's direct forecasts is worthwhile, in terms of either accuracy or relevance relative to USDA's direct forecasts. Several challenges to Extension's role of providing marketing information have appeared in the literature over the last 20 years. Some have questioned whether the land grant university system in general (Armbruster, 1993), and Extension forecasters in particular (Brorsen and Irwin, 1994), are providing redundant information that is available from the private sector. Others have used surveys to determine the importance to producers of Extension as a market information provider relative to other sources such as radio or magazines (Harris, 1976; Smith, 1989; Batte, Schnitkey, and Jones, 1990). Of course, these other market information sources often rely heavily on Extension for their information.

Implicit within the challenges described is a concern for forecasting efficiency. If forecast accuracy can be improved while reducing forecast construction costs, the resultant efficiency gains should be of interest to both forecast users as well as those paying for forecast construction (often taxpayers). Because mechanical, model-based forecasts are less expensive than judgmental forecasts (e.g. Armstrong, 1978; Fildes, 1985; Makridakis, 1986; van Vught, 1987), determining the relationship between mechanical model usage and forecast accuracy could be relevant in efforts to improve the benefit/cost ratio associated with forecasters. In general, understanding the relationships between forecast/forecaster features and forecasting accuracy should be useful in attempts to improve the efficiency of forecast construction. Thus, uncovering those relationships is an important objective of this research.

In a more restrictive framework, if Extension forecasts are less accurate than USDA's direct forecasts, from a benefit/cost perspective Extension forecast providers should focus on disseminating USDA's forecasts rather than constructing their own. Furthermore, where Extension forecasts are less

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accurate and no less expensive than those readily accessible to users, it may not be appropriate for Extension to continue investing in forecast development. Therefore, a second objective of this research focuses on comparing the accuracy of Extension forecasts to those provided by USDA, the futures markets, and naive models.

Extension Forecasting Accuracy Studies

Green (1926), one of the earliest Extension forecasters, was acutely aware of the importance of testing Extension's forecasting accuracy and began testing the accuracy of his own price forecasts after only one year of price forecasting. However, Green also realized the inherent reluctance among both forecast users and forecasters to consider the underlying forecast accuracy:

> The real job is in getting county agents, extension men in other lines, and scientific workers who have been used to measure things with calipers, even to look at anything that may be as much as 25 per cent off when it comes to measurements. (p.187)

> ...workers will naturally be very reluctant about saying anything that may later necessitate the admission of a mistake. Almost unconsciously they work toward an end such that so far as this kind of work is concerned, it can truthfully be said of one of them, 'he never said a foolish thing nor ever did a wise one.' In so strenuously trying to avoid the first fate workers run headlong into the latter. (p.190)

Green's concerns were apparently well founded. Over the ensuing years, numerous studies have examined the accuracy of USDA's forecasts, with far fewer examining Extension's accuracy.[1] There were a few exceptions, however. In 1949, Seltzer and Eggert concluded that Kansas State College's monthly hog price forecasts (1925-1940) were more accurate (64% correct based on an arbitrary scoring technique) than a simple seasonal price forecast (37% correct). Corresponding cattle price forecasts were 62.7% accurate compared to 52.7% for the seasonal forecast. Heer (1954) similarly scored the monthly grain price forecasts for Iowa State College for the 1948-1951 period.

More recently, Gerlow, Irwin, and Liu (1993) compared expert opinion forecasts from the Purdue University Agricultural Economics Department with those of a single-equation econometric model, an ARIMA model, and two composite models. Forecasts were of U.S. quarterly hog prices from 1976 through 1985, and were compared by using traditional statistical measures as well as with an economic measure comprised of simulated trading profits based on the forecasts. Expert opinion ranked about in the middle of the procedures by statistical measures of accuracy, but ranked last by the economic criterion. The econometric model, although ranked last by statistical measures of accuracy, was the only procedure that generated statistically significant profits by the economic criterion.

Another recent study (Lawrence, 1991) further illuminated the importance of choosing forecast accuracy measures appropriately. Lawrence studied the accuracy of Iowa State University's hog price forecasts for the 1968-1986 period. He revealed that a persistent downward bias in the hog price forecasts was an underlying attempt to tailor forecast error to match the loss function of the user. Specifically, hog producers were assumed to value lost opportunity differently than real dollars lost.

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[1] Extension forecasting is distinguished from USDA outlook work to the degree that its forecasts are developed by individual agricultural economists, usually at the state university level, rather than by a USDA committee at the national level. Extension forecasting is distinguished from the balance of applied agricultural economics forecasting according to the degree in which 1) forecasts are regular and developed in real time, and 2) the targeted users are producers and business people, as opposed to other researchers.

This suggests forecast error variance should be penalized more heavily than bias. However, if downward bias extends to price forecasts of commodities that are inputs for some producers but outputs for others, then tailoring forecasts for user loss functions is potentially troubling. That is, different point forecasts must be developed for alternative groups of risk averse producers.

Research relating to Extension forecasting has rarely appeared in the academic literature, however, it has frequently been assessed. Each year, since 1978, just prior to the American Agricultural Economics Association's (AAEA) annual meeting, an annual outlook survey (AOS) has been conducted of members routinely involved in forecasting. The surveys solicit price and production forecasts for the coming year.[2] At the outlook session of the AAEA annual meeting, the current survey results and accuracy of the preceding year's survey are presented. Generally, evaluations of accuracy have not been comprehensive or rigorous, nor across time. Cornelius, Ikerd, and Nelson (1981) provided a preliminary evaluation after the first two years of forecasting, noting that soybean price forecasts had been more accurate than corn price forecasts, and hog prices were easier to forecast than cattle prices.

In 1988, Ferris evaluated AOS accuracy to date, using root mean squared and percentage error (RMSE and RMSPE) to compare AOS forecasts for 1979-1988 with those from the USDA, from a naive no-change model, and from the futures market (adjusted for basis). AOS forecasts were less accurate than futures or naive models for slaughter steer prices and feeder steer prices, but more accurate for hog prices (USDA forecasts were not compared). In each case (slaughter steers, feeder steers, and hogs), the average AOS forecast was biased upward, predicting prices that were too high. Apparently Lawrence's (1991) findings of downward bias did not extend to Extension hog price forecasting in general during that time period.

For crop price forecasts, Ferris reported that the average AOS forecast was less accurate (RMSPE) than either USDA or futures for wheat, more accurate than USDA or futures for corn, and less accurate than futures for soybeans, but equivalent to USDA for soybeans. The historical accuracy of AOS forecasts was revisited by Miller and Plain in 1991. No comparisons with other forecasts were offered. However, examination of the forecast errors lead the researchers to conclude: "Overall, our livestock forecasting ability exceeds that of crop forecasting. . . . The absolute percent error of all crop production estimates increased [since the previous year] for all crops estimated. The accuracy of crop price forecasts declined for all but soybeans." (p.1)

No sweeping conclusions regarding Extension's forecasting accuracy emerge from past studies. What stands out is the inconsistency in the way Extension forecast accuracy has been measured. Metrics ranged from arbitrary accuracy scores to economic profits to several forecast error test statistics. Because the measures are not perfect substitutes for each other, it is difficult to generalize about Extension's forecast accuracy over time when alternative measures have been used.

