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Abstract

This study investigates empirical methods of generating prediction intervals for WASDE forecasts of corn, soybean, and wheat prices over the 1980/81 through 2006/07 marketing years. Empirical methods use historical forecast errors to estimate forecast error distributions, which are then used to predict confidence limits of forecasts. Five procedures were used to estimate empirical confidence limits, including histograms, kernel density estimation, logistic distribution, quantile regression, and quantile regression with stocks-to-use ratios. The procedures were compared based on out-of-sample performance, where the first 15 observations (1980/81-1994/95) were used to generate confidence limits for the 16th year (1995/96); the first 16 observations were used to generate confidence limits for the 17th year (1996/97) and so on. Based on the results of accuracy tests for empirical confidence intervals over 1995/96 through 2006/07, all five empirical procedures included in this study generated confidence intervals that were not significantly different from the target confidence levels (80% pre-harvest and 90% post harvest). When monthly hit rates were averaged pre- and post-harvest across all three commodities, the kernel density-based method appears most accurate prior to harvest with an average hit rate of 82%, followed by the logistic distribution (76%), quantile regression-based methods (71-72%), and histogram (71%). After harvest, the kernel density-based method and the quantile regression-based method were the most accurate with average hit rates of 95%, followed by the logistic distribution based methods (92%), the histogram-based methods (89%), and the quantile regression methods with stocks/use ratio (88%). Overall, this study demonstrates that empirical approaches may be used to construct more accurate confidence intervals for WASDE corn, soybean, and wheat price forecasts.

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Managers want accurate forecasts, with little or no uncertainty. Their attitude toward the preparers of forecasts is, 'If you cannot be confident about your predictions, how do you expect me to use them?' Forecasters may, therefore, pretend to be much more confident than experience or their models warrant… The end result is that uncertainty is often underestimated or its influence inadequately considered.

Makridakis and Hibon (1987, p. 489)

Introduction

Agricultural markets are inherently unstable, primarily due to a combination of inelastic demand for food and production technology that is subject to the natural vagaries of weather, disease and pests. Price volatility causes many agricultural firms to rely on forecasts in decision-making. Consequently, the U.S. Department of Agriculture (USDA) devotes substantial resources to agricultural situation and outlook programs (Offutt, 2002). It is a commonly held belief of market participants and analysts that these forecasts function as the "benchmark" to which other private and public estimates are compared (e.g., Irwin, Gerlow, and Liu, 1994; Kastens, Schroeder and Plain, 1998).

A prominent example of USDA forecasting efforts is the WASDE (World Agricultural Supply and Demand Estimates) program, which provides monthly forecasts for major crops, both for the U.S. and the world. WASDE price forecasts (unlike all other WASDE estimates) are published in the form of an interval. Interval forecasts, in contrast to point estimates, represent a range of values in which the realized value of the series is expected to fall with some pre-specified probability (Diebold, 1998, p. 41). WASDE price forecasts are generated using a balance sheet approach, with published intervals reflecting uncertainty associated with prices in the future (Vogel and Bange, 1999). For example, the October 2007 WASDE forecast of the 2007/08 marketing year average farm price was $2.90-$3.50/bushel for corn, $7.85-$8.85/bushel for soybeans and $5.80-$6.40/bushel for wheat. Vogel and Bange (1999) note that, "The process of forecasting price and balance sheet items is a complex one involving the interaction of expert judgment, commodity models, and in-depth research by Department analysts on key domestic and international issues" (p. 10). Thus, these forecasts cannot be described by a formal statistical model.

The need for probability and interval forecasting has been repeatedly expressed in the agricultural economics literature (e.g., Timm, 1966; Teigen and Bell, 1978; Bessler and Kling, 1989; Bessler, 1989). However, application and analysis of interval and probability forecasts has received relatively little attention. Sanders and Manfredo (2003) examined one-quarter ahead WASDE interval forecasts of livestock prices from 1982 through 2002. They find that actual market prices fall in the forecasted ranges a relatively small proportion of the time, about 48% of the time for broilers and only 35% of the time for hogs. Isengildina, Irwin, and Good (2004) showed that monthly WASDE interval forecasts of corn and soybean prices during the 1980/81 through 2001/02 marketing years also had relatively low hit rates (the proportion of time the interval contains the subsequent actual price) ranging from 36 to 82% for corn and from 59 to 89% for soybeans depending on the forecast month. In addition, actual prices were more likely to be above the forecast intervals, suggesting that observed symmetric USDA forecast intervals did not reflect the true asymmetry in the distribution of underlying prices.

Given the importance of WASDE price forecasts and low accuracy of interval forecasts demonstrated in previous studies, it is critical to ensure that all available tools and resources are utilized in generation of these interval forecasts. Isengildina, Irwin, and Good (2004) suggest that symmetric WASDE price forecast intervals should be adjusted to reflect asymmetries in the distributions of underlying commodity prices. The authors further argue that specific confidence levels should accompany forecast intervals in order to minimize confusion and misunderstanding in forecast interpretation. While numerous procedures have been proposed to calculate confidence limits for forecasts generated by statistical models (e.g., Chatfield, 1993, Prescott and Stengos, 1987; Bessler and Kling, 1989), these procedures provide little guidance for forecasts based on a combination or a consensus process rather than formal models, as is the case with WASDE forecasts. In reviewing the prediction interval literature, Chatfield (1993) observes that, when theoretical formulae are not available or there are doubts about model assumptions, the use of empirically-based methods should be considered as a general purpose alternative. Chatfield also notes that the empirical method, "…is attractive in principle, however, it seems to have been little used in practice, presumably because of the heavy computational demands (p. 127)." He suggests that since computational demands have become much less of a burden, this method should be re-examined.

An empirical method is based on the notion that confidence limits for future forecasts may be estimated by evaluating historical forecast errors. The empirical approach was first applied to construction of confidence limits for economic forecasts by Williams and Goodman (1971). Their approach consists of splitting the data in two parts and fitting the method or model to the first part in order to find forecast errors. The model is then refitted each year adding an additional observation in the first part and increasing the part of the sample used to estimate forecast errors. The key assumption of this method is that future forecast errors belong to approximately the same distribution as past forecast errors.[1] Williams and Goodman (1971) argue that this assumption is less restrictive than the standard assumption that a forecasting model describes the series adequately in the future. Therefore, by accumulating forecast errors through time one can obtain an empirical distribution of forecast errors and determine confidence limits for future forecasts by using the percentage points of the empirical distribution generated from past errors. The benefit of this method is that it can be applied in a straightforward manner to any type of error distribution, including fat-tailed and/or asymmetric distributions. This method is also particularly useful when the forecasting model is not fully identified and based on consensus or a combination of several sources, which makes the standard model-based methods for confidence limit calculation difficult to apply.

An empirical approach was also used by Gardner (1988), who applied the chosen forecasting model to all of the data, finding within-sample forecast errors at 1, 2, 3, …*k*-steps-ahead from all available time origins, and then computing the variances of these errors at each

[1] It is worth noting that most theoretical variance expressions are based on the same assumption.

lead time. The model is not re-estimated each time, and the variances at different lead times are based on within-sample fitted errors, rather than post-sample forecast errors. Gardner (1988) argues that the advantage of this method of computing variances is that the validity of the model and the form of the generating function are irrelevant. Confidence intervals can then be based on the standard deviation of the *k*-step-ahead errors and an assumption of normality. According to Gardner, his approach is less tedious than William and Goodman's as it doesn't involve numerous re-estimations of the model. However, other studies (e.g., Makridakis and Winkler, 1989) provide evidence that actual forecast errors based on this approach tend to be larger, on average, than in-sample fit errors. To overcome this limitation Gardner (1988) proposes the use of the Chebychev inequality. This approach appears to provide results comparable to theoretical formulas when the latter are available (Bowerman and Koeler, 1989; Yar and Chatfield, 1990).

Empirical methods of constructing forecast confidence intervals have been used successfully in a variety of fields (e.g., Murphy and Winkler, 1977; Stoto, 1983; Keilman, 1990; Zarnowitz, 1992; Shlyakhter et al, 1994; Jorgensen and Sjoberg, 2003). One of the main limitations of empirical methods is the data requirement. Therefore, these methods have been most widely-used in areas where data limitations are less common, such as weather, population, and software development forecasting. Recently, the importance of empirical control of a model's probability assessments has been recognized in engineering applications (e.g., Mahadevan, 2006). Taylor and Bunn (1999a, 1999b) suggested a combination of empirical and theoretical approaches, whereby quantile regression models are fit to empirical errors as a function of forecast lead time. The specification is based on theoretically derived forecast variance expressions.

The purpose of this research report is to explore the use of empirical methods for calculation of confidence limits for WASDE forecasts of marketing year average corn, soybean, and wheat prices. WASDE interval price forecasts for corn, soybean, and wheat over the 1980/81 to 2006/07 marketing years are included in the analysis. Empirical confidence limits are estimated using non-parametric distributions, parametric distributions, and quantile regressions. The procedures are compared based on out-of-sample performance, where the first 15 observations (1980/81-1994/95) are used to generate confidence limits for the 16th year (1995/96); the first 16 observations are used to generate confidence limits for the 17th year (1996/97) and so on. The accuracy of the out-of-sample intervals generated using the three procedures will be compared to each other and to actual intervals in terms of hit rates. Statistical significance of the differences of hit rates from a target confidence level will be assessed using an unconditional coverage test developed by Christoffersen (1998). The results of this research will provide valuable information that can be used to more accurately estimate confidence limits for WASDE price interval forecasts.

Data

This study investigates marketing year average corn, soybean, and wheat interval price forecasts from WASDE reports released monthly by the USDA, usually between the 9th and 12th of the month. The first price forecast for a marketing year is released in May preceding the U.S. marketing year (September through August for corn and soybeans and June through May for wheat). Estimates are typically finalized by July (for wheat), and October (for corn and soybeans) of the following marketing year. Thus, 17 forecast updates of corn and soybeans and 14 forecast updates of wheat prices are generated in the WASDE forecasting cycle each marketing year. While the forecasts are published in the form of an interval, the probability with which the realized price is expected to fall within the forecast interval is not specified.

Following Isengildina, Irwin, and Good (2004), the sample period starts with the 1980/81 marketing year. WASDE reports became available in 1973/74, but price interval forecasts were not part of these early publications. Price interval forecasts were first published in 1976/77, but these forecasts were published sparingly. Because of many missing observations, price interval forecasts published from 1976/77 to 1979/80 are not included in the sample. The current calendar of forecast releases was adopted in 1985/86. Prior to that, two forecasts of crop prices were published in some months. For these years, the analysis uses forecasts published at the beginning of the month, similarly to the current calendar of releases. The sample period ends with the 2006/07 marketing year, which is the last marketing year with a complete set of published forecasts.

Descriptive statistics for WASDE interval price forecasts for corn, soybeans, and wheat over 1980/81 through 2006/07 are presented in Tables 1-3.[2] During the study period, the first (May prior to harvest) forecast intervals averaged \$0.39/bushel for corn, \$1.27/bushel for soybeans, and \$0.46/bushel for wheat. In relative terms, May forecast intervals for wheat were the narrowest representing about 14% of the average forecast price, compared to 17% for corn and 22% for soybeans.[3] By November after harvest these average intervals narrowed to \$0.36/bushel for corn, \$0.90/bushel for soybeans, and \$0.25/bushel for wheat. The relative magnitude of post-harvest wheat forecast intervals was about half the size of corn and soybean price intervals, with a November average of 7% and 15%, respectively. These forecast intervals usually collapsed to point estimates in May after harvest for wheat and soybeans and in August after harvest for corn. No trends in the magnitude of interval forecasts over time were detected. Thus, intervals in the same months did not become smaller (or larger) from the beginning to the end of the sample period.

Interval forecast accuracy is typically described in terms of the hit rate; i.e., the proportion of time the forecast interval included the final value. Tables 1-3 demonstrate that hit rates for individual months ranged from 30 to 85% for corn, 26 to 81% for soybeans, and 37 to 89% for wheat. Prior to harvest, hit rates for corn and wheat price forecast intervals were lower, both averaging 46%, compared to 67% for soybeans. This implies that, on average, corn and wheat price interval forecasts prior to harvest contained the final price estimate only 46% of the time. After harvest, the hit rates for all commodities increased, averaging 71% for corn, 65% for soybeans, and 67% for wheat price interval forecasts. All three commodities demonstrated some

[2] Tables 1-2 present descriptive statistics for 17 monthly forecasts of corn and soybean prices and Table 3 presents descriptive statistics for 14 monthly forecasts of wheat prices because the last "forecast" provides the final estimate for each commodity.

[3] Isengildina, Irwin, and Good (2004) provide survey evidence that WASDE price intervals are symmetric. That is, a midpoint is forecast and then an equal interval is added to each side of the midpoint. Therefore, the average forecast price is computed in this study by taking an average of the midpoint of forecast prices for each month.

very low hit rates late in the forecasting cycle. For example, hit rates for corn price interval forecasts averaged 44 and 48% in August and September after harvest; soybean hit rates averaged 26, 41, and 48% from May through July after harvest, and wheat hit rates averaged 41 and 37% in May and June after harvest. This loss in accuracy late in the forecasting cycle is associated with prematurely collapsing forecast intervals to point estimates.