Testing Forecast Accuracy

The choice of forecast accuracy test statistic(s) is relevant because different test statistics capture different information associated with forecast error. Mathews and Diamantopoulos (1994) showed that at least four unique classes of information are available from commonly used accuracy test statistics. They suggested that forecast accuracy studies should include a measure from each of the four classes. With *A* and *F* denoting the actual series and forecasted series, respectively, the four classes

[2] AOS respondents represent private, government, and university concerns. Most, however, are agricultural economists from universities — usually those involved in Extension outlook work.

and a representative test statistic for each are 1)Bias, e.g. mean error, ME: $\Sigma(A\text{-}F)/n$; 2) ratio-type, e.g. mean absolute percentage error, MAPE (in a proportional, not percentage, framework): $\Sigma|(A\text{-}F)/A|/n$; 3) volume-type, e.g. root mean squared forecast error, RMSE: $[\Sigma(A\text{-}F)^2/n]^{1/2}$; and 4) fit, e.g. r-squared, RSQ: $[\Sigma(A\text{-}\overline{A})(F\text{-}\overline{F})]^2/\Sigma(A\text{-}\overline{A})^2\Sigma(F\text{-}\overline{F})^2$.

Empirically, because individual point forecasts often are on either side of the actual value, a composite forecast series (where, for each time period, the point forecast is the mean of several competing forecasts) is often more accurate than the most accurate of the individual series making up the composite — by each of the four test statistics. In the case of root mean squared error this is especially well known (see for example, Granger, 1989). This empirical result should be valuable to forecast users who have access to the composite forecast series. If there is no access to the composite series, and when no individual forecast series consistently covers a time period of interest, users should be more interested in the accuracy of a representative forecast series (where, for each time period, one of several competing forecasts is randomly drawn). Composite forecast accuracy is not equal to representative forecast accuracy.

Percentage, rather than level errors, have appeal where accuracy measures are aggregated across series that vary widely in scale. For computing the accuracy of a representative forecast series, absolute errors are intuitively appealing. For a single time period, the representative forecast accuracy is the mean of the individual absolute errors. Across time, the representative forecast accuracy is the mean of the time periods' absolute errors. Of the four accuracy test statistics noted, only MAPE has this broad-based appeal. For these reasons, and to contain the quantity of reported results, this research uses only MAPE (and the single point counterpart, APE) to measure forecast accuracy.

Data

This study uses the AOS survey collected annually for the AAEA outlook sessions. Only surveys from 1983-1995 were available. The survey has been modified in several ways over the 13 years examined. Forecasted series were added, dropped, or redefined to keep reasonably compatible with USDA's forecasted series. Whenever possible, a compatible USDA forecast series, naive series, and futures series were constructed to compare with the AOS forecasts. The survey contains a personal information section; a production and price forecast section for livestock, poultry, and milk; a supply and utilization section for crops; a low and high monthly price forecast section for livestock, poultry, milk, and crops; and a general macroeconomics forecast section. Monthly high/low forecasts and macroeconomics-related responses were not analyzed.

Surveys were mailed in early July each year to university, private, and government individuals with agricultural forecasting interests. Survey responses were to be returned by July 24 on the average. The total number of surveys examined for the 1983-1995 period was 557, involving 201 unique respondents, for an average number of years that an individual participated of 2.77. The least number of annual responses, 27, was received in 1989, the most, 68, in 1985. No analyst responded all 13 years. Only 7 individuals responded at least 10 years, and only 41 responded at least 5 years. Ninety-eight individuals responded only one year. Of the 103 individuals who responded more than one year, 58 delivered non-consecutive responses. The low number and non-consecutive responses for individuals precluded analyzing individual forecaster accuracy, forcing the analysis into representative and composite forecast frameworks.

In the personal information section of surveys, respondents reported levels of econometric model usage, importance of forecasting in their job responsibilities, and indicated areas in which they have major forecasting responsibilities. Besides personal information provided directly by the survey responses, additional personal information was derived from the responses, informational directories, or by direct follow-up requests. The respondents' years and types of terminal academic degrees were collected to serve as indications of forecasting experience and professional training. The average number of years experience associated with the 530 responses where it could be obtained was 17.2 (standard deviation of 11.3 years). Affiliating institutions reported by respondents were categorized as university, government, or private. Table 1 summarizes personal information categories. In brief, it shows that most respondents are university forecasters with PhD's, who make little use of econometric models, and who are primarily involved with the traditional commodities of beef, pork, wheat, corn, and soybeans.

Table 1. AOS Forecaster Personal Information Summary, 1983-1995.[a]

Econometric Model Use:								
Major	Moderate	Minor	None		No Indication			
10.4	21.2	41.3	24.1		3.0			
Level of Forecasting Responsibility:								
Major	Moderate	Minor		No Indication				
38.2	34.5	23.7		3.6				
Areas of Major Forecasting Responsibility:								
Beef	Pork	Broilers	Eggs	Milk[b]	Wheat	Corn	Cotton	Soybeans
32.1	31.8	12.2	6.6	4.9	27.8	29.1	11.7	30.5
Terminal Degree of Forecaster:								
PhD	Masters	Bachelors		Unknown				
77.9	18.3	0.4		3.4				
Forecasting Institution:								
University	Gov't	Private		Unknown				
72.5	7.4	20.1		0.0				

[a] Table values are percentages of 557 total surveys received 1983-1995.
[b] Milk forecasts began in 1991. Of the 185 surveys for 1991-1995, 27 (14.6%) indicated milk expertise.

Livestock, Poultry, and Milk Forecasts

The periods forecasted for this section of the survey were the third quarter, the fourth quarter, and the annual value for the survey (current) year, and each quarter and the annual value for the following year. Percent changes (from the same period in the prior year) were forecasted for commercial beef and pork production, federally inspected broiler production, farm egg production, and farm milk production (started with the 1991 survey). Prices were forecasted for the same time periods associated with the production forecasts. The prices forecasted were choice slaughter steers ($/cwt. Omaha: 1000-1100 lbs., 1983-1994; Nebraska Direct: 1100-1300 lbs., 1995), feeder steers ($/cwt. Kansas City: 600-700 lbs., 1983-1990; Oklahoma City: 600-700 lbs., 1991-1994, 750-800 lbs., 1995), barrows and gilts ($/cwt. U.S. 7-market: 1983-1991; U.S. 6-market: 1992-1993; Iowa/Minnesota: 230-250 lbs., 1994-1995), broilers (¢/lb. U.S. 12-city, ready-to-cook: 1983-1995), eggs (¢/doz. NY grade A large: 1983-1995), and milk ($/cwt. M-W series, 3.5% BF: 1991-1995).

The actual production and price series underlying the forecasts were obtained from various USDA publications. Compatible USDA forecasts (most recent prior to July 24), were obtained from various USDA outlook publications.[3] The naive production forecast series were no-change. The naive price forecast series assumed that each quarterly and annual price forecasted was the same as the second quarter price in the survey year. For slaughter steers, feeder steers, and barrows and gilts a futures-derived compatible forecast was constructed using the Chicago Mercantile Exchange (CME) futures prices for live cattle, feeder cattle, and hogs, respectively, and a rolling 5-year average basis.[4]

In order to determine the relationship between forecast accuracy and forecast/forecaster features, the absolute percentage error (APE) for each point forecast was expressed as a function of several variables of interest in a regression framework:

$$\begin{aligned} APE_{it} = {} & \beta_0 + \beta_1 GOVT_{it} + \beta_2 PRIV_{it} + \beta_3 EXPER_{it} + \beta_4 MAST_i + \beta_5 MODMOR_{it} + \\ & \beta_6 MAJFORC_{it} + \beta_7 RESPONS_{it} + \beta_8 QTRO4_t + \beta_9 QTROA_t + \beta_{10} QTRN1_t + \\ & \beta_{11} QTRN2_t + \beta_{12} QTRN3_t + \beta_{13} QTRN4_t + \beta_{14} QTRNA_t + \\ & \beta_{83} YR1983_t + \beta_{84} YR1984_t \ldots \beta_{93} YR1993_t + \beta_{95} YR1995_t + \varepsilon_{it}, \end{aligned} \tag{1}$$

where i refers to forecaster, t refers to year (1983-1995), and ε_{it} is a stochastic error. GOVT and PRIV are variables equal to 1 if the response is associated with a forecaster from the government or private sector, respectively, else 0 (default is a university employee). EXPER denotes the respondent's years of experience (survey year less year of terminal degree). MAST equals 1 if forecaster has less than a PhD, else 0 (default is PhD). MODMOR equals 1 if the respondent indicated major or moderate use of formal econometric models in forecast construction, else 0 (default is minor or no use). MAJFORC equals 1 if forecasting was in general a major or moderate part of the forecaster's responsibility, else 0 (default is minor part). RESPONS equals 1 if the forecaster had a major forecasting responsibility in the commodity corresponding to the model, else 0. QTRO4 equals 1 if the forecast is for the fourth quarter in the survey year (old year), else 0. Similarly, OA denotes old year annual, QTRN1-N4 denote quarters corresponding to the year following the survey year (new year), and QTRNA denotes new year annual (the default quarter is O3, or the third quarter in the survey year). YR19xx equals 1 if the survey year is 19xx, else 0 (default is YR1994).

Equation 1 was estimated independently for each production series and each price series. The

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[3] For information regarding the exact USDA publication or database from which each point actual or point forecast was obtained, consult the authors. For some point forecasts, in computing forecast error, a different actual value was used for USDA than for AOS (as when USDA changed to a new commodity definition earlier than AOS). USDA began forecasting table egg production in 1995, rather than farm production. It is assumed that the AOS respondents also began to forecast changes in table egg production beginning in 1995. USDA began forecasting milk prices in 1994.

[4] Monthly futures prices were derived using the July 20 closing price for the appropriate deferred futures contracts (for compatibility, this assumes AOS surveys were completed 4 days prior to the deadline of July 24). Delivery months are assumed to be comprised of 3 weeks from the nearby contract and 1 week from the next contract. For example, the futures-derived October slaughter steer price forecast made July 20, 1995 is 3/4 times the October live cattle futures price on July 20 plus 1/4 times the December futures price on July 20, and adjusted by the October average basis for 1990-1994. The historical monthly basis is the difference between the average daily closing prices of the nearby futures contract for that month and the actual monthly cash price for that month. For July in the survey year, the average daily close through the 20th is multiplied by 3/4, and added to the price on the 20th times 1/4, to obtain the futures part of the futures-derived July price forecast. Quarterly and annual futures-derived price forecasts are calculated from the monthly price forecasts.

estimated regression models corresponding to production forecasts for beef, pork, broilers, eggs, and milk are presented in table 2. Results of models corresponding to price forecasts for slaughter steers, feeder steers, barrows and gilts, broilers, eggs, and milk are presented in table 3. At the bottom of each table MAPE (mean absolute percentage error, or mean of the dependent variable) is reported along with the number of observations used in the estimation and R^2 for each model. Standard errors were computed using White's heteroscedasticity-consistent covariance estimator.

The MAPE's in tables 2 and 3 show that, except for eggs, the survey respondents are substantially less accurate in forecasting price than production. Of course this could be because production tends to be less variable than price. Except for beef and milk, government respondents are more accurate forecasters of production than are university respondents (table 2). On the other hand, private forecasters tend to be less accurate than university forecasters. In general, in price forecasting (table 3), the distinction between the relative accuracy of government and private versus university forecasters is less clear. Private forecasters are significantly better in broiler price forecasting, but worse for milk prices. Although only one is statistically significant at the 0.10 level (broilers, table 2), 8 of 11 MODMOR coefficient estimates are negative. This suggests that forecasters making more use of formal econometric models may forecast slightly more accurately than those who do not.

Those with greater general forecasting responsibility (MAJFORC) are generally more accurate production forecasters (table 2) than those with less, although only statistically more accurate in beef. In egg and milk price forecasting those who have greater forecasting responsibility are statistically less accurate than those who do not. In general, in both production and price forecasting, forecasters who have a major forecasting responsibility in the particular commodity (RESPONS) are more accurate than those developed by more casual forecasters.

Except for pork production, relative to quarter 3's forecast (the default), quarter 4's forecast is less accurate (QTRO4). Generally, the QTRN1 estimates tend to be larger than the QTRO4 estimates, implying diminished forecast accuracy as forecast horizon expands. Pork production in quarter 3 appears especially difficult to forecast (table 2). More distant forecasts are more accurate for both the current year and the next year out (QTRO4 < default and QTRN4 < QTRN3). Perhaps this is because seasonal hog production risk is highest during the summer — which translates to high 3rd quarter production variability. Alternatively, this could be because 3rd quarter production has been lower than 4th quarter production on average (12.6% lower for 1983-95) and because 3rd quarter percent changes have been larger than 4th quarter percent changes (32.6% larger). It is interesting to note that the next-year-4th-quarter forecast is more accurate than the next-year-3rd-quarter forecast for all prices except eggs. Few generalities are immediately apparent from the yearly dummies in tables 2 and 3. Beef and pork production do appear to have been more difficult to forecast in the 1980's than in 1994 (default).

The MAPE's for the AOS survey production and price forecasts are shown as tables 4 and 5, respectively. By tabular section, simple columnar averages are reported as well. Where available (requiring a minimum of 3 forecast years), MAPE's from competing USDA, Naive, and Futures forecasts are included for comparison. To focus attention on individuals most likely to be Extension forecasters, only pairwise comparisons involving university respondents who have declared major or moderate forecasting responsibility are considered. To differentiate this subset of AOS forecasts from those whose accuracy was modeled in tables 2 and 3, it is referred to as EXT, for Extension.[5]

[5] To prevent the potential distortion from differing numbers of survey responses across years, an EXT MAPE is developed by first computing the MAPE across all EXT forecasts for a single survey year, and then averaging the yearly MAPE's. Intuitively, the reported 13-observation MAPE depicts the accuracy associated with following a representative forecaster for each of the 13 years.

Extension forecasters forecasting at least one time period for beef production number 158. Corresponding numbers for other production categories are pork, 158, broilers, 94, eggs, 61, and milk, 50. Corresponding numbers forecasting prices of slaughter steers are 154, feeder steers, 140, barrows and gilts, 141, broilers, 76, eggs, 56, and milk, 47. Because of the small sample size (maximum of 13 representative forecasts), except for the naive forecast comparisons, only a few of the pairwise comparisons involve statistical significance at the 0.10 level as determined by a paired-t test.