Another issue is whether forecast intervals accurately reflect the shape of the underlying price distribution. Statistics on the proportion of misses above and below the forecast interval reported in Tables 1-3 provide insight on this issue. If the forecast intervals accurately reflected the shape of the underlying price distribution, one would expect equal probability of misses above and below the forecast interval. Table 2 demonstrates that for soybean price forecast intervals the proportion of misses above the interval was 2 times greater than the proportion of misses below the interval prior to harvest and 2.9 times greater after harvest. Furthermore, the magnitude of misses in soybean forecast intervals tended to be much greater on the upside then the downside, averaging \$0.71/bushel and \$0.28/bushel, respectively, prior to harvest and \$0.17/bushel and \$0.10/bushel, respectively, after harvest. The other two commodities do not exhibit such persistent tendencies.

The evidence presented in this section describes several major concerns regarding WASDE interval forecasts of corn, soybeans, and wheat prices: 1) these intervals are characterized by relatively low hit rates; 2) in soybeans, symmetric forecast intervals do not accurately reflect the shape of the underlying price distribution; and 3) confidence levels associated with these forecast intervals are not specified. The remainder of the report applies and compares several procedures of deriving empirical confidence limits that may be used to improve WASDE price forecast intervals.

Empirical Confidence Interval Estimates

Empirical methods of calculating confidence intervals are based on splitting the data in two parts and fitting the method or model to the first part in order to find the forecast error distribution which is then used to provide confidence limits for the forecast intervals in the second part of the sample. It is important to keep in mind that the objective of this study is limited to examining empirical approaches to calculating confidence intervals for WASDE forecasts of corn, soybeans, and wheat prices. The validity of the forecasting methods currently used by the USDA are not analyzed, but rather, procedures are examined that will provide correct confidence intervals for these forecasts. Therefore, rather than fitting a forecasting model to the first part of the sample (as was done by Williams and Goodman, 1971, and Gardner, 1988), actual forecast errors from the first part of the sample are used to estimate forecast error distributions for the second part of the sample.

The key assumption of an empirical method is that future forecast errors belong to approximately the same distribution as past forecast errors. A critical assumption of empirical approaches to estimating confidence limits is that the distribution of forecast errors remains stable over time. Previous studies (e.g., Stoto, 1983; Smith and Sincich, 1988) have evaluated this assumption and found that the distribution of population forecast errors remained relatively stable over time and data on past forecast errors provided very useful predictions of future forecast errors. In the present study we test the validity of this assumption for corn, soybean and wheat price forecast errors by dividing the sample in two parts, from 1980/81 through 1994/95 and from 1995/96 through 2006/07 and examining whether the first two moments of forecast error distributions differed between two sub-periods. Results of this analysis are presented in Tables A1-A3 of the Appendix. Forecast errors were calculated as the difference between the final (November for corn and soybeans and September for wheat) estimate and the midpoint of the forecast interval. Independent sample t-tests showed no statistically significant difference at the 1% level in mean forecast errors for each forecasting month between the two sub-periods. Levene's F-statistic showed no statistically significant difference in forecast error variances at the 1% level for each forecasting month between the two sub-periods. This evidence suggests that forecast error distributions of monthly WASDE corn, soybean, and wheat price forecasts were stable over time.

In order to determine a split point between the first and the second part of the sample, data availability issues should be taken into account. In this study, 27 annual observations were available for each monthly forecast for each commodity. Dividing the sample in two parts, from 1980/81 through 1994/95 and from 1995/96 through 2006/07 provides us with a minimum of 15 years of data to estimate forecast error distributions and 12 years out-of-sample to evaluate the performance of the proposed approaches. One drawback of an empirical method is the requirement of enough historical data in order to estimate forecast error distributions. Taylor and Bunn (1999) argue that, "…the number of forecast errors needed depends on the accuracy required, but it is probably fair to say that empirical methods need at least fifty observations to produce reasonable results (p. 328)." It has been shown that variance estimates using Gardner's approach are unreliable for small sample sizes and are based on model-fitting errors rather than true post-sample forecast errors (e.g., Bowerman and Koehler, 1989). At the same time Williams and Goodman (1971) demonstrate that empirical confidence intervals using 24 observations were satisfactory at the 80% level, but 90% and 95% levels improved when more observations were included. These arguments suggest that some confidence intervals calculated within this study may not be entirely reliable due to small sample sizes, but the use of the larger sample for calculation of the most recent forecast intervals should provide reasonable estimates.

Another issue is selection of the confidence level for interval forecasts. As was mentioned, confidence levels associated with published WASDE interval price forecasts are not specified. Isengildina, Irwin, and Good (2004) conducted a survey of USDA officials involved in compiling WASDE corn and soybean price interval forecasts inquiring about the confidence levels associated with published forecasts. Analyst responses were variable across respondents (by as much as 30% in the beginning of the season) and over the forecasting cycle (from 65% in May prior to harvest to 95% in April after harvest). The average confidence level prior to harvest was 81% for corn and 78% for soybeans; the average confidence level after harvest was 91% for corn and 87% for soybeans. Based on this information, and assuming that wheat analysts provide interval forecasts for similar confidence levels, this study calculates confidence intervals for 80% level prior to harvest and 90% level after harvest.

Finally, the most important question is how the historical error distributions should be estimated. This report explores several non-parametric and parametric procedures for estimating forecast error distributions. The analysis consists of estimating error distributions using the first part of the sample, which starts with 15 observations (1980/81 through 1994/95) and adds one observation for each additional year.[4] Upper and lower interval bounds will be calculated based on the percentiles of the estimated error distributions. These interval bounds are added to the midpoint of the first observation in the second (prediction) part of the sample (e.g., 1995/96) to construct the empirical confidence interval. Thus, the empirical confidence intervals for the 2007/08 estimates are based on 27 observations (1980/81 through 2006/07). The procedures for estimating forecast error distributions are introduced and discussed in the remainder of this section. Finally, the accuracy measures used to assess and compare the performance of empirical confidence intervals are described.

Histogram Estimates

The simplest procedure for estimation of non-parametric forecast error distributions is via histograms. The histograms are constructed by sorting forecast errors from smallest to largest. Figure 1 gives an example of such histograms for November soybean price forecasts based on the first 15 and the first 26 observations. These histograms demonstrate that the distribution of soybean price forecast errors remained stable over time with relatively unchanged extreme values. The confidence intervals based on the histograms can be constructed by dropping extreme observations to achieve the desired confidence level.[5] For the sample ranging from 15 to 26 observations, the confidence intervals constructed by dropping the largest positive and the largest negative error correspond to confidence levels from 87% (13 out of 15 observations) to 92% (24 out of 26 observations). Thus, the empirical 90% level confidence intervals for the post-harvest months can be constructed by adding the second largest positive and second largest negative error to the midpoint of the forecast. Similarly, confidence intervals constructed by dropping the two largest positive and two largest negative errors correspond to confidence levels from 73% (11 out of 15 observations) to 85% (24 out of 26 observations). These confidence intervals are used to approximate an 80% confidence level for the pre-harvest months. While this non-parametric procedure is straightforward, several drawbacks should be pointed out: 1) the discrete nature of the histograms limits the flexibility of selecting a specific confidence level; 2) this procedure concentrates on the tails of the distribution (its extreme values in this case), without taking into account the complete shape of the probability distribution and 3) the histogram may be sensitive to the choice of origin and bin width. Histogram confidence intervals were computed in *Excel* spreadsheets.

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[4] It is important to note that the forecasting cycle for each of the commodities included in this analysis exceeds one calendar year. This implies that the final estimate for the previous year is not known until the 5^{th} month into the next forecasting cycle for wheat, 6^{th} for corn and 7^{th} for soybeans. Therefore, exact errors for the previous year are not known early in the next forecasting cycle and error distributions are estimated using all but the previous year data. Once the final estimates become available error distributions are updated to include an additional year.

[5] This procedure was used by Isengildina, Irwin, and Good (2004) to construct 95% confidence level forecast intervals and implied confidence level forecast intervals as described in footnote 9 of their paper.

Kernel Density Estimates

An alternative non-parametric approach to estimation of empirical error distributions is the use of kernel density estimators. The kernel density estimator replaces the "boxes" in a histogram by "bumps" that are smooth (Silverman, 1986). Smoothing is accomplished by putting less weight on observations that are further from the point being evaluated. Specifically, the kernel density estimate of series X at a point x is estimated by,

(1) $$f(x) = \frac{1}{Nh}\sum_{i=1}^{N} K\left(\frac{x - X_i}{h}\right)$$

where N is the number of observations, h is the bandwidth (or smoothing parameter) and $K(\,)$ is a kernel function that integrates to one. Silverman (1986, p. 43) shows that the optimal kernel function is given by,

(2) $$K_e(t) = \left\{ \frac{3}{4\sqrt{5}}\left(1 - \frac{1}{5}t^2\right) \right. \qquad -\sqrt{5} \le t \le \sqrt{5}\text{, 0 otherwise}$$

often referred to as the Epanechnikov kernel. Optimal bandwidth is given by (Silverman, 1986, pp. 47-48),

(3) $$h_{opt} = 0.9AN^{-1/5}$$

where A is an adaptive estimate of spread given by,

(4) A = min(standard deviation, interquantile range/1.34).

Figure 2 provides an example of kernel density estimates for November soybean price forecasts based on the first 15 and the first 26 observations. Once the kernel density is estimated, the appropriate upper and lower bounds for the 80% and 90% confidence levels are found by integrating the density function using the Lobatto adaptive quadrature method. The empirical forecast intervals are constructed by adding these upper and lower bounds to the midpoint of the published forecasts. While this empirical approach is not as straight forward as the approach based on histogram, it does offer the advantages of continuous non-parametric estimation of error distributions. Limitations of this approach include the changing shape of a kernel density estimate as observations are added or dropped. Additionally, the choice of h may impact the results of smoothing. Silverman's h_{opt} (equation 1.3) has been used in numerous studies as a rule-of-thumb, but may not fit all types of data equally well. The issue of bandwidth selection is still a point of debate in statistics literature. Kernel density estimates were computed using the MATLAB library of statistical functions.

Parametric Distribution Estimates

Some of the limitations of the non-parametric approaches can be addressed by fitting parametric probability distributions to forecast errors from the first part of the sample. This procedure includes finding a parametric distribution that best fits the empirical data. Five distributions were used as likely alternatives: normal, logistic, extreme value, uniform, and Rayleigh distributions. Goodness-of-fit of the parametric distributions to forecast errors was evaluated using the Anderson-Darling statistic,

$$(5) \qquad A_N^2 = N \int_{-\infty}^{+\infty} \left[F_N(x) - \hat{F}(x) \right]^2 \psi(x) \hat{f}(x) dx$$

where $\Psi^2 = \dfrac{1}{\hat{F}(x)[1-\hat{F}(x)]}$, $\hat{f}(x)$ is the hypothesized density function, $\hat{F}(x)$ is the hypothesized cumulative distribution function, $F_N(x) = \dfrac{N_x}{N}$, and N_x is the number of observations less than x. The Anderson-Darling statistic is preferred to the Chi-squared statistic because it does not require binning. Furthermore, the Anderson-Darling statistic is selected over the Kolmogorov-Smirnov statistic because it concentrates on the differences between the tails of the fitted distribution and input data rather than the middle of the distribution.

Figure 3 presents the best fitting probability distributions for November soybean price forecasts based on the first 15 and the first 26 observations. The logistic distribution was selected as best-fitting in both cases. The main drawback of this approach is that a different best-fitting distribution may be chosen from one year to the next as more observations are added. Allowing distributions to vary over time can be viewed as a violation of the underlying assumption of the empirical approach that future forecast errors belong to approximately the same distribution as past forecast errors. To avoid this shortcoming the probability distribution that is most often ranked as the best fitting distribution is selected. For example, Williams and Goodman (1971) report that forecast errors from their data set approximately followed a gamma distribution. It is found that the forecast errors from the data set used in this study most often followed a logistic distribution. The logistic distribution was selected as best-fitting using an Anderson-Darling statistic in 73% of cases in corn, in 97% of cases in soybeans, and in 95% of cases in wheat.[6] Therefore, this distribution was applied in all cases for calculation of the confidence interval. The upper and lower bounds for the 80% and 90% confidence levels were calculated by integrating the logistic density function using the Lobatto adaptive quadrature method. The empirical forecast intervals were constructed by adding these upper and lower bounds to the midpoint of the published forecasts. A benefit of this approach is that shape and properties of the distribution are well-known and do not change from one year to the next as observations are added/dropped. A disadvantage of this approach is that logistic distribution is not always the best fitting parametric distribution. Finally, since logistic distribution is not as flexible as kernel density estimator, it may not fit the data as well as the kernel density function. Logistic distribution confidence intervals were computed using MATLAB computing library.

[6] Computations were also made where the best-fitting distribution was allowed to change from year-to-year for corn. These alternative computations yielded quite similar results to those limited to the logistic distribution and are available from the authors upon request.

Quantile Regression Estimates

One of the shortcomings of the previous non-parametric and parametric procedures for generating empirical confidence intervals is that they are not based on large samples. Each method is based on the available annual observations for each forecast horizon, with samples ranging from 15 to 26 observations. Small sample problems may be addressed by pooling the data across months and marketing years and estimating forecast error distributions using quantile regressions. The quantile regression approach to the construction of prediction intervals was first introduced by Taylor and Bunn (1999a, 1999b). The authors argue that this method is a hybrid of the empirical and theoretical approaches in that it uses the empirical fit errors and produces forecast error quantile models which are functions of lead time, *k*, as suggested by theoretically derived variance expressions. The use of quantile regression avoids the normality and optimality assumptions which underlie theoretical forecast variance expressions. Another benefit of this approach is that it relaxes the assumption that error distributions for each forecasting month are independent, since forecast errors tend to decline from the beginning to the end of the forecasting cycle as more information becomes available.

Quantile regression was developed by Koenker and Bassett (1978) as an extension of the linear model for estimating rates of change in not just the mean but all parts of the distribution of a response variable. Consider the simple case of the constant only model $y_t = \beta_0 + e_t$, where β_0 is a constant parameter and e_t is an i.i.d. random error term. Koenker and Basset note that the τ^{th} quantile of y_t can be derived from a sample of observations, as the solution $\beta_0(\tau)$ to the following minimization problem: $\min \beta_0 \left[\sum_{t|y_t \geq \beta_0} \tau |y_t - \beta_0| + \sum_{t|y_t < \beta_0} (1-\tau)|y_t - \beta_0| \right]$. This minimization problem, as a means for finding the τ^{th} sample quantile, readily extends for the more general case where y_t is a linear function of explanatory variables (*X*). The estimates are semi-parametric in the sense that no parametric distributional form is assumed for the random error part of the model, although a parametric form is assumed for the deterministic part of the model. The conditional quantiles denoted by $Q_y(\tau|X)$ are the inverse of the conditional cumulative distribution function of the response variable, $F_y^{-1}(\tau|X)$, where $\tau \in [0,1]$ denotes the quantiles (Koenker and Machado, 1999). As an example, for τ=0.90, $Q_y(0.90|X)$ is the 90th percentile of the distribution of *y* conditional on the values of *X*. An approximation of the full probability distribution can be produced from the quantile estimates corresponding to a range of values of τ ($0< \tau<1$). For symmetric distributions, the 0.50 quantile (or median) is equal to the mean μ.

Taylor and Bunn (1999a, 1999b) show that quantile regressions expressed as a function of forecast lead time *k* are consistent with theoretical forecast variance formulas. Assuming lead time *k* corresponds to the forecast error series for *k*-step ahead forecasts, this results in the following quantile regression specification for a given level of τ,

(6) $$y_t(\tau) = \beta_0 + \beta_1 k + \beta_2 k^2 + \varepsilon_t .$$

In the present application, k is substituted for its reverse, *FM,* the forecast month from the beginning to the end of the forecast cycle (1 through 19 for corn and soybeans and 1 through 15 for wheat),

(7) $$y_t(\tau) = \beta_0 + \beta_1 FM + \beta_2 FM^2 + \varepsilon_t .$$

Following Taylor and Bunn, standard errors were estimated by bootstrap resampling in order to correct for heteroscedasticity. Bootstrap resampling used the *XY*-pair method with 100 replications and samples the same size as the original data.

Economic theory indicates that the size of the forecast error in each marketing year may be related to the "tightness" of underlying supply and demand conditions. These supply and demand conditions may be summarized by the stocks/use ratio. For example, historical stocks/use ratios during the period of study for corn ranged from 5% in 1995 to 66% in 1985. It may be hypothesized that during the periods of low stocks/use ratios, forecast errors may be larger than during the periods of high stocks/use ratios. This hypothesis may be built into the quantile regression model by adding the stocks/use ratio estimate (SU) made in month FM,

(8) $$y_t = \beta_0 + \beta_1 FM + \beta_2 FM^2 + \beta_3 SU + \varepsilon_t$$

This specification, along with equation (7), was used in the empirical analysis to generate upper (τ=0.90) and lower (τ=0.10) bounds of the 80% confidence interval and upper (τ=0.95) and lower (τ=0.05) bounds of the 90% confidence interval pre- and post- harvest, respectively, for each commodity. All quantile regressions were estimated using *Eviews* econometric software.

Quantile regression results yield coefficient estimates for τ=0.05, 0.10, 0.90, and 0.95 for each sub-sample and commodity. The lower bound of the 90% confidence interval based on equation (7) is calculated by substituting estimated coefficients for τ=0.05, the respective value of the forecast month (e.g., 2 for June pre-harvest), and the squared value of forecast month (4 for this example). The upper bound of the 90% confidence interval based on equation (7) is calculated by substituting estimated coefficients for τ=0.95, the respective value of forecast month (e.g., 2 for June pre-harvest), and the squared value of forecast month (4 for this example). The upper and lower bounds for 80% confidence levels are computed using estimated coefficients for τ=0.90 and τ=0.10, respectively. The upper and lower bounds for both confidence levels in equation (8) are computed in a similar manner with addition of the stocks/use estimate released in the respective forecast month. The empirical forecast intervals are constructed by adding these upper and lower bounds to the midpoint of the published forecasts. The quantile regression approach offers the benefit of pooling data across months and years, and thus substantially increasing the statistical power of estimation. Quantile regression relaxes the assumption that forecast errors for separate months are uncorrelated. Quantile regression also adds the flexibility of including other variables (such as stocks/use) that may affect forecast error distribution. A theoretical limitation of this method is inefficiency due to the likely correlation between forecast errors for the same marketing year. Unlike the ordinary least squares, it is not clear how to handle this issue in quantile regression.

Accuracy Measures

The next step of the empirical analysis is to assess and compare the performance of the empirical confidence intervals derived using the procedures described above to the target confidence level. Accuracy of forecast intervals is traditionally examined in terms of hit rates and forecast coverage. Hit rates describe the proportion of times forecast intervals contain the final or "true" value (y_t) and may be defined as an indicator variable, I_t^k ,

(9) $$I_t^k = \begin{cases} 1, & \text{if} \quad y_t \in [l_{t/k}(\alpha), u_{t/k}(\alpha)] \\ 0, & \text{if} \quad y_t \notin [l_{t/k}(\alpha), u_{t/k}(\alpha)] \end{cases}$$

where $[l_{t/k}(\alpha), u_{t/k}(\alpha)]$ are the lower and upper limits of the interval forecast for y_t made at time k with confidence level α. The closer the hit rate to the stated confidence level, the more accurate is the forecast. Forecast coverage is based on the expectation of the indicator variable, I_t^k and examines whether the proportion of times the forecast interval includes the true value is equal to the target (stated) confidence level. Thus, forecast coverage may be examined by testing the hypothesis H_0: $E(I_t^k)=\alpha$ against H_1: $E(I_t^k)\neq\alpha$. If H_0 is not rejected and the interval hit rate is equal to the stated confidence level, forecasts are said to be calibrated. Since the indicator variable I_t^k has a binomial distribution (Christoffersen, 1998), the likelihood function under the null hypothesis is,

(10) $$L(\alpha) = (1-\alpha)^{n_0}\alpha^{n_1}.$$

where L is a likelihood function. Under the alternative hypothesis, the likelihood function is,

(11) $$L(p) = (1-p)^{n_0} p^{n_1}$$

where n_1 and n_0 are the number of times an interval was "hit" (1) or "missed" (0) in the indicator sequence I_t^k. Then, forecast coverage may be tested via the likelihood ratio test,

(12) $$LR_c = -2\ln\left(\frac{L(\alpha)}{L(\hat{p})}\right) \overset{asy}{\rightarrow} \chi^2(1)$$

where $\hat{p} = n_1/(n_0+n_1)$ is the maximum likelihood estimator of p. This test is described by Christoffersen (1998) as an unconditional coverage test.[7] The remainder of this report discusses the characteristics of empirical confidence intervals and compares their performance using accuracy tests described in this section.

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[7] Christoffersen (1998) also proposed additional tests that examine interval forecast independence and forecast coverage conditional on independence. However, due to a small number of observations, these tests cannot be applied reliably to the prediction part of the sample (1995/96-2004/05).

Results

The empirical confidence intervals were calculated using histogram, kernel density, logistic distribution, and quantile regression procedures described in the previous section for WASDE corn, soybean, and wheat price forecasts over the 1995/96 through 2006/07 marketing years. These empirical confidence intervals are computed using the first 15 observations (1980/81-1994/95) to generate confidence limits for the 16th year (1995/96); the first 16 observations to generate confidence limits for the 17th year (1996/97) and so on. Tables 4-6 compare descriptive statistics of empirical confidence intervals calculated using raw (unit) forecast errors and published WASDE forecast intervals of corn, soybean, and wheat prices over 1995/96 through 2006/07 marketing years. Because of the generally low hit rates of the published forecasts shown in Tables 1-3, it was expected that the empirical confidence intervals calibrated at the 80% confidence level prior to harvest and 90% confidence level after harvest would be wider than published intervals. Table 4 demonstrates that prior to harvest, empirical confidence intervals were from 1.75 times (histogram) to 2.2 times (kernel density) wider on average than published forecast intervals of corn prices.[8] After harvest, the difference was not as dramatic with histogram-based intervals about 33% wider, and kernel density-based intervals about 83% wider, on average, than published intervals. Logistic distribution and quantile regression-based procedures generated intervals that were wider than histogram-based intervals but narrower than kernel density-based intervals. A similar pattern is observed for both soybean and wheat price forecast intervals in Tables 5 and 6, respectively, with histogram-based intervals about 60% wider and kernel density-based intervals about 2 times wider, on average, than published forecast intervals both prior and after harvest. Like corn, logistic distribution and quantile regression-based interval ranges were in between the histogram and kernel density-based interval ranges in wheat and soybeans, with logistic distribution-based interval ranges slightly smaller than quantile regression-based ranges. Similar results are presented in Tables A4-A6 of the Appendix for empirical confidence intervals calculated using percentage forecast errors.

Another issue with the WASDE price forecasts is whether the symmetric forecast intervals accurately reflected the distributions of the underlying commodity prices. Because empirical confidence intervals were calculated using actual forecast errors, they take into account the asymmetries of error distributions. These asymmetries based on the raw (unit) errors are reflected in the uneven interval magnitudes below and above the mean of the empirical confidence intervals reported in Tables 4-6.[9] Based on these statistics it appears that the downside price risk (average magnitude below relative to magnitude above the mean) is greater for corn price forecasts after harvest and the upside price variability (average magnitude above relative to magnitude below the mean) is greater for soybeans and wheat after harvest. Prior to harvest, the evidence is not always consistent across all evaluation methods, even though price risk tends to be on the upside for all three commodities. Similar results are presented in Tables

[8] It is important to keep in mind that these interval widths are conditional on the selected confidence levels (80-90%). If the selected confidence level was equal to the actual hit rates, the widths of the empirical confidence intervals would be approximately equal to that of published intervals.

[9] Since the published intervals are symmetric according to Isengildina, Irwin, and Good (2004), the magnitudes above and below the mean would be equal to one half of the interval.

A4-A6 of the Appendix for empirical confidence intervals calculated using percentage forecast errors.

Tables 7-9 present the results of the accuracy tests of published WASDE forecast intervals and empirical confidence intervals based on raw (unit) errors for corn, soybean, and wheat prices over 1995/96 through 2006/07. As was observed in Tables 1-3 for the entire sample, published forecasts had relatively low hit rates in the prediction sub-sample, 1995/96 through 2006/07 although significant improvement in forecast accuracy was observed in corn price forecast intervals after harvest. Tables 7-9 allow comparison of the five methods of empirical confidence interval estimation based on their accuracy. The average hit rates of the empirical confidence intervals ranged from 71% to 82% in corn prior to harvest and from 88% to 95% after harvest. In soybeans, the average hit rates ranged from 78% to 83% prior to harvest and from 83% to 90% after harvest. Similarly, in wheat, the average hit rates ranged from 64% to 72% prior to harvest and from 86% to 95% after harvest. Similar results are presented in Tables A7-A9 of the Appendix for empirical confidence intervals calculated using percentage forecast errors. The findings are consistent between raw (unit) error and percentage error results.

No specific method stands out as the most accurate according to these commodity-specific hit rates and associated ranks. When monthly hit rates are averaged pre- and post-harvest across all three commodities, the kernel density-based method appears most accurate prior to harvest with an average hit rate of 81%, followed by the logistic distribution (75%), both quantile regression-based methods (74%), and histogram (73%). After harvest, the kernel density-based method and both quantile regression-based methods were the most accurate with an average hit rate of 91%, followed by logistic distribution based methods (88%) and the histogram based approach (86%). Furthermore, when hit rates for the first May prior to harvest forecast were compared across all commodities, kernel density-based intervals and logistic distribution based intervals appeared to outperform other methods.