Compared to USDA, Extension appears more accurate in beef production (table 4) and price (table 5) forecasts, losing only one of the 6 competitions (4th quarter slaughter steer price). USDA is more accurate for pork production forecasts and Extension is more accurate for pork price forecasts. USDA is more accurate for production and price forecasts of broilers, and results for eggs are mixed. Extension's forecasts are generally more accurate than Naive forecasts. However, Naive forecasts are frequently more accurate than Extension for beef production and price forecasts, beginning with the first quarter of the next year out (N1). This implies that producers might just as well use current beef conditions (production and price) as reasonable estimates of conditions beyond 6 months.

It should be easy to improve accuracy using a forecasting system over a naive no-change model when the underlying series displays substantial trending, as for broiler production. Each quarterly and annual production value was larger than the corresponding value from the year before, attesting to the broiler industry expansion. Consequently, Extension forecasters were substantially more accurate than corresponding Naive broiler production forecasts (although, for price, results were mixed).

Examination of the Futures-derived forecasts (table 5) shows that Extension was more accurate in slaughter steer price forecasting but less accurate with feeder steer and barrows and gilts prices. Futures-based price forecasts appear to be viable substitutes for Extension forecasts. Overall, tables 4 and 5 depict Extension winning 60 of 88 Naive competitions, 10 of 24 USDA competitions, and 7 of 15 Futures competitions.

Supply, Utilization, and Market Year Average Price Forecasts for Crops

The items forecasted in this section of the survey were current (survey) year U.S. production, U.S. exports, carryout, and market year average price for the crop marketing year beginning with the survey year harvest. Crops forecasted were wheat, corn, soybeans (all in mil. bu. and $/bu.), and cotton (upland and ELS, mil. bales and ¢/lb.). The actual production and price series underlying the forecasts were obtained from USDA's WASDE reports issued in November of the year following the survey year. Compatible USDA forecasts were constructed from WASDE's July reports (usually released around July 11), where projections were made for the marketing year which had just begun in June (wheat) or about to begin in August (cotton) or September (corn and soybeans). Naive forecasts were WASDE's July estimates for the marketing year just ending. Thus, the Naive forecasts are essentially no-change forecasts.

Similar to the explanatory APE models for livestock, poultry, and milk forecasts, depicted as equation 1, a supply/utilization APE model was constructed for each of the crops forecasted:

$$
\begin{aligned}
APE_{it} = {} & \beta_0 + \beta_1 GOVT_{it} + \beta_2 PRIV_{it} + \beta_3 EXPER_{it} + \beta_4 MAST_t + \beta_5 MODMOR_{it} + \\
& \beta_6 MAJFORC_{it} + \beta_7 RESPONS_{it} + \beta_8 EXPORT_t + \beta_9 CARRYOUT_t + \\
& \beta_{83} YR1983_t + \beta_{84} YR1984_t \ldots \beta_{93} YR1993_t + \varepsilon_{it}, \qquad (2)
\end{aligned}
$$

where i refers to forecaster, t refers to year (1983-1994), and ε_{it} is a stochastic error. Except for

EXPORT and *CARRYOUT*, all explanatory variables in (2) are defined following equation 1. Production, exports, and carryout forecasting percentage errors for a crop were considered in the same model, with intercept shifting dummy variables serving to isolate production (the default) from exports (EXPORT) and carryout (CARRYOUT). Year dummies were included to capture unaccounted for changes in supply and demand (default is 1994). Equation 2 was estimated independently for each of the crops: wheat, corn, cotton, and soybeans. Market year average price APE models were constructed for each of the crops as well:

$$(3) \qquad APE_{it} = \beta_0 + \beta_1 GOVT_{it} + \beta_2 PRIV_{it} + \beta_3 EXPER_{it} + \beta_4 MAST_i + \beta_5 MODMOR_{it} + \beta_6 MAJFORC_{it} + \beta_7 RESPONS_{it} + \beta_{83} YR1983_t + \beta_{84} YR1984_t \ldots \beta_{93} YR1993_t + \varepsilon_{it} ,$$

where all explanatory variables in (3) have already been defined. Notice that (3) contains no exports and carryout dummies because only market year average price forecasts are considered. Equation 3 was estimated independently for wheat, corn, cotton, and soybeans.

The estimated results for the four supply/utilization APE models depicted by (2) and the four market year average price APE models depicted by (3) are reported in table 6. The MAPE line shows that the market year price forecasts for a crop are more accurate than the supply/utilization forecasts for the same crop. This could be because exports and carryout are especially difficult to forecast (in an absolute percentage error framework). CARRYOUT is associated with larger APE's than EXPORT, and both are forecasted substantially less accurately than production (the default).

Although only two of 16 coefficient estimates in the GOVT and PRIV rows of table 6 are significant, most (12 of 16) are negative, indicating that government and private forecasters appear to have an edge over university forecasters in crop supply/utilization and price forecasting. With standard errors for EXPER typically larger than associated parameter estimates, and the estimates typically positive, experience does not appear to enhance forecasting accuracy. Forecasters with Masters degrees (MAST) forecast less accurately than those with PhD's. Most (5 of 8) MODMOR estimates are negative, and two significantly negative. Consistent with livestock, poultry, and milk, formal econometric models enhance forecasting accuracy for most crops. Also similar to livestock, poultry, and milk forecasts, those forecasters with greater forecasting responsibilities (MAJFORC) make quantity forecasts more accurately and price forecasts less accurately than those who have less forecasting responsibilities. Unlike the situation for livestock forecasts, those who have a major forecasting responsibility (RESPONS) in the area of crops are no more accurate than those who do not.

The year dummies emphasize the forecasting inaccuracy associated with certain events. For example, a major drouth year for corn (1983) and a major flood year (1993) are associated with substantially less accurate (relative to 1994) supply/utilization forecasts. On the other hand, especially inaccurate price years for corn were 1986 and 1990.

As in the case of livestock, poultry, and milk forecasts, MAPE's were computed for the Extension subset of AOS survey respondents and for competing USDA and Naive forecasts. MAPE's are reported in table 7. Extension forecasters forecasting at least one of the categories (production, exports, carryout, or market year average) for each crop number: wheat, 125, corn, 135, cotton, 56, and soybeans, 125. When judged against Naive forecasts, Extension delivers greater accuracy, winning 15 of 15 comparisons, suggesting the potential for Extension forecasting value. However, compared to USDA, Extension forecasters forecast supply/utilization and market year average price for wheat, cotton, and soybeans less accurately. For corn, results are mixed, with Extension winning the competition in production and carryout but losing in exports and price. This suggests that Extension forecasts, winning only 2 of 15 comparisons, may add little of value to USDA forecasts.

Composite Forecasts

After considering the accuracies associated with representative Extension forecasters, the question arises, Would composite forecasts be better? Could Extension forecasters leave annual meetings with more accurate forecasts for their users than those they brought in? To test this, we computed MAPE's for composite-AOS (COMP) forecasts to compare with the same USDA series and the same futures series reported in previous tables. Here, COMP forecasts are annual means over all (not just EXT) AOS forecasts. The COMP/USDA accuracy comparisons are reported in tables 8 (livestock and poultry production), 9 (livestock and poultry prices), and 10 (crop quantities and prices).