Coverage tests revealed that confidence levels of published forecast intervals of corn prices over 1995/96 through 2006/07 marketing years were significantly different from 80% in 5 out of 6 cases prior to harvest and significantly different from 90% in 3 out of 11 cases after harvest. In soybeans, confidence levels of published forecast intervals were significantly different from 80% in 2 out of 6 cases prior to harvest and significantly different from 90% in 6 out of 11 cases after harvest. The confidence level of published forecast intervals of wheat prices was significantly different from 80% in 2 out of 3 cases prior to harvest and significantly different from 90% in 3 out of 11 cases after harvest. Coverage tests failed to reject the null hypothesis of the confidence level of the empirical forecast intervals calculated using raw (unit) errors being equal to 80% prior to harvest in all cases except May wheat for all methods and June wheat for quantile regression based methods. Statistically significant deviations from target confidence level for intervals calculated using raw (unit) errors were found for August after harvest intervals for soybean price forecasts based on quantile regression. As shown in tables 7-9 of the Appendix, empirical confidence intervals calculated using percentage errors showed statistically significant deviations from target confidence in 16 out of 255 cases. All other empirical confidence intervals were not statistically different from the target confidence levels. Some of the significant deviations from target confidence levels may be explained by several small misses ($0.01 outside the prediction interval). More details on the proportion and magnitude of misses for the empirical forecast intervals of corn, soybean, and wheat prices over 1995/96 through 2006/07 marketing years are shown in Tables A10-A12 of the Appendix for the intervals based on raw (unit) errors and in Tables A13-A15 of the Appendix for the intervals based on percentage errors.

The discussion of the results so far concentrated only on the issue of interval accuracy. While obviously important, interval accuracy may not be the only argument in forecaster's utility function. For example, the results show that the kernel density-based intervals appear most accurate. However, they also tend to be some of the widest. If the objective of the forecaster is to provide the most accurate interval that also has the narrowest width, both accuracy (measured by hit rates) and informativeness (interval width) should be taken into account. Isengildina, Irwin, and Good (2004) used Yaniv and Foster's (1995) accuracy-informativeness trade-off model to evaluate interaction between these two objectives. However, the results of such analysis heavily depend on the assumptions about forecast user's preferences for accuracy versus informativeness. Yaniv and Foster's model was calibrated to the responses of the university students. If their preferences do not adequately reflect the preferences of forecast users, the results of the model may be misleading. Therefore, in this study a different approach is used to illustrate the tradeoff between interval accuracy and informativeness. Forecast informativeness, as measured by interval width, is plotted against interval accuracy, as measured by hit rate. Statistical theory predicts that interval width should have a positive relationship to hit rates, i.e., wider intervals are more accurate. The benefit of this approach is that it is simpler, more intuitive and is not based on any assumptions regarding forecast user's preferences.

The plots of interval width against hit rates using pre- and post- harvest averages over 1995/96 through 2006/07 are presented for each commodity in Figures 4 through 9. For example, figure 4 shows the tradeoff between accuracy and informativeness for pre-harvest empirical forecast intervals of corn prices. This figure demonstrates that the same accuracy level of 72% may be obtained using three different procedures: histogram, quantile regression with stocks-to-use, and logistic distribution. However, the histogram method obtains this level of accuracy with the narrowest interval widths of $0.70/bu relative to $0.76/bu and $0.77/bu, respectively, with the other two methods. Therefore, for this level of accuracy, the histogram may be considered a preferred method. Accuracy may be improved to a 77% hit rate by using the kernel density procedure, but the improvement comes at a cost of increasing the average interval width to $0.88/bu. Figure 4 also illustrates the accuracy-informativeness tradeoff for the published forecast intervals, and shows that the $0.40/bu published intervals resulted in an average hit rate of only 53%. Similar information may be obtained from Figures 5-9. Unfortunately, these graphs do not give a clear cut answer regarding which procedure is the best. This ultimately depends on the shape of the forecaster's utility function and the combination of accuracy and informativeness (and probably computational ease) that would maximize forecaster's utility. However, this information may be useful for making a choice of the preferred procedure.

Recommendations

The findings of this study can be used to estimate confidence intervals for corn, soybean, and wheat price forecasts. Specifically, confidence limits for future forecasts can be calculated based on percentage points of the distributions of past forecast errors. The use of an empirical approach to confidence interval calculation provides accurate intervals that reflect the properties of the underlying price distributions. While this study reports results for the 80% and 90% confidence level, other confidence levels may be selected by USDA analysts in order to improve informativeness of these forecasts.

A specific application of the empirical approaches to interval estimation for the 2007/08 marketing year is found in Tables 10-15. The confidence limits are calculated using histogram, kernel density, logistic distribution, and quantile regression methods based on raw (unit) errors from 1980/81 through 2006/07. The reported confidence limits can be added to point forecasts to generate respective confidence intervals. For example, the midpoint of May 2007 estimate of the 2007/08 price was $3.40/bu. for corn, $7.00/bu. for soybeans, and $4.65/bu. for wheat. The following 80% confidence intervals for these forecasts can be constructed using the intervals in Tables 10-12,

	Corn	Soybeans	Wheat
Histogram	$2.98/bu.-$3.99/bu.	$5.98/bu.-$8.24/bu.	$4.13/bu.-$5.37/bu.
Kernel Density	$2.93/bu.-$4.03/bu.	$5.99/bu.-$8.38/bu.	$4.10/bu.-$5.36/bu.
Parametric Distribution	$3.00/bu.-$3.98/bu.	$6.17/bu.-$8.33/bu.	$4.08/bu.-$5.19/bu.
Quantile Regression	$2.93/bu.-$3.99/bu.	$5.97/bu.-$8.31/bu.	$4.18/bu.-$5.33/bu.

These empirical confidence limits provide the ranges that are expected to contain the final estimate 80% of the time. Tables 13-15 provide empirical confidence limits for a 90% confidence level.

Similar application of the empirical approaches using percentage forecast errors is found in Tables 16-21. These results are particularly interesting given the substantial jump in price levels since the fall of 2006. Confidence limits in percentage form for an 80% confidence level are given in Tables 16-18, while limits for a 90% confidence level are given in Tables 19-21. Returning to the same example of May 2007 midpoints estimates of 2007/08 prices, $3.40/bu. for corn, $7.00/bu. for soybeans, and $4.65/bu. for wheat, 80% confidence intervals for these forecasts can be constructed using the percentage intervals in Tables 16-18,

	Corn	Soybeans	Wheat
Histogram	$2.73/bu.-$4.34/bu.	$5.93/bu.-$8.61/bu.	$4.00/bu.-$5.77/bu.
Kernel Density	$2.91/bu.-$4.54/bu.	$6.28/bu.-$9.10/bu.	$4.00/bu.-$5.83/bu.
Parametric Distribution	$2.98/bu.-$4.45/bu.	$6.36/bu.-$8.93/bu.	$3.88/bu.-$5.45/bu.
Quantile Regression	$2.73/bu.-$4.25/bu.	$5.93/bu.-$8.70/bu.	$4.04/bu.-$5.68/bu.

As expected, the confidence intervals based on percentage forecast errors are much wider in all cases because of the higher price levels. While this example describes 80% confidence intervals, any other confidence level can be selected by forecast providers to provide the desired balance between accuracy and informativeness.

Finally, the format in which the forecasts are released is also important. Currently, WASDE price forecasts are only published in the form of an interval. For example, the May 2007 forecast of the 2007/08 corn price was reported in the following form:

Average farm price ($/bu.)	3.10-3.70.

Such a format may be confusing to users of the forecast because it doesn't include information about the expected value of the forecast or the confidence level associated with the interval. If forecast users have to make assumptions about this missing information, their interpretation of forecasts could be incorrect, which would result in sub-optimal allocation of resources. Therefore, it is important that complete information about the forecast be published. An alternative and more informative format for the May 2007 forecast of the 2007/08 corn price generated for example using a histogram procedure, would be:

Average farm price ($/bu.)	3.40
80% confidence interval	2.73-4.34.

While this format will add an extra line to existing WASDE reports, it clearly identifies the: 1) expected price ($3.40/bu.); 2) confidence interval ($2.73/bu. to $4.34/bu.); 3) asymmetry in the upper and lower limits ($3.40 – 2.73/bu.= $0.67 /bu. and $4.34 – 3.40/bu.= $0.94/bu.); and 4) confidence level (80%). In sum, the suggested format would provide more complete information about forecasts and significantly aid interpretation and use by market participants and policy-makers.

Summary and Conclusions

WASDE marketing year average price forecasts (unlike all other WASDE estimates) are published in the form of an interval to reflect uncertainty associated with prices in the future. Several major concerns regarding WASDE forecast intervals of corn, soybeans, and wheat prices include: 1) forecast intervals have relatively low hit rates; 2) forecast intervals do not necessarily reflect the shape of the underlying price distribution; and 3) confidence levels associated with these forecast intervals are not specified.

This study applies and compares several procedures for calculating empirical confidence intervals for WASDE forecasts of corn, soybean, and wheat prices over the 1980/81 through 2006/07 marketing years. The basic approach was first introduced by Williams and Goodman (1971), and is based on the notion that by accumulating forecast errors through time one can obtain an empirical distribution of forecast errors. If the key assumption of this method is satisfied and future forecast errors belong to approximately the same distribution as past forecast errors, confidence limits for future forecasts can be determined by using the percentage points of the empirical distribution generated from past errors. Based on the results of independent sample *t*-tests and Levene's F-tests, forecast error distributions of monthly WASDE corn, soybean and wheat forecasts appeared stable over time.

Five procedures were used to estimate forecast error distributions, including histograms, kernel density estimation, logistic distribution, quantile regression, and quantile regression with stocks-to-use ratios. The procedures were compared based on out-of-sample performance, where the first 15 observations (1980/81-1994/95) were used to generate confidence limits for the 16th year (1995/96); the first 16 observations were used to generate confidence limits for the 17th year (1996/97) and so on.

Based on the results of accuracy tests for empirical confidence intervals over 1995/96 through 2006/07, all five empirical procedures included in this study generated confidence intervals that were not significantly different from the target confidence levels (80% pre-harvest and 90% post harvest). When monthly hit rates are averaged pre- and post-harvest across all three commodities, the kernel density-based method appears most accurate prior to harvest with an average hit rate of 81%, followed by the logistic distribution (75%), both quantile regression-based methods (74%), and histogram (73%). After harvest, the kernel density-based method and both quantile regression-based methods were the most accurate with an average hit rate of 91%, followed by logistic distribution based methods (88%) and the histogram based approach (86%). Furthermore, when hit rates for the first May prior to harvest forecast were compared across all commodities, kernel density-based intervals and logistic distribution based intervals appeared to outperform other methods.

This study also demonstrated the relative performance of the above methods in the context of the trade-off between accuracy and informativeness. While the kernel density-based intervals are most accurate, they also tend to be some of the widest. If the objective of the forecaster is to provide the most accurate interval that also has the narrowest width, both accuracy (measured by hit rates) and informativeness (interval width) should be taken into account. In this study, the tradeoff between accuracy and informativeness is illustrated graphically by plotting interval width against hit rates using pre- and post- harvest averages over 1995/96 through 2006/07 for each commodity. As expected, the graphical analysis does not give a clear cut answer regarding which procedure is the best. This ultimately depends on the shape of the forecaster's utility function and the combination of accuracy and informativeness (and probably computational ease) that would maximize forecaster's utility. However, this information may be useful for making a choice of the preferred procedure.

Overall, this study demonstrates how empirical approaches may be used to construct confidence intervals for WASDE corn, soybean, and wheat price forecasts. The results of this study may be extended to calculation of confidence intervals for price forecasts associated with other WASDE commodities. Furthermore, the empirical approaches discussed in this study may be used to generate confidence intervals for non-price WASDE categories, such as stocks/use forecasts, that are not currently published in interval form. Finally, this research provides only descriptive accuracy-informativeness analysis. Investigation of WASDE forecast users' preferences for accuracy versus informativeness is an interesting topic for future research.

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Table 1. Descriptive and Accuracy Statistics for WASDE Corn Price Interval Forecasts, 1980/81-2006/07 Marketing Years.

Month	Mean Forecast Price ($/bu.)	Average Interval ($/bu.)	Minimum Interval ($/bu.)	Maximum Interval ($/bu.)	Hit Rate (%)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest									
May	2.29	0.39	0.20	0.60	37	19	44	0.27	0.24
June	2.31	0.39	0.20	0.60	30	26	44	0.23	0.22
July	2.35	0.39	0.20	0.50	44	22	33	0.26	0.19
August	2.39	0.38	0.20	0.50	56	26	19	0.15	0.22
September	2.39	0.37	0.20	0.50	56	26	19	0.14	0.23
October	2.38	0.37	0.20	0.40	56	22	22	0.11	0.13
Average	2.35	0.38	0.20	0.52	46	23	30	0.19	0.21
After harvest									
November	2.38	0.36	0.20	0.40	74	11	15	0.18	0.13
December	2.37	0.34	0.20	0.40	81	7	11	0.15	0.14
January	2.38	0.30	0.15	0.40	85	7	7	0.10	0.20
February	2.38	0.25	0.15	0.40	81	7	11	0.10	0.10
March	2.38	0.20	0.10	0.40	74	11	15	0.05	0.06
April	2.39	0.14	0.00	0.30	74	11	15	0.04	0.06
May	2.39	0.10	0.00	0.25	70	19	11	0.06	0.05
June	2.38	0.07	0.00	0.20	70	19	11	0.05	0.05
July	2.38	0.04	0.00	0.10	74	19	7	0.04	0.06
August	2.38	0.01	0.00	0.10	44	30	26	0.03	0.03
September	2.38	0.00	0.00	0.10	48	30	22	0.02	0.02
Average	2.38	0.17	0.07	0.28	71	15	14	0.07	0.08

Note: Mean forecast price is calculated by averaging the midpoints of forecast intervals. Hit rate is the proportion of times the interval contained the final (November) estimate. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table 2. Descriptive Accuracy Statistics for WASDE Soybean Price Interval Forecasts, 1980/81-2006/07 Marketing Years.

Month	Mean Forecast Price ($/bu.)	Average Interval ($/bu.)	Minimum Interval ($/bu.)	Maximum Interval ($/bu.)	Hit Rate (%)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest									
May	5.72	1.27	0.40	2.50	52	19	30	0.31	0.71
June	5.73	1.22	0.40	2.50	56	15	30	0.36	0.71
July	5.77	1.19	0.30	2.50	67	7	26	0.29	0.70
August	5.89	1.19	0.30	2.50	81	4	15	0.05	0.91
September	5.96	1.07	0.30	2.50	78	7	15	0.39	0.79
October	5.93	0.97	0.30	2.50	70	11	19	0.30	0.44
Average	5.83	1.15	0.33	2.50	67	10	22	0.28	0.71
After harvest									
November	5.93	0.90	0.30	2.50	70	11	19	0.35	0.39
December	5.94	0.79	0.30	2.50	81	7	11	0.15	0.42
January	5.92	0.68	0.20	1.25	78	4	19	0.10	0.20
February	5.91	0.59	0.15	1.25	81	0	19	0.00	0.19
March	5.89	0.44	0.15	1.00	81	0	19	0.00	0.17
April	5.91	0.26	0.00	0.50	78	4	19	0.06	0.14
May	5.93	0.00	0.00	0.00	26	22	52	0.11	0.09
June	5.94	0.00	0.00	0.00	41	15	44	0.14	0.08
July	5.95	0.00	0.00	0.00	48	15	37	0.09	0.06
August	5.63	0.00	0.00	0.00	63	15	22	0.05	0.04
September	5.95	0.00	0.00	0.00	67	11	22	0.01	0.03
Average	5.90	0.33	0.10	0.82	65	9	26	0.10	0.17

Note: Mean forecast price is calculated by averaging the midpoints of forecast intervals. Hit rate is the proportion of times the interval contained the final (November) estimate. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table 3. Descriptive Accuracy Statistics for WASDE Wheat Price Interval Forecasts, 1980/81-2006/07 Marketing Years.

Month	Mean Forecast Price ($/bu.)	Average Interval ($/bu.)	Minimum Interval ($/bu.)	Maximum Interval ($/bu.)	Hit Rate (%)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest									
May	3.31	0.46	0.20	0.70	41	33	26	0.19	0.40
June	3.32	0.46	0.20	0.70	37	37	26	0.15	0.32
July	3.28	0.44	0.20	0.60	59	22	19	0.07	0.33
Average	3.30	0.45	0.20	0.67	46	31	23	0.14	0.35
After harvest									
August	3.30	0.43	0.20	0.60	67	15	19	0.07	0.19
September	3.30	0.36	0.20	0.60	74	7	19	0.09	0.15
October	3.33	0.31	0.15	0.60	78	7	15	0.12	0.12
November	3.34	0.25	0.10	0.40	67	15	19	0.10	0.06
December	3.34	0.21	0.10	0.30	70	15	15	0.06	0.05
January	3.34	0.17	0.10	0.30	70	15	15	0.04	0.03
February	3.34	0.12	0.10	0.20	70	15	15	0.03	0.03
March	3.33	0.10	0.00	0.20	78	7	15	0.04	0.03
April	3.33	0.07	0.00	0.20	67	11	22	0.03	0.03
May	3.34	0.00	0.00	0.05	41	33	26	0.03	0.03
June	3.34	0.00	0.00	0.00	37	37	26	0.03	0.03
Average	3.33	0.18	0.09	0.31	65	16	19	0.06	0.07

Note: Mean forecast price is calculated by averaging the midpoints of forecast intervals. Hit rate is the proportion of times the interval contained the final (November) estimate. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table 4. Descriptive Statistics for Empirical Confidence Intervals for WASDE Corn Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
	Average Interval	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above
Prior to harvest								--------------$/bu.----------------								
May	0.40	0.82	-0.31	0.51	1.12	-0.38	0.74	0.98	-0.35	0.64	1.03	-0.48	0.55	1.05	-0.53	0.52
June	0.40	0.89	-0.38	0.51	1.11	-0.42	0.69	0.98	-0.37	0.61	0.92	-0.44	0.49	0.92	-0.47	0.45
July	0.40	0.82	-0.40	0.42	0.98	-0.51	0.47	0.86	-0.43	0.43	0.82	-0.39	0.43	0.80	-0.41	0.39
August	0.40	0.52	-0.27	0.24	0.74	-0.45	0.29	0.66	-0.40	0.25	0.72	-0.35	0.37	0.69	-0.37	0.32
September	0.40	0.60	-0.31	0.29	0.71	-0.44	0.28	0.63	-0.42	0.21	0.63	-0.31	0.32	0.59	-0.32	0.27
October	0.40	0.57	-0.29	0.28	0.62	-0.37	0.25	0.54	-0.37	0.17	0.54	-0.27	0.27	0.50	-0.27	0.22
Average	0.40	0.70	-0.33	0.37	0.88	-0.43	0.45	0.77	-0.39	0.39	0.78	-0.37	0.41	0.76	-0.39	0.36
After harvest																
November	0.40	0.64	-0.40	0.24	0.77	-0.42	0.35	0.66	-0.38	0.28	0.63	-0.31	0.32	0.59	-0.32	0.27
December	0.38	0.40	-0.20	0.20	0.63	-0.31	0.32	0.52	-0.30	0.22	0.54	-0.27	0.27	0.50	-0.28	0.22
January	0.34	0.34	-0.15	0.19	0.53	-0.25	0.27	0.42	-0.25	0.17	0.46	-0.23	0.23	0.42	-0.24	0.18
February	0.28	0.34	-0.15	0.19	0.47	-0.24	0.23	0.36	-0.21	0.15	0.38	-0.19	0.19	0.34	-0.20	0.14
March	0.22	0.29	-0.10	0.19	0.36	-0.16	0.20	0.30	-0.17	0.13	0.32	-0.16	0.16	0.28	-0.17	0.11
April	0.13	0.21	-0.11	0.10	0.27	-0.13	0.13	0.23	-0.14	0.08	0.26	-0.13	0.13	0.23	-0.14	0.08
May	0.11	0.14	-0.08	0.06	0.20	-0.11	0.09	0.17	-0.12	0.05	0.21	-0.11	0.10	0.18	-0.12	0.06
June	0.09	0.12	-0.06	0.06	0.18	-0.09	0.09	0.15	-0.10	0.05	0.16	-0.08	0.08	0.14	-0.10	0.04
July	0.05	0.09	-0.05	0.04	0.12	-0.07	0.05	0.10	-0.07	0.03	0.12	-0.07	0.06	0.11	-0.08	0.03
August	0.00	0.07	-0.05	0.02	0.08	-0.05	0.03	0.07	-0.05	0.02	0.09	-0.05	0.04	0.09	-0.07	0.02
September	0.00	0.06	-0.05	0.01	0.08	-0.05	0.03	0.06	-0.04	0.02	0.07	-0.04	0.03	0.08	-0.06	0.02
Average	0.18	0.24	-0.13	0.12	0.33	-0.17	0.16	0.28	-0.17	0.11	0.29	-0.15	0.15	0.27	-0.16	0.11

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward.

Table 5. Descriptive Statistics for Empirical Confidence Intervals for WASDE Soybean Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
	Average Interval	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above
Prior to harvest								--------------$/bu.----------------								
May	1.09	2.21	-1.03	1.18	2.59	-1.17	1.42	2.22	-0.82	1.40	2.55	-1.32	1.23	2.53	-1.31	1.21
June	1.08	2.20	-1.03	1.17	2.54	-1.14	1.41	2.19	-0.82	1.36	2.25	-1.16	1.09	2.23	-1.15	1.07
July	1.05	1.64	-0.68	0.96	2.06	-0.90	1.17	1.80	-0.85	0.95	1.97	-1.01	0.96	1.95	-1.01	0.94
August	1.03	1.22	-0.67	0.55	1.53	-0.82	0.71	1.37	-0.80	0.57	1.71	-0.87	0.84	1.69	-0.88	0.82
September	0.92	1.04	-0.65	0.39	1.58	-1.07	0.51	1.38	-0.96	0.42	1.47	-0.75	0.73	1.45	-0.75	0.70
October	0.83	1.10	-0.65	0.45	1.55	-1.02	0.53	1.36	-0.83	0.52	1.25	-0.63	0.62	1.23	-0.63	0.60
Average	1.00	1.57	-0.78	0.79	1.98	-1.02	0.96	1.72	-0.85	0.87	1.87	-0.96	0.91	1.85	-0.96	0.89
After harvest																
November	0.81	1.79	-0.99	0.80	2.06	-1.17	0.89	1.67	-0.90	0.77	1.56	-0.76	0.81	1.53	-0.74	0.79
December	0.73	1.30	-0.65	0.65	1.55	-0.87	0.68	1.26	-0.69	0.57	1.32	-0.62	0.70	1.29	-0.61	0.68
January	0.68	0.84	-0.35	0.49	1.01	-0.46	0.55	0.89	-0.49	0.40	1.10	-0.50	0.60	1.07	-0.49	0.58
February	0.59	0.65	-0.27	0.39	0.85	-0.34	0.51	0.73	-0.38	0.35	0.90	-0.39	0.51	0.87	-0.38	0.49
March	0.40	0.39	-0.10	0.29	0.62	-0.12	0.50	0.48	-0.19	0.29	0.72	-0.30	0.43	0.70	-0.29	0.41
April	0.31	0.21	-0.06	0.15	0.36	-0.09	0.27	0.33	-0.12	0.22	0.57	-0.22	0.35	0.55	-0.22	0.33
May	0.00	0.20	-0.08	0.13	0.30	-0.10	0.20	0.28	-0.11	0.17	0.43	-0.15	0.28	0.42	-0.15	0.26
June	0.00	0.19	-0.08	0.11	0.26	-0.09	0.17	0.23	-0.09	0.15	0.31	-0.09	0.21	0.31	-0.11	0.20
July	0.00	0.11	-0.03	0.08	0.14	-0.04	0.10	0.12	-0.04	0.08	0.21	-0.05	0.16	0.22	-0.08	0.14
August	0.00	0.07	-0.01	0.06	0.10	-0.02	0.08	0.07	-0.03	0.04	0.13	-0.02	0.11	0.15	-0.06	0.09
September	0.00	0.03	0.00	0.03	0.06	-0.01	0.05	0.03	-0.01	0.02	0.07	0.00	0.06	0.11	-0.05	0.05
Average	0.32	0.53	-0.24	0.29	0.66	-0.30	0.36	0.55	-0.28	0.28	0.67	-0.28	0.38	0.66	-0.29	0.37

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward.