Comparing table 8 with table 4 and table 9 with table 5 shows that in every case (39 of 39) COMP had a lower MAPE than did its EXT counterpart. For livestock and poultry production and prices composed forecasts certainly appear more accurate than representative forecasts. Generally, this result applies to crop forecasts as well, where COMP had lower MAPE's than EXT in 12 of 15 comparisons (compare table 10 with table 7). Along with the improved accuracy associated with COMP over EXT, the number of pairwise comparisons where COMP was superior to USDA increased from the number of EXT wins over USDA. For example, whereas USDA was better than EXT in 10 of 12 broiler and egg competitions it was better than COMP in only 7 of 12. Over all livestock and poultry forecasts, COMP won 13 of 24 USDA competitions (compared to the 10 of 24 that EXT had won). COMP won 7 of 15 futures comparisons (the same number EXT had won). The largest number of competitive gains due to the composing process came in the area of crop forecasting. Before, EXT had won only 2 of 15 USDA comparisons. Now, COMP won 9 of 15 USDA comparisons.

Conclusions

This research provides a framework whereby forecasters in general, and Extension forecasters in particular, may be evaluated over time. Individual forecasters, or those who hire forecasters, should compare their accuracies to the representative accuracies provided by this research. USDA forecasts are generally more accurate than representative university-based forecasts for supply/utilization and market-year average prices of crops, and also for broiler and egg production and prices. For these areas, Extension programs should evaluate whether additional training and emphasis on forecasting accuracy is merited, or whether university forecasting efforts should be reduced, and emphasis placed on disseminating USDA's forecasts instead. Alternatively, because averaging forecasts improves accuracy, increased emphasis should be placed on Extension's rapid dissemination of average forecasts from the Annual Outlook Survey of the AAEA.

Although the evidence is not strong, this research suggests that forecasters responding to AAEA's Annual Outlook Survey may deliver more accurate forecasts if they rely more heavily on formal econometric models. If model-based forecasts are less expensive to construct than judgmental forecasts the efficiency of forecasting could be improved as well.

It is hoped that a study of this type can revisit Extension's forecasting accuracy more frequently in the future so that constructive feedback may guide future forecasting programs.

References

Armbruster, W.J. "The Future of Land Grant Universities and Agricultural Economists." *Review of Agricultural Economics*. 15(1993):591-602.

Armstrong, J.S. *Long Range Forecasting: From Crystal Ball to Computer*. New York: Wiley, 1978.

Batte, M.T., G.D. Schnitkey, and E. Jones. "Sources, Uses, and Adequacy of Marketing Information for Commercial Midwestern Cash Grain Farmers." *North Central Journal of Agricultural Economics*. 12(1990):187-196.

Brorsen, B.W. and S.H. Irwin. "Research on Price Forecasting and Marketing Strategies: Improving Our Relevance." Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting and Market Risk Management. April 18-19, 1994. Chicago.

Cornelius, J.C., J.E. Ikerd, and A.G. Nelson. "Preliminary Evaluation of Price Forecasting Performance by Agricultural Economists." *American Journal of Agricultural Economics*. 63(1981):712-714.

Ferris, J.N. "Evaluation of Forecasts from the Annual AAEA Outlook Survey, 1979-1988." Staff Paper No. 88-62. Dept. of Agricultural Economics. Michigan State University. August 1988.

Fildes, R. "Quantitative Forecasting — the State of the Art: Econometric Models." *Journal of Operational Research*. 36(1985):549-580.

Gerlow, M.E., S.H. Irwin, and T. Liu. "Economic Evaluation of Commodity Price Forecasting Models." *International Journal of Forecasting*. 9(1993):387-397.

Granger, C.W.J. "Combining Forecasts — Twenty Years Later." Invited Review. *Journal of Forecasting*. 8(1989):167-173.

Green, R.M. "Batting Averages in Agricultural Forecasting." *Journal of Farm Economics*. 8(1926):174-193.

Harris, H.M. Jr. "University Outlook Programs: A Review and Some Suggestions." *Southern Journal of Agricultural Economics*. 8(1976):139-144.

Heer, J.F. "Accuracy of Iowa Farm Outlook Information." *Journal of Farm Economics*. 36(1954):143-147.

Lawrence, D.B. "Models for the Assessment of the Value of Forecast Information." *Journal of Forecasting*. 10(1991):425-443.

Makridakis, S. "The Art and Science of Forecasting." *International Journal of Forecasting*. 2(1986):15-39.

Mathews, B.P., and A. Diamantopoulos. "Towards a Taxonomy of Forecast Error Measures." *Journal of Forecasting*. 13(1994):409-416.

Miller, D. and R. Plain. "Extension Outlook Session: 1990-91 Composite Forecast Evaluation." Paper presented at the annual meeting of the American Agricultural Economics Association, Manhattan, Kansas, 1991.

Seltzer, R.E. and R.J. Eggert. "Accuracy of Livestock Price Forecasts at Kansas State College." *Journal of Farm Economics*. 31(1949):342-345.

Smith, R.D. *National Assessment of Producer Marketing Alternatives: Practices and Attitudes*. Texas Agricultural Extension Service. Texas A&M University. College Station, Texas, 1989.

U.S. Department of Agriculture. World Agricultural Supply and Demand Estimates (WASDE). Several Issues.

van Vught, F.A. "Pitfalls of Forecasting: Fundamental Problems for the Methodology of Forecasting from the Philosophy of Science." *Futures*. (April 1987):184-196.

Table 2. Absolute Percentage Error Models for Production Forecasts. Survey Years 1983-1995.[a, b]