Table 6. Descriptive Statistics for Empirical Confidence Intervals for WASDE Wheat Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
	Average Interval	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above
Prior to harvest								--------------$/bu.----------------								
May	0.54	1.03	-0.46	0.57	1.18	-0.54	0.64	1.01	-0.59	0.42	1.09	-0.47	0.62	1.11	-0.48	0.63
June	0.54	0.96	-0.42	0.53	1.12	-0.53	0.59	0.96	-0.57	0.39	0.95	-0.41	0.54	0.96	-0.41	0.54
July	0.54	0.71	-0.24	0.48	0.82	-0.28	0.54	0.65	-0.36	0.29	0.82	-0.35	0.46	0.82	-0.35	0.47
Average	0.54	0.90	-0.37	0.53	1.04	-0.45	0.59	0.88	-0.51	0.37	0.95	-0.41	0.54	0.96	-0.42	0.55
After harvest																
August	0.54	0.81	-0.32	0.49	0.95	-0.34	0.61	0.80	-0.38	0.42	0.86	-0.35	0.51	0.86	-0.35	0.51
September	0.44	0.59	-0.20	0.39	0.71	-0.24	0.47	0.59	-0.27	0.32	0.72	-0.30	0.42	0.72	-0.29	0.42
October	0.38	0.49	-0.20	0.29	0.57	-0.23	0.34	0.51	-0.25	0.26	0.59	-0.24	0.34	0.59	-0.24	0.35
November	0.29	0.41	-0.21	0.20	0.48	-0.23	0.25	0.44	-0.21	0.23	0.47	-0.20	0.27	0.48	-0.20	0.28
December	0.23	0.31	-0.16	0.16	0.37	-0.19	0.18	0.33	-0.16	0.18	0.37	-0.16	0.21	0.38	-0.16	0.22
January	0.19	0.22	-0.10	0.12	0.27	-0.14	0.13	0.26	-0.15	0.11	0.29	-0.12	0.16	0.30	-0.13	0.17
February	0.11	0.18	-0.09	0.09	0.23	-0.12	0.10	0.21	-0.13	0.09	0.22	-0.10	0.12	0.23	-0.10	0.13
March	0.10	0.13	-0.05	0.08	0.17	-0.07	0.10	0.16	-0.08	0.08	0.16	-0.07	0.09	0.17	-0.08	0.10
April	0.07	0.12	-0.05	0.07	0.15	-0.05	0.10	0.14	-0.06	0.08	0.12	-0.06	0.06	0.13	-0.06	0.07
May	0.00	0.10	-0.05	0.05	0.11	-0.05	0.06	0.09	-0.05	0.04	0.09	-0.04	0.05	0.11	-0.05	0.05
June	0.00	0.10	-0.05	0.05	0.11	-0.05	0.06	0.09	-0.05	0.04	0.08	-0.04	0.04	0.10	-0.05	0.04
Average	0.21	0.31	-0.13	0.18	0.37	-0.16	0.22	0.33	-0.16	0.17	0.36	-0.15	0.21	0.37	-0.16	0.21

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward.

Table 7. Accuracy Statistics for Empirical Confidence Intervals for WASDE Corn Price Forecasts, 1995/96-2006/07 Marketing Years.

	Published Intervals		Histogram Intervals		Kernel Density Intervals		Logistic Distribution Intervals		Quantile Regression Intervals		Quantile Regression with Stocks/Use Intervals	
Month	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test
Prior to harvest												
May	42	8.46 **	67	1.17	92	1.24	83	0.09	75	0.18	75	0.18
June	33	12.26 **	67	1.17	92	1.24	75	0.18	75	0.18	75	0.18
July	50	5.36 **	67	1.17	83	0.09	75	0.18	67	1.17	75	0.18
August	58	2.92 *	75	0.18	75	0.18	75	0.18	75	0.18	75	0.18
September	67	1.17	83	0.09	75	0.18	75	0.18	75	0.18	75	0.18
October	58	2.92 *	67	1.17	75	0.18	75	0.18	58	2.92	58	2.92
Average	51		71		82		76		71		72	
Rank	4		2		1		2		3		2	
After harvest												
November	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04
December	92	0.04	92	0.04	100	n/a	92	0.04	100	n/a	92	0.04
January	100	n/a	92	0.04	100	n/a	100	n/a	100	n/a	92	0.04
February	92	0.04	92	0.04	100	n/a	100	n/a	100	n/a	92	0.04
March	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04
April	67	4.83 **	92	0.04	100	n/a	92	0.04	92	0.04	92	0.04
May	75	2.22	83	0.50	92	0.04	92	0.04	100	n/a	92	0.04
June	75	2.22	75	2.22	92	0.04	92	0.04	83	0.50	75	2.22
July	83	0.50	83	0.50	92	0.04	83	0.50	92	0.04	83	0.50
August	42	16.99 ***	92	0.04	92	0.04	83	0.50	100	n/a	75	2.22
September	58	8.20 ***	92	0.04	100	n/a	100	n/a	100	n/a	92	0.04
Average	79		89		95		92		95		88	
Rank	5		3		1		2		1		4	

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward. Target confidence level is 80% prior to harvest and 90% after harvest. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table 8. Accuracy Statistics for Empirical Confidence Intervals for WASDE Soybean Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Published Intervals		Histogram Intervals		Kernel Density Intervals		Logistic Distribution Intervals		Quantile Regression Intervals		Quantile Regression with Stocks/Use Intervals	
	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test
Prior to harvest												
May	58	2.92 *	83	0.09	92	1.24	92	1.24	92	1.24	92	1.24
June	67	1.17	92	1.24	92	1.24	92	1.24	83	0.09	83	0.09
July	67	1.17	83	0.09	92	1.24	83	0.09	83	0.09	83	0.09
August	75	0.18	75	0.18	75	0.18	75	0.18	83	0.09	83	0.09
September	67	1.17	67	1.17	75	0.18	75	0.18	75	0.18	75	0.18
October	58	2.92 *	67	1.17	75	0.18	75	0.18	75	0.18	75	0.18
Average	65		78		83		82		82		82	
Rank	4		3		1		2		2		2	
After harvest												
November	67	4.83 **	92	0.04	92	0.04	83	0.50	92	0.04	92	0.04
December	75	2.22	83	0.50	83	0.50	83	0.50	83	0.50	83	0.50
January	75	2.22	83	0.50	83	0.50	83	0.50	92	0.04	92	0.04
February	83	0.50	83	0.50	92	0.04	83	0.50	92	0.04	92	0.04
March	83	0.50	83	0.50	92	0.04	92	0.04	92	0.04	92	0.04
April	83	0.50	83	0.50	83	0.50	83	0.50	83	0.50	83	0.50
May	17	35.66 ***	83	0.50	92	0.04	83	0.50	92	0.04	92	0.04
June	25	28.58 ***	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04
July	25	28.58 ***	75	2.22	83	0.50	75	2.22	92	0.04	92	0.04
August	42	16.99 ***	75	2.22	75	2.22	75	2.22	67	4.83 **	83	0.50
September	42	16.99 ***	75	2.22	75	2.22	75	2.22	83	0.50	100	n/a
Average	56		83		86		83		87		90	
Rank	5		4		3		4		2		1	

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward.Target confidence level is 80% prior to harvest and 90% after harvest. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table 9. Accuracy Statistics for Empirical Confidence Intervals for WASDE Wheat Price Forecasts, 1995/96-2006/07 Marketing Years.

	Published Intervals		Histogram Intervals		Kernel Density Intervals		Logistic Distribution Intervals		Quantile Regression Intervals		Quantile Regression with Stocks/Use Intervals	
Month	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test
Prior to harvest												
May	33	12.26 ***	58	2.92 *	58	2.92 *	42	8.46 **	58	2.92 *	58	2.92 *
June	33	12.26 ***	75	0.18	67	1.17	67	1.17	58	2.92 *	58	2.92 *
July	67	1.17	67	1.17	92	1.24	67	1.17	75	0.18	75	0.18
Average	44		67		72		58		64		64	
Rank	5		3		1		2		4		4	
After harvest												
August	75	2.22	83	0.50	83	0.50	83	0.50	83	0.50	92	0.04
September	83	0.50	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04
October	92	0.04	92	0.04	100	n/a	92	0.04	100	n/a	100	n/a
November	75	2.22	83	0.50	92	0.04	92	0.04	92	0.04	92	0.04
December	75	2.22	75	2.22	75	2.22	75	2.22	83	0.50	83	0.50
January	75	2.22	92	0.04	92	0.04	92	0.04	100	n/a	100	n/a
February	75	2.22	92	0.04	100	n/a	92	0.04	100	n/a	100	n/a
March	83	0.50	83	0.50	92	0.04	83	0.50	92	0.04	100	n/a
April	67	4.83 **	83	0.50	92	0.04	92	0.04	92	0.04	100	n/a
May	42	16.99 ***	83	0.50	100	n/a	83	0.50	83	0.50	100	n/a
June	42	16.99 ***	83	0.50	100	n/a	92	0.04	83	0.50	92	0.04
Average	71		86		92		88		91		95	
Rank	5		4		1		3		2		1	

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward. Target confidence level is 80% prior to harvest and 90% after harvest. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table 10. Empirical 80% Confidence Limits for 2007/08 WASDE Corn Price Forecasts.

Month	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------$/bu.--------------								
May	0.60	1.02	-0.43	0.59	1.10	-0.39	0.72	0.98	-0.32	0.67	1.06	-0.47	0.59	1.12	-0.54	0.58
June	0.60	1.02	-0.43	0.59	1.10	-0.43	0.67	0.98	-0.36	0.62	0.94	-0.43	0.52	0.99	-0.48	0.51
July	0.60	0.87	-0.42	0.45	0.95	-0.44	0.52	0.85	-0.36	0.49	0.83	-0.38	0.45	0.86	-0.42	0.44
August	0.60	0.76	-0.48	0.29	0.75	-0.40	0.35	0.69	-0.40	0.29	0.73	-0.34	0.39	0.75	-0.37	0.38
September	0.60	0.64	-0.33	0.31	0.73	-0.39	0.34	0.66	-0.40	0.25	0.63	-0.30	0.33	0.64	-0.32	0.32
October	0.60	0.61	-0.30	0.31	0.64	-0.32	0.32	0.57	-0.32	0.25	0.55	-0.26	0.28	0.54	-0.27	0.27
Average	0.60	0.82	-0.40	0.42	0.88	-0.39	0.49	0.79	-0.36	0.43	0.79	-0.36	0.43	0.82	-0.40	0.42
After harvest																
November	0.60	0.44	-0.23	0.21	0.51	-0.25	0.26	0.47	-0.24	0.23	0.47	-0.23	0.24	0.45	-0.23	0.22
December	0.60	0.35	-0.15	0.20	0.39	-0.18	0.21	0.38	-0.20	0.18	0.39	-0.20	0.19	0.37	-0.20	0.17
January	0.60	0.27	-0.15	0.12	0.32	-0.18	0.13	0.30	-0.18	0.12	0.33	-0.17	0.16	0.30	-0.17	0.13
February	0.50	0.26	-0.15	0.11	0.28	-0.16	0.12	0.26	-0.16	0.10	0.27	-0.14	0.12	0.24	-0.14	0.10
March	0.50	0.19	-0.10	0.09	0.24	-0.14	0.10	0.21	-0.13	0.09	0.21	-0.12	0.09	0.19	-0.11	0.07
April	0.40	0.19	-0.10	0.09	0.19	-0.12	0.07	0.17	-0.12	0.05	0.17	-0.10	0.07	0.14	-0.10	0.05
May	0.30	0.10	-0.05	0.05	0.13	-0.09	0.04	0.13	-0.10	0.03	0.13	-0.08	0.05	0.11	-0.08	0.03
June	0.20	0.10	-0.05	0.05	0.12	-0.08	0.04	0.11	-0.08	0.03	0.10	-0.06	0.04	0.09	-0.07	0.02
July	0.20	0.09	-0.05	0.04	0.09	-0.06	0.03	0.07	-0.05	0.03	0.08	-0.05	0.03	0.07	-0.06	0.02
August	0.00	0.07	-0.05	0.02	0.07	-0.03	0.03	0.06	-0.03	0.02	0.06	-0.04	0.02	0.07	-0.05	0.02
September	0.00	0.05	-0.03	0.02	0.04	-0.03	0.02	0.04	-0.03	0.02	0.05	-0.03	0.02	0.07	-0.05	0.02
Average	0.35	0.19	-0.10	0.09	0.22	-0.12	0.10	0.20	-0.12	0.08	0.20	-0.11	0.09	0.19	-0.11	0.08

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from 1980/81 through 2006/07.

Table 11. Empirical 80% Confidence Limits for 2007/08 WASDE Soybean Price Forecasts.

Month	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------$/bu.--------------								
May	1.00	2.26	-1.03	1.24	2.39	-0.78	1.61	2.16	-0.59	1.58	2.34	-1.03	1.31	2.38	-1.06	1.32
June	1.00	2.55	-1.40	1.15	2.31	-0.72	1.59	2.12	-0.61	1.51	2.09	-0.91	1.18	2.12	-0.94	1.18
July	1.00	1.90	-0.65	1.25	2.05	-0.63	1.42	1.88	-0.68	1.21	1.85	-0.80	1.05	1.89	-0.84	1.05
August	1.00	1.60	-0.67	0.93	1.61	-0.61	1.01	1.52	-0.76	0.75	1.63	-0.70	0.93	1.67	-0.74	0.93
September	1.00	1.68	-0.65	1.03	1.77	-0.80	0.97	1.45	-0.83	0.62	1.42	-0.60	0.82	1.45	-0.64	0.81
October	1.00	1.49	-0.65	0.84	1.58	-0.76	0.83	1.37	-0.63	0.75	1.22	-0.51	0.71	1.26	-0.55	0.71
Average	1.00	1.91	-0.84	1.07	1.95	-0.72	1.24	1.75	-0.68	1.07	1.76	-0.76	1.00	1.79	-0.79	1.00
After harvest																
November	1.00	1.54	-0.75	0.79	1.39	-0.66	0.73	1.19	-0.51	0.68	1.04	-0.43	0.61	1.08	-0.47	0.61
December	1.00	1.36	-0.63	0.73	1.16	-0.54	0.61	0.93	-0.43	0.50	0.88	-0.36	0.52	0.91	-0.40	0.51
January	1.00	0.88	-0.35	0.53	0.80	-0.32	0.48	0.69	-0.31	0.38	0.73	-0.29	0.44	0.77	-0.34	0.43
February	0.80	0.63	-0.25	0.38	0.61	-0.21	0.40	0.57	-0.23	0.34	0.59	-0.23	0.36	0.63	-0.28	0.35
March	0.80	0.38	-0.10	0.28	0.38	-0.06	0.32	0.36	-0.10	0.26	0.46	-0.18	0.29	0.51	-0.24	0.28
April	0.50	0.18	-0.05	0.13	0.27	-0.05	0.22	0.29	-0.07	0.21	0.36	-0.13	0.23	0.40	-0.19	0.22
May	0.00	0.18	-0.05	0.13	0.21	-0.05	0.16	0.24	-0.07	0.16	0.26	-0.09	0.17	0.32	-0.15	0.16
June	0.00	0.18	-0.05	0.13	0.18	-0.03	0.14	0.20	-0.06	0.14	0.18	-0.06	0.12	0.25	-0.13	0.11
July	0.00	0.13	-0.05	0.08	0.12	-0.04	0.09	0.12	-0.04	0.08	0.11	-0.03	0.08	0.19	-0.11	0.07
August	0.00	0.07	-0.04	0.03	0.08	-0.04	0.04	0.07	-0.03	0.04	0.06	-0.02	0.05	0.14	-0.10	0.04
September	0.00	0.04	-0.01	0.03	0.02	-0.01	0.02	0.03	-0.01	0.02	0.02	0.00	0.02	0.11	-0.09	0.02
Average	0.46	0.51	-0.21	0.29	0.47	-0.18	0.29	0.43	-0.17	0.26	0.43	-0.17	0.26	0.48	-0.23	0.25

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from 1980/81 through 2006/07.

Table 12. Empirical 80% Confidence Limits for 2007/08 WASDE Wheat Price Forecasts.

	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------$/bu.--------------								
May	0.60	1.24	-0.52	0.72	1.27	-0.53	0.74	1.11	-0.58	0.53	1.15	-0.48	0.68	1.18	-0.50	0.68
June	0.60	1.06	-0.45	0.61	1.16	-0.51	0.65	1.02	-0.53	0.49	1.00	-0.41	0.59	1.02	-0.43	0.59
July	0.60	0.82	-0.25	0.57	0.87	-0.25	0.62	0.74	-0.32	0.42	0.85	-0.35	0.50	0.87	-0.37	0.50
Average	0.60	1.04	-0.41	0.63	1.10	-0.43	0.67	0.96	-0.48	0.48	1.00	-0.41	0.59	1.02	-0.43	0.59
After harvest																
August	0.60	0.56	-0.24	0.32	0.64	-0.24	0.40	0.57	-0.24	0.33	0.72	-0.30	0.42	0.73	-0.31	0.42
September	0.60	0.41	-0.19	0.22	0.46	-0.17	0.29	0.43	-0.17	0.25	0.59	-0.25	0.35	0.61	-0.26	0.35
October	0.60	0.39	-0.19	0.20	0.39	-0.18	0.21	0.36	-0.18	0.18	0.48	-0.20	0.28	0.50	-0.22	0.28
November	0.40	0.36	-0.21	0.15	0.36	-0.19	0.17	0.31	-0.16	0.15	0.38	-0.16	0.22	0.40	-0.18	0.22
December	0.40	0.28	-0.16	0.12	0.29	-0.16	0.12	0.25	-0.12	0.12	0.30	-0.13	0.17	0.32	-0.14	0.17
January	0.40	0.18	-0.09	0.09	0.20	-0.11	0.09	0.18	-0.11	0.07	0.22	-0.10	0.13	0.24	-0.11	0.13
February	0.40	0.16	-0.07	0.09	0.17	-0.09	0.08	0.15	-0.09	0.05	0.16	-0.07	0.09	0.18	-0.09	0.09
March	0.30	0.12	-0.05	0.07	0.13	-0.05	0.08	0.11	-0.06	0.05	0.11	-0.05	0.06	0.13	-0.07	0.06
April	0.20	0.12	-0.05	0.07	0.11	-0.04	0.07	0.10	-0.05	0.05	0.07	-0.04	0.04	0.10	-0.06	0.04
May	0.00	0.08	-0.04	0.04	0.07	-0.04	0.03	0.06	-0.03	0.03	0.04	-0.03	0.02	0.07	-0.05	0.02
June	0.00	0.08	-0.04	0.04	0.07	-0.04	0.03	0.06	-0.04	0.03	0.03	-0.02	0.01	0.06	-0.05	0.01
Average	0.35	0.25	-0.12	0.13	0.26	-0.12	0.14	0.23	-0.11	0.12	0.28	-0.12	0.16	0.30	-0.14	0.16

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from 1980/81 through 2006/07.

Table 13. Empirical 90% Confidence Limits for 2007/08 WASDE Corn Price Forecasts.

Month	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------$/bu.--------------								
May	0.60	1.32	-0.60	0.72	1.37	-0.53	0.84	1.32	-0.49	0.83	1.39	-0.67	0.72	1.34	-0.68	0.66
June	0.60	1.19	-0.60	0.59	1.35	-0.57	0.78	1.31	-0.52	0.79	1.24	-0.60	0.64	1.19	-0.61	0.59
July	0.60	0.91	-0.42	0.49	1.20	-0.59	0.61	1.14	-0.50	0.63	1.10	-0.53	0.57	1.06	-0.54	0.53
August	0.60	1.24	-0.65	0.59	1.07	-0.52	0.56	0.93	-0.52	0.41	0.97	-0.47	0.50	0.93	-0.47	0.46
September	0.60	0.92	-0.43	0.49	0.98	-0.47	0.51	0.88	-0.51	0.36	0.85	-0.41	0.43	0.82	-0.41	0.40
October	0.60	0.62	-0.30	0.32	0.79	-0.39	0.40	0.77	-0.42	0.35	0.74	-0.36	0.37	0.71	-0.36	0.35
Average	0.60	1.03	-0.50	0.53	1.13	-0.51	0.62	1.06	-0.49	0.56	1.05	-0.51	0.54	1.01	-0.51	0.50
After harvest																
November	0.60	0.72	-0.40	0.32	0.73	-0.39	0.34	0.62	-0.32	0.31	0.63	-0.31	0.32	0.61	-0.31	0.30
December	0.60	0.42	-0.20	0.22	0.53	-0.24	0.28	0.50	-0.26	0.24	0.54	-0.27	0.27	0.51	-0.26	0.25
January	0.60	0.35	-0.16	0.19	0.44	-0.23	0.21	0.41	-0.23	0.17	0.45	-0.22	0.23	0.42	-0.22	0.20
February	0.50	0.35	-0.16	0.19	0.41	-0.21	0.20	0.35	-0.20	0.15	0.37	-0.19	0.19	0.35	-0.19	0.16
March	0.50	0.35	-0.16	0.19	0.35	-0.17	0.18	0.29	-0.17	0.12	0.30	-0.15	0.15	0.28	-0.16	0.13
April	0.40	0.23	-0.13	0.10	0.25	-0.14	0.10	0.22	-0.15	0.08	0.24	-0.13	0.12	0.22	-0.13	0.10
May	0.30	0.17	-0.10	0.07	0.18	-0.11	0.07	0.17	-0.12	0.05	0.19	-0.10	0.09	0.18	-0.10	0.07
June	0.20	0.15	-0.08	0.07	0.17	-0.09	0.07	0.15	-0.10	0.05	0.15	-0.08	0.07	0.14	-0.08	0.05
July	0.20	0.10	-0.05	0.05	0.11	-0.06	0.05	0.10	-0.06	0.04	0.12	-0.06	0.05	0.11	-0.07	0.04
August	0.00	0.09	-0.05	0.04	0.07	-0.03	0.04	0.07	-0.04	0.03	0.09	-0.05	0.04	0.09	-0.06	0.03
September	0.00	0.07	-0.05	0.02	0.07	-0.05	0.02	0.06	-0.03	0.02	0.07	-0.04	0.03	0.08	-0.05	0.02
Average	0.35	0.27	-0.14	0.13	0.30	-0.16	0.14	0.27	-0.15	0.12	0.29	-0.15	0.14	0.27	-0.15	0.12

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from 1980/81 through 2006/07.

Table 14. Empirical 90% Confidence Limits for 2007/08 WASDE Soybean Price Forecasts.

	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------$/bu.--------------								
May	1.00	2.78	-1.40	1.38	3.23	-1.28	1.95	2.90	-0.95	1.95	3.38	-1.58	1.80	3.40	-1.60	1.80
June	1.00	3.42	-1.92	1.50	3.25	-1.29	1.96	2.84	-0.97	1.87	3.03	-1.40	1.63	3.03	-1.40	1.63
July	1.00	2.10	-0.80	1.30	2.69	-0.89	1.79	2.53	-1.00	1.53	2.69	-1.24	1.46	2.70	-1.24	1.46
August	1.00	2.05	-0.75	1.30	2.29	-0.83	1.46	2.03	-1.02	1.01	2.38	-1.08	1.30	2.38	-1.08	1.30
September	1.00	2.45	-1.15	1.30	2.45	-1.10	1.35	1.95	-1.07	0.87	2.09	-0.94	1.15	2.08	-0.93	1.15
October	1.00	2.02	-0.99	1.03	2.07	-1.00	1.07	1.84	-0.86	0.98	1.81	-0.80	1.01	1.80	-0.79	1.01
Average	1.00	2.47	-1.17	1.30	2.66	-1.06	1.60	2.35	-0.98	1.37	2.56	-1.17	1.39	2.56	-1.17	1.39
After harvest																
November	1.00	1.87	-0.99	0.88	1.96	-1.01	0.95	1.59	-0.71	0.88	1.55	-0.68	0.88	1.54	-0.66	0.88
December	1.00	1.40	-0.65	0.75	1.53	-0.74	0.78	1.25	-0.59	0.66	1.32	-0.57	0.75	1.31	-0.56	0.75
January	1.00	0.95	-0.35	0.60	1.04	-0.40	0.64	0.93	-0.43	0.50	1.10	-0.46	0.64	1.10	-0.46	0.64
February	0.80	0.87	-0.27	0.60	0.88	-0.27	0.62	0.76	-0.33	0.43	0.90	-0.37	0.53	0.91	-0.38	0.53
March	0.80	0.59	-0.10	0.49	0.66	-0.09	0.57	0.49	-0.17	0.32	0.72	-0.29	0.43	0.75	-0.32	0.43
April	0.50	0.44	-0.10	0.34	0.50	-0.09	0.41	0.38	-0.12	0.26	0.56	-0.22	0.35	0.60	-0.25	0.35
May	0.00	0.30	-0.15	0.15	0.34	-0.14	0.20	0.32	-0.11	0.20	0.42	-0.15	0.27	0.48	-0.22	0.27
June	0.00	0.28	-0.15	0.13	0.32	-0.14	0.17	0.27	-0.09	0.17	0.30	-0.10	0.20	0.39	-0.19	0.20
July	0.00	0.14	-0.06	0.08	0.17	-0.07	0.10	0.16	-0.06	0.10	0.19	-0.06	0.13	0.31	-0.18	0.13
August	0.00	0.12	-0.06	0.06	0.12	-0.05	0.07	0.09	-0.04	0.05	0.11	-0.03	0.08	0.25	-0.17	0.08
September	0.00	0.05	-0.02	0.03	0.03	-0.01	0.02	0.05	-0.02	0.03	0.05	-0.01	0.04	0.22	-0.19	0.04
Average	0.46	0.64	-0.26	0.37	0.68	-0.27	0.41	0.57	-0.24	0.33	0.66	-0.27	0.39	0.72	-0.33	0.39

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from 1980/81 through 2006/07.

Table 15. Empirical 90% Confidence Limits for 2007/08 WASDE Wheat Price Forecasts.