	Production APE Models				
Estimate	Beef	Pork	Broilers	Eggs	Milk
Intercept	2.09** (0.22)	3.66** (0.35)	2.28** (0.27)	1.81** (0.20)	1.03** (0.19)
GOVT	0.56** (0.26)	-1.00** (0.31)	-0.44** (0.18)	-0.26* (0.14)	0.62 (0.50)
PRIV	0.28* (0.15)	0.28 (0.20)	0.33** (0.16)	-0.06 (0.16)	0.21 (0.20)
EXPER	-0.00 (0.00)	0.01** (0.01)	0.02** (0.00)	-0.00 (0.00)	0.00 (0.01)
MAST	-0.23** (0.12)	-0.12 (0.17)	0.39** (0.13)	-0.23* (0.13)	0.28** (0.13)
MODMOR	-0.00 (0.11)	0.15 (0.15)	-0.56** (0.12)	-0.11 (0.10)	-0.15 (0.11)
MAJFORC	-0.30* (0.15)	-0.37 (0.23)	-0.23 (0.15)	-0.03 (0.12)	-0.01 (0.14)
RESPONS	-0.18 (0.12)	-0.72** (0.18)	-0.18 (0.13)	-0.19* (0.12)	-0.07 (0.09)
QTRO4	0.13 (0.17)	-0.01 (0.26)	0.38* (0.22)	0.09 (0.14)	0.36** (0.18)
QTROA	-0.93** (0.14)	-1.99** (0.20)	-0.96** (0.16)	-0.58** (0.12)	-0.47** (0.12)
QTRN1	0.39** (0.19)	-0.45* (0.25)	0.49** (0.22)	0.45** (0.17)	0.17 (0.19)
QTRN2	1.52** (0.21)	0.19 (0.28)	0.01 (0.20)	0.34** (0.17)	-0.51** (0.15)
QTRN3	0.63** (0.20)	1.75** (0.31)	1.15** (0.23)	0.83** (0.19)	0.50** (0.21)
QTRN4	0.57** (0.20)	1.68** (0.33)	1.36** (0.26)	1.09** (0.24)	0.79** (0.20)
QTRNA	0.15 (0.17)	-0.36 (0.23)	0.21 (0.18)	0.44** (0.15)	-0.15 (0.15)
YR1983	1.03** (0.25)	2.89** (0.34)	-0.41 (0.29)	0.37 (0.28)	----
YR1984	0.71** (0.21)	1.25** (0.32)	0.01 (0.27)	0.06 (0.24)	----
YR1985	2.30** (0.25)	1.13** (0.28)	-0.50** (0.25)	-0.02 (0.20)	----
YR1986	1.03** (0.29)	1.01** (0.33)	0.41 (0.26)	-0.77** (0.20)	----
YR1987	0.87** (0.22)	0.76** (0.33)	-0.88** (0.23)	-0.44** (0.19)	----
YR1988	0.35 (0.23)	0.34 (0.33)	1.64** (0.53)	0.90* (0.48)	----
YR1989	0.39* (0.24)	0.25 (0.32)	0.74** (0.25)	-0.69** (0.18)	----
YR1990	0.00 (0.18)	-1.33** (0.22)	-0.63** (0.25)	-0.47** (0.17)	----
YR1991	-0.28 (0.18)	0.37 (0.30)	-0.44 (0.27)	-0.51** (0.18)	0.45** (0.14)
YR1992	0.04 (0.21)	-0.46* (0.26)	-0.67** (0.24)	-0.36* (0.19)	0.35** (0.14)
YR1993	0.96** (0.20)	0.10 (0.25)	0.61** (0.30)	0.29 (0.21)	0.26** (0.13)
YR1995	-0.75** (0.18)	0.40 (0.29)	0.11 (0.39)	0.85** (0.21)	0.55** (0.17)
No. of Obs	1603	1551	1141	798	416
MAPE	2.57	3.62	2.59	1.60	1.49
R^2	0.25	0.27	0.26	0.21	0.27

[a] Significance at the 0.10 and 0.05 levels denoted by 1 and 2 stars, respectively. Standard errors (in parentheses) computed using White's heteroscedasticity-consistent covariance estimator.

[b] Milk production forecasting began in 1991.

Table 3. Absolute Percentage Error Models for Price Forecasts. Survey Years 1983-1995.[a,b]

	Price APE Models					
Estimate	Slaughter Steers	Feeder Steers	Barrows & Gilts	Broilers	Eggs	Milk
Intercept	3.91** (0.53)	10.12** (1.01)	6.03** (1.18)	3.93** (0.83)	3.49** (1.07)	2.48** (0.77)
GOVT	0.27 (0.54)	0.55 (0.56)	-0.03 (0.84)	0.64 (0.83)	0.45 (0.93)	-1.70 (1.55)
PRIV	-0.19 (0.34)	-0.18 (0.45)	-0.31 (0.59)	-1.41** (0.55)	0.05 (0.85)	1.11* (0.60)
EXPER	0.00 (0.01)	-0.02 (0.01)	0.08** (0.02)	-0.01 (0.01)	-0.02 (0.02)	0.05** (0.02)
MAST	0.21 (0.28)	-0.44 (0.36)	1.26** (0.51)	-0.14 (0.48)	0.16 (0.67)	-0.97** (0.44)
MODMOR	0.14 (0.26)	0.18 (0.30)	-0.21 (0.42)	-0.62 (0.42)	-0.73 (0.55)	-0.26 (0.46)
MAJFORC	-0.09 (0.36)	-1.58** (0.56)	0.55 (0.56)	0.69 (0.55)	1.26** (0.60)	1.30** (0.50)
RESPONS	-0.72** (0.27)	-0.52 (0.37)	-1.13** (0.52)	0.11 (0.49)	0.58 (0.59)	-1.25** (0.42)
QTRO4	0.19 (0.39)	0.39 (0.49)	3.46** (0.73)	2.08** (0.73)	5.16** (0.89)	2.28** (0.68)
QTROA	-1.98** (0.34)	-2.08** (0.43)	-2.86** (0.51)	-2.30** (0.57)	-1.82** (0.62)	-1.29** (0.48)
QTRN1	1.94** (0.39)	3.42** (0.61)	4.01** (0.69)	0.50 (0.74)	9.36** (0.97)	2.07** (0.85)
QTRN2	4.97** (0.51)	3.36** (0.57)	4.58** (0.74)	4.03** (0.70)	5.91** (0.91)	1.11* (0.66)
QTRN3	4.93** (0.65)	5.37** (0.61)	6.40** (0.76)	5.98** (0.98)	3.80** (0.79)	2.06** (0.75)
QTRN4	3.18** (0.46)	5.19** (0.67)	5.98** (0.98)	4.70** (0.88)	5.68** (1.02)	0.81 (0.76)
QTRNA	2.56** (0.40)	3.60** (0.53)	2.87** (0.64)	2.73** (0.67)	4.24** (0.74)	0.73 (0.56)
YR1983	-0.92** (0.45)	-4.59** (0.88)	-1.87* (1.14)	9.29** (0.97)	3.96** (1.42)	----
YR1984	6.47** (0.71)	-1.37 (0.91)	4.32** (0.11)	1.32* (0.70)	4.30** (1.27)	----
YR1985	4.49** (0.55)	0.79 (0.98)	-0.39 (1.21)	3.02** (0.80)	-1.11 (1.09)	----
YR1986	-0.89* (0.51)	-2.27** (0.94)	-1.61 (1.19)	3.99** (0.95)	-0.56 (1.22)	----
YR1987	-0.51 (0.39)	1.32 (0.84)	-3.50** (1.03)	7.66** (1.01)	1.75 (1.11)	----
YR1988	-0.08 (0.51)	-0.18 (1.26)	-2.63** (1.11)	9.22** (1.57)	13.24** (2.08)	----
YR1989	-1.51** (0.43)	-4.97** (0.85)	4.72** (1.21)	6.10** (0.93)	4.42** (1.15)	----
YR1990	-9.68** (0.45)	-5.31** (0.83)	-3.11** (1.13)	2.13** (0.74)	1.43 (1.22)	----
YR1991	-1.03** (0.52)	-4.68** (0.83)	1.58 (1.20)	-1.71** (0.63)	3.17** (1.16)	2.37** (0.52)
YR1992	-1.34** (0.40)	-2.73** (0.82)	-3.39** (0.99)	0.68 (0.57)	-0.78 (1.03)	0.79 (0.56)
YR1993	3.51** (0.45)	-4.92** (0.84)	0.70 (1.48)	-2.08** (0.66)	-0.74 (1.16)	-0.14 (0.48)
YR1995	-0.90** (0.42)	-4.51** (0.84)	-0.18 (1.20)	6.41** (0.68)	9.19** (1.42)	0.50 (0.66)
No. of Obs	1593	1419	1493	976	775	406
MAPE	5.89	7.77	9.52	8.81	1.01	5.25
R^2	0.39	0.31	0.25	0.35	0.34	0.25

[a] Significance at the 0.10 and 0.05 levels denoted by 1 and 2 stars, respectively. Standard errors (in parentheses) computed using White's heteroscedasticity-consistent covariance estimator..

[b] Milk forecasting began in 1991.

Table 4. MAPE for AOS and Competing Production Forecasts, Survey Years 1983-1995.[a]

Forecast	Production Forecast Series									
	Beef		Pork		Broilers		Eggs		Milk	
Period	EXT	USDA	EXT	USDA	EXT	USDA	EXT	USDA	EXT	USDA
O3	2.11	3.46	3.32	2.65	2.44	1.87*	1.43	1.41	----	----
O4	2.26*	3.69	3.19	2.49	2.61	2.08	1.66	1.95	----	----
OA	1.32	1.83	1.59	1.26	1.46	0.92*	0.87	1.11	----	----
Avg.	1.90	2.99	2.70	2.13	2.17	1.63	1.32	1.49	----	----
	EXT	Naive	EXT	Naive	EXT	Naive	EXT	Naive	EXT	Naive
O3	2.11	2.78	3.32*	6.33	2.44*	5.41	1.43*	2.00	1.39	1.53
O4	2.30	2.21	3.51*	6.04	2.57*	6.09	1.62*	2.39	1.74	1.54
OA	1.32	1.95	1.59*	3.64	1.46*	5.81	0.86*	1.58	0.93	1.18
N1	2.56	2.46	2.97	3.69	2.79*	6.02	1.61	2.01	1.43	1.60
N2	3.69	2.87	3.67	4.98	2.22*	5.69	1.63	1.31	0.83	1.21
N3	2.79	2.40	5.39	6.27	3.35*	5.56	2.38	1.93	1.78	1.66
N4	2.68	2.19	5.09	5.24	3.94*	6.58	3.01	2.25*	1.99	1.91
NA	2.36	1.86	3.25	3.36	2.62*	6.05	2.02	1.50	1.08	1.44
Avg.	2.48	2.34	3.60	4.94	2.67	5.90	1.82	1.87	1.40	1.51

[a] MAPE's statistically smaller than competitor's denoted by a star (0.10, paired-t test). Averages are simple sectional columnar averages and are not statistically compared.

Table 5. MAPE for AOS and Competing Price Forecasts, Survey Years 1983-1995.[a]

Forc.	Price Forecast Series											
	Slaughter Steers		Feeder Steers		Barrows&Gilts		Broilers		Eggs		Milk	
Period	EXT	USDA	EXT	USDA	EXT	USDA	EXT	USDA	EXT	USDA	EXT	USDA
O3	3.84	4.68	----	----	6.59	8.12	9.01	6.78	7.37	5.86	----	----
O4	4.57	4.47	----	----	10.43	11.54	9.82	8.66	11.40	10.82	----	----
OA	2.10	2.33	----	----	3.95	5.21	6.13	4.45	5.61	4.35	----	----
Avg.	3.50	3.83	----	----	6.99	8.29	8.32	6.63	8.13	7.01	----	----
	EXT	Naive	EXT	Naive	EXT	Naive	EXT	Naive	EXT	Naive	EXT	Naive
O3	3.84*	6.75	5.07	4.50	6.59	6.42	9.01	7.37	7.37*	10.46	4.27	5.16
O4	4.42	5.89	5.32	5.82	10.31*	15.32	10.51	10.32	11.61	15.22	7.11	6.89
OA	2.10	3.29	3.09	3.03	3.95*	5.73	6.13	3.86	5.61*	7.85	3.32	3.49
N1	5.78	4.22	8.09	7.76	10.54	10.98	8.79	8.94	15.81	15.85	6.88	5.91
N2	8.96	7.14	8.60	9.30	10.65	13.20	11.74	10.92	13.01	13.45	5.81	6.24
N3	9.00	10.04	10.65	11.69	12.48	17.90	10.78	11.14	8.53	10.31	6.35	7.18
N4	6.98	7.66	10.98	11.77	12.72	19.81	10.64	12.48	12.69	13.67	5.13	6.80
NA	6.84	5.77	9.25	9.55	9.38	13.55	9.30	9.61	11.10	12.95	5.50	4.43
Avg.	5.99	6.34	7.63	7.93	9.58	12.86	9.61	9.33	10.72	11.16	5.55	5.76
	EXT	Futures	EXT	Futures	EXT	Futures						
O3	3.84	6.11	5.07	4.00	6.59	4.42*						
O4	4.42	7.04	5.32	4.64	10.31	7.68*						
OA	2.10	2.88	3.09	2.01	3.95	2.55*						
N1	5.78	7.79	8.09	8.52	10.54	7.15*						
N2	8.96	10.27	8.60	8.43	10.65	13.05						
Avg.	5.02	6.82	6.03	5.52	8.41	6.97						

[a] See note for table 5.

Table 6. Absolute Percentage Error Models for Supply/Utilization and Market Year Average Price Forecasts. Survey Years 1983-1994.[a, b]

	Supply/Utilization APE Models				Market Year Average Price APE Models			
Estimate	Wheat	Corn	Cotton	Soybeans	Wheat	Corn	Cotton	Soybeans
Intercept	5.33* (2.78)	2.09 (5.38)	6.53 (7.62)	1.42 (3.13)	10.89** (1.59)	3.62** (1.49)	10.35** (3.64)	1.75 (1.36)
GOVT	-2.48 (2.08)	-2.42 (5.15)	-0.78 (7.92)	1.08 (1.85)	-1.36 (1.19)	-1.06 (1.63)	-5.80 (8.77)	0.89 (1.09)
PRIV	-2.72* (1.44)	-0.20 (3.23)	3.58 (5.36)	-0.28 (1.67)	0.69 (0.96)	-1.49 (0.93)	-0.28 (3.42)	-1.70* (0.88)
EXPER	0.04 (0.05)	0.08 (0.09)	0.11 (0.17)	0.06 (0.06)	0.03 (0.06)	-0.00 (0.04)	0.06 (0.16)	-0.01 (0.03)
MAST	3.80** (1.75)	0.34 (3.11)	5.07 (5.83)	0.54 (1.43)	0.70 (0.88)	2.89** (1.14)	0.71 (2.82)	0.57 (1.10)
MODMOR	-0.63 (1.03)	0.64 (2.63)	2.20 (5.08)	-2.63** (1.30)	-2.00** (0.80)	-1.11 (0.69)	-0.38 (2.75)	0.13 (0.76)
MAJFORC	-1.47 (1.43)	-1.24 (3.80)	-0.86 (6.43)	1.93 (2.94)	0.89 (0.87)	0.89 (1.08)	3.55** (1.51)	1.62 (1.19)
RESPONS	0.26 (1.11)	-0.06 (2.47)	-1.81 (3.72)	1.37 (1.59)	-1.06 (0.80)	-0.59 (0.72)	0.93 (1.90)	-0.42 (0.77)
EXPORT	9.83** (0.95)	7.81** (2.01)	22.45** (4.34)	8.48** (0.92)	----	----	----	----
CARRYOUT	14.98** (1.16)	35.00** (2.65)	31.28** (3.68)	23.19** (1.65)	----	----	----	----
YR1983	-6.79** (2.70)	68.02** (10.03)	14.27** (6.57)	29.49** (5.16)	-6.60** (1.74)	9.26** (1.20)	----	17.04** (1.06)
YR1984	-8.49** (2.67)	-6.36 (4.39)	-12.39** (4.58)	12.93** (2.80)	-7.65** (1.09)	1.91* (1.06)	----	11.85** (1.51)
YR1985	7.41** (2.99)	15.46** (4.29)	41.00** (11.14)	0.86 (2.42)	-6.83** (0.99)	5.26** (1.11)	----	8.57** (0.91)
YR1986	-5.62** (2.77)	-9.99** (4.89)	3.02 (5.03)	-6.90** (2.66)	-6.27** (1.35)	22.60** (1.96)	----	-1.07 (0.92)
YR1987	10.17** (3.14)	-7.83* (4.62)	-9.34* (4.83)	14.32** (3.77)	-6.84** (1.12)	7.82** (1.44)	----	13.82** (1.27)
YR1988	-2.37 (3.65)	-0.09 (5.44)	-10.64 (7.85)	2.75 (2.79)	-2.39 (1.94)	8.67** (2.49)	-5.62 (3.79)	9.96** (2.18)
YR1989	-3.79 (2.87)	2.31 (4.35)	0.13 (7.14)	-7.38** (2.69)	-5.68** (1.25)	4.32** (1.33)	-6.20 (4.00)	2.92* (1.72)
YR1990	-4.62* (2.68)	0.88 (4.38)	-8.84* (4.97)	-4.07* (2.41)	9.64** (2.87)	11.85** (1.70)	-6.85** (2.89)	2.26** (1.01)
YR1991	3.70 (2.96)	3.01 (4.31)	-18.09** (4.23)	-0.39 (2.87)	-5.13** (1.43)	1.83 (1.45)	1.97 (3.71)	1.19 (0.91)
YR1992	-4.39 (2.82)	-2.77 (4.41)	-9.35** (2.71)	-6.88** (3.19)	-7.11** (1.13)	7.58** (1.66)	-7.02** (2.61)	-0.19 (0.93)
YR1993	-2.56 (2.74)	22.57** (5.19)	-6.72* (3.92)	4.03 (2.60)	0.37 (1.74)	2.49* (1.38)	-7.29** (3.02)	4.62** (1.74)
No. of Obs	536	586	284	581	196	218	44	206
MAPE	11.74	24.95	28.30	18.03	6.71	10.52	9.77	9.69
R^2	0.41	0.52	0.36	0.49	0.55	0.58	0.44	0.63

[a] Significance at the 0.10 and 0.05 levels denoted by 1 and 2 stars, respectively. Standard errors (in parentheses) computed using White's heteroscedasticity-consistent covariance estimator.

[b] Market year average price forecast for upland cotton unavailable before 1988.

Table 7. MAPE for AOS and Competing Supply/Utilization and Market Year Average Price Forecasts, Survey Years 1983-1994.[a, b, c]

	Forecast Series							
	Production		Exports		Carry Out		Mkt. Yr. Avg Price	
Crop	EXT	USDA	EXT	USDA	EXT	USDA	EXT	USDA
Wheat	3.62	3.38	12.26	10.10*	19.32	16.73	7.05	5.89
Corn	10.29	10.76	17.72	15.98*	42.89	43.00	11.09	10.70
Cotton	8.92	7.61	24.27	23.27	37.91	35.74	----	----
Soybeans	7.34	7.10	15.60	14.83	29.11	28.90	9.22	7.67
Avg.	7.54	7.21	17.46	16.04	32.31	31.10	9.12	8.08
	EXT	Naive	EXT	Naive	EXT	Naive	EXT	Naive
Wheat	3.62*	13.59	12.26*	15.70	19.32	29.14	7.05	12.36
Corn	10.29*	31.85	17.72*	20.45	42.89*	82.53	11.09*	17.78
Cotton	8.92*	21.67	24.27*	38.52	37.91*	58.16	9.81	12.26
Soybeans	7.34*	15.02	15.60	20.01	29.11*	51.74	9.22*	15.26
Avg.	7.54	20.53	17.46	23.67	32.31	55.39	9.29	14.42

[a] See note for table 4.

[b] Last market year with full information is 1994.

[c] USDA does not make cotton price forecasts.

Table 8. MAPE for Composite-AOS and USDA Production Forecasts, Survey Years 1983-1995.[a]

Forecast	Production Forecast Series							
	Beef		Pork		Broilers		Eggs	
Period	COMP	USDA	COMP	USDA	COMP	USDA	COMP	USDA
O3	1.85	3.46	3.10	2.65	2.14	1.87	1.08	1.41
O4	1.83*	3.69	2.75	2.49	2.44	2.08	1.28*	1.95
OA	1.00*	1.83	1.52	1.26	1.15	0.93	0.59*	1.11
Avg.	1.56	2.99	2.46	2.13	1.91	1.63	0.98	1.49

[a] See note for table 4.

Table 9. MAPE for Composite-AOS and Competing Price Forecasts, Survey Years 1983-1995.[a]

Forc.	Price Forecast Series									
	Slaughter Steers		Feeder Steers		Barrows&Gilts		Broilers		Eggs	
Period	COMP	USDA	COMP	USDA	COMP	USDA	COMP	USDA	COMP	USDA
O3	3.31	4.68	----	----	6.05	8.12	6.43	6.78	6.36	5.86
O4	3.68	4.47	----	----	9.84	11.54	8.66	8.66	10.87	10.82
OA	1.77	2.33	----	----	3.43	5.21	4.50	4.45	4.53	4.35
Avg.	2.92	3.83	----	----	6.44	8.29	6.53	6.63	7.25	7.01
	COMP	Futures	COMP	Futures	COMP	Futures				
O3	3.31	6.11	4.56	4.00	6.05	4.42				
O4	3.48*	7.04	4.89	4.64	9.73	7.68				
OA	1.77	2.88	2.79	2.01	3.43	2.55				
N1	5.20	7.79	7.61	8.52	10.12	7.15				
N2	7.73	10.27	8.45	8.43	10.48	13.05				
Avg.	4.30	6.82	5.66	5.52	7.96	6.97				

[a] See note for table 4.

Table 10. MAPE for Composite-AOS and USDA Supply/Utilization and Market Year Average Price Forecasts, Survey Years 1983-1994.[a, b, c]

	Forecast Series							
	Production		Exports		Carry Out		Mkt. Yr. Avg Price	
Crop	COMP	USDA	COMP	USDA	COMP	USDA	COMP	USDA
Wheat	3.25	3.38	10.33	10.09	16.05	16.73	5.59	5.89
Corn	9.92	10.76	17.11	15.98	39.95	43.00	9.52	10.70
Cotton	9.42	7.61	24.50	23.27	39.53	35.74	----	----
Soybeans	6.41	7.10	13.74	14.83	25.65	28.90	7.80	7.67
Avg.	7.25	7.21	16.42	16.04	30.29	31.10	7.64	8.08

[a] See note for table 4.

[b] Last market year with full information is 1994.

[c] USDA does not make cotton price forecasts.