	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
	---------------------------$/bu------------------------------															
Prior to harvest																
May	0.60	1.36	-0.60	0.76	1.58	-0.66	0.92	1.49	-0.77	0.72	1.32	-0.56	0.76	1.31	-0.54	0.77
June	0.60	1.11	-0.49	0.62	1.45	-0.63	0.82	1.37	-0.70	0.66	1.15	-0.48	0.66	1.14	-0.47	0.67
July	0.60	0.86	-0.25	0.61	1.05	-0.32	0.73	0.99	-0.44	0.54	0.98	-0.41	0.57	0.98	-0.41	0.57
Average	0.60	1.11	-0.45	0.66	1.36	-0.54	0.82	1.28	-0.64	0.64	1.15	-0.49	0.66	1.15	-0.48	0.67
After harvest																
August	0.60	0.84	-0.33	0.51	0.89	-0.31	0.58	0.77	-0.34	0.43	0.84	-0.35	0.49	0.84	-0.35	0.49
September	0.60	0.61	-0.20	0.41	0.66	-0.22	0.44	0.57	-0.24	0.33	0.70	-0.29	0.41	0.71	-0.30	0.41
October	0.60	0.50	-0.20	0.30	0.53	-0.22	0.31	0.48	-0.24	0.24	0.58	-0.24	0.34	0.59	-0.25	0.34
November	0.40	0.43	-0.23	0.20	0.46	-0.24	0.22	0.42	-0.21	0.21	0.47	-0.19	0.27	0.48	-0.21	0.27
December	0.40	0.33	-0.17	0.16	0.37	-0.20	0.17	0.33	-0.16	0.17	0.37	-0.15	0.22	0.39	-0.17	0.22
January	0.40	0.22	-0.10	0.12	0.25	-0.13	0.12	0.24	-0.14	0.10	0.29	-0.12	0.17	0.30	-0.14	0.17
February	0.40	0.19	-0.09	0.09	0.21	-0.11	0.10	0.20	-0.12	0.08	0.22	-0.09	0.12	0.24	-0.11	0.13
March	0.30	0.13	-0.05	0.08	0.16	-0.07	0.09	0.15	-0.08	0.07	0.16	-0.07	0.09	0.18	-0.09	0.09
April	0.20	0.13	-0.05	0.08	0.14	-0.05	0.09	0.13	-0.06	0.07	0.11	-0.05	0.06	0.14	-0.07	0.07
May	0.00	0.10	-0.05	0.05	0.10	-0.05	0.05	0.08	-0.04	0.04	0.08	-0.04	0.04	0.11	-0.06	0.05
June	0.00	0.10	-0.05	0.05	0.10	-0.05	0.05	0.08	-0.05	0.04	0.06	-0.04	0.02	0.10	-0.06	0.04
Average	0.35	0.32	-0.14	0.19	0.35	-0.15	0.20	0.31	-0.15	0.16	0.35	-0.15	0.20	0.37	-0.16	0.21

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using raw (unit) errors from 1980/81 through 2006/07.

Table 16. Empirical 80% Confidence Limits for 2007/08 WASDE Corn Price Forecasts.

	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------%--------------								
May	18	47	-20	28	48	-14	34	43	-12	31	45	-19	26	43	-19	24
June	18	44	-20	24	47	-16	31	42	-14	28	40	-17	23	38	-17	21
July	19	35	-18	18	39	-16	22	35	-13	21	35	-15	20	33	-15	19
August	19	29	-15	14	32	-16	16	29	-16	12	31	-13	18	29	-13	16
September	19	27	-12	15	30	-14	16	27	-16	11	27	-11	15	25	-11	14
October	19	26	-11	15	26	-11	15	23	-12	11	23	-10	13	21	-10	12
Average	19	35	-16	19	37	-15	22	33	-14	19	33	-14	19	32	-14	17
After harvest																
November	17	20	-8	11	22	-8	14	19	-9	10	19	-9	11	18	-9	10
December	16	17	-6	11	17	-6	11	16	-8	8	16	-8	9	15	-7	8
January	15	11	-6	6	14	-7	7	13	-7	5	13	-6	7	12	-6	6
February	13	11	-5	6	12	-6	6	11	-6	5	11	-5	6	10	-5	4
March	13	8	-5	3	9	-5	5	9	-5	4	9	-4	4	7	-4	3
April	9	8	-4	4	7	-4	3	7	-5	2	7	-4	3	6	-3	2
May	7	5	-3	2	5	-4	2	6	-4	2	5	-3	2	4	-3	2
June	5	5	-3	2	5	-3	2	5	-3	2	4	-2	2	4	-2	1
July	5	3	-2	1	4	-2	1	3	-2	1	3	-2	1	3	-2	1
August	0	3	-2	1	3	-1	1	2	-1	1	3	-2	1	3	-2	1
September	0	2	-1	1	2	-1	1	2	-1	1	2	-2	1	3	-2	1
Average	9	8	-4	4	9	-4	5	8	-5	4	9	-4	4	8	-4	4

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percent errors from 1980/81 through 2006/07.

Table 17. Empirical 80% Confidence Limits for 2007/08 WASDE Soybean Price Forecasts.

	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------%--------------								
May	14	38	-15	23	40	-10	30	37	-9	28	40	-14	26	39	-14	24
June	14	39	-15	24	39	-10	29	36	-10	26	35	-12	23	34	-13	22
July	13	31	-11	20	35	-9	26	33	-11	22	31	-11	21	30	-11	19
August	13	27	-10	17	28	-9	19	26	-13	14	28	-9	18	27	-10	17
September	13	30	-11	19	29	-11	19	23	-13	10	24	-8	16	23	-8	15
October	12	23	-10	13	26	-10	16	22	-10	13	21	-6	14	20	-7	13
Average	13	31	-12	19	33	-10	23	30	-11	19	30	-10	20	29	-10	18
After harvest																
November	11	25	-11	14	22	-9	14	19	-8	11	18	-7	11	18	-7	11
December	10	19	-8	11	18	-8	10	15	-7	8	15	-6	9	15	-6	9
January	10	13	-5	8	13	-5	8	12	-5	7	12	-5	8	13	-5	8
February	8	9	-4	5	10	-3	7	10	-4	6	10	-4	6	11	-4	6
March	8	5	-2	4	6	-1	5	6	-2	5	8	-3	5	9	-3	5
April	5	4	-1	3	5	-1	4	5	-1	4	6	-2	4	7	-3	4
May	0	4	-1	3	4	-1	3	4	-1	3	4	-2	3	5	-2	3
June	0	3	-1	2	3	0	3	3	-1	2	3	-1	2	4	-2	2
July	0	2	-1	1	2	-1	2	2	-1	1	2	-1	1	3	-2	2
August	0	1	-1	1	1	-1	1	1	0	1	1	0	1	3	-2	1
September	0	1	0	1	1	0	1	1	0	0	0	0	0	2	-2	1
Average	5	8	-3	5	8	-3	5	7	-3	4	7	-3	5	8	-3	5

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percent errors from 1980/81 through 2006/07.

Table 18. Empirical 80% Confidence Limits for 2007/08 WASDE Wheat Price Forecasts.

	Published	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------%--------------								
May	13	38	-14	24	39	-14	25	34	-17	17	35	-13	23	35	-13	22
June	13	34	-14	20	36	-14	22	31	-15	16	30	-11	19	30	-11	19
July	12	26	-8	18	28	-7	21	24	-10	14	26	-9	17	25	-9	16
Average	12	33	-12	21	34	-12	23	29	-14	16	30	-11	20	30	-11	19
After harvest																
August	11	18	-8	10	20	-7	13	18	-7	11	22	-8	13	22	-8	13
September	10	12	-5	7	15	-5	10	13	-5	8	18	-7	11	18	-7	11
October	10	12	-5	7	12	-5	7	11	-5	6	14	-6	9	14	-6	9
November	7	10	-5	5	10	-5	5	9	-4	5	11	-4	7	11	-5	7
December	6	9	-4	5	8	-4	4	7	-3	4	9	-4	5	9	-4	5
January	6	5	-3	3	6	-3	3	5	-3	2	6	-3	4	6	-3	3
February	6	5	-2	2	5	-3	2	4	-3	2	5	-2	3	5	-2	2
March	5	4	-2	2	4	-2	2	3	-2	2	3	-2	2	3	-2	1
April	3	3	-1	2	4	-1	2	3	-1	2	2	-1	1	2	-2	1
May	0	2	-1	1	2	-1	1	2	-1	1	1	-1	0	2	-1	0
June	0	2	-1	1	2	-1	1	2	-1	1	1	-1	0	4	-3	1
Average	6	8	-3	4	8	-3	5	7	-3	4	8	-3	5	9	-4	5

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percent errors from 1980/81 through 2006/07.

Table 19. Empirical 90% Confidence Limits for 2007/08 WASDE Corn Price Forecasts.

	Published	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------%--------------								
May	18	52	-22	30	59	-20	39	58	-20	38	51	-23	28	52	-23	29
June	18	50	-22	28	58	-21	37	56	-21	35	46	-21	25	46	-21	26
July	19	38	-20	18	47	-21	26	46	-19	27	41	-18	22	41	-18	23
August	19	39	-16	22	42	-19	23	38	-21	17	36	-16	20	36	-16	20
September	19	31	-13	18	38	-17	21	36	-20	16	32	-14	18	32	-14	17
October	19	26	-11	15	31	-14	18	31	-16	15	29	-12	17	28	-12	15
Average	19	39	-17	22	46	-19	27	44	-20	25	39	-17	22	39	-17	22
After harvest																
November	17	26	-11	15	28	-11	17	26	-12	13	25	-11	15	23	-11	13
December	16	17	-6	11	22	-8	14	21	-10	11	22	-9	13	20	-9	10
January	15	17	-6	11	20	-8	12	17	-9	8	19	-8	11	16	-8	8
February	13	17	-6	11	18	-7	11	14	-8	6	16	-6	9	13	-6	6
March	13	14	-5	9	15	-6	9	12	-7	5	13	-5	8	10	-5	5
April	9	9	-5	4	10	-5	4	9	-6	3	10	-4	6	8	-4	4
May	7	7	-3	4	8	-5	4	8	-5	3	8	-3	5	6	-3	3
June	5	7	-3	4	8	-4	4	7	-4	3	6	-3	4	5	-3	2
July	5	4	-3	2	5	-3	2	4	-2	2	5	-2	3	4	-2	2
August	0	3	-2	2	4	-2	2	3	-2	1	4	-2	2	3	-2	1
September	0	2	-2	1	3	-2	1	2	-1	1	3	-2	1	3	-2	1
Average	9	11	-5	7	13	-5	7	11	-6	5	12	-5	7	10	-5	5

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percent errors from 1980/81 through 2006/07.

Table 20. Empirical 90% Confidence Limits for 2007/08 WASDE Soybean Price Forecasts.

	Published	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest									---------------%--------------							
May	14	44	-19	24	52	-16	36	49	-15	34	55	-22	34	57	-22	35
June	14	44	-19	24	51	-16	36	48	-16	32	50	-19	30	51	-19	31
July	13	39	-12	27	47	-12	34	44	-17	27	44	-17	27	45	-17	28
August	13	38	-11	27	42	-11	30	35	-17	18	39	-15	24	40	-15	25
September	13	40	-14	27	40	-13	27	31	-17	14	34	-13	21	35	-13	22
October	12	31	-12	19	34	-13	21	30	-13	16	30	-11	19	30	-11	19
Average	13	39	-15	25	44	-14	31	40	-16	24	43	-15	28	43	-15	27
After harvest																
November	11	27	-12	16	30	-12	18	26	-11	15	26	-9	16	26	-9	16
December	10	24	-10	14	24	-10	15	20	-9	11	22	-8	14	22	-8	14
January	10	16	-6	11	18	-6	12	16	-7	9	18	-7	12	18	-6	12
February	8	15	-4	11	16	-4	12	13	-5	8	15	-5	10	15	-5	10
March	8	11	-2	9	9	-1	8	8	-3	6	12	-4	8	12	-4	8
April	5	8	-1	6	9	-1	8	7	-2	5	9	-3	6	10	-3	6
May	0	5	-2	3	6	-2	4	5	-2	4	7	-2	5	8	-3	5
June	0	5	-2	3	5	-2	4	4	-1	3	5	-2	4	6	-3	3
July	0	3	-1	2	3	-1	2	3	-1	2	3	-1	2	5	-3	2
August	0	2	-1	1	2	-1	1	1	-1	1	2	-1	1	4	-3	1
September	0	1	0	1	1	0	1	1	0	0	1	0	1	4	-3	0
Average	11	11	-4	7	11	-4	8	9	-4	6	11	-4	7	12	-5	7

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percent errors from 1980/81 through 2006/07.

Table 21. Empirical 90% Confidence Limits for 2007/08 WASDE Wheat Price Forecasts.

	Published	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Interval Range	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit	Interval Range	Lower Limit	Upper Limit
Prior to harvest								---------------%--------------								
May	13	43	-16	27	48	-17	31	45	-22	23	43	-16	27	43	-16	27
June	13	35	-15	21	43	-17	26	41	-20	21	37	-14	23	37	-14	23
July	12	29	-9	20	33	-9	24	32	-14	18	32	-12	20	32	-12	20
Average	12	36	-13	23	42	-15	27	39	-19	21	34	-13	21	37	-14	23
After harvest																
August	11	26	-8	18	27	-9	18	24	-10	14	27	-10	17	26	-10	16
September	10	18	-5	12	19	-6	13	18	-7	11	22	-8	14	22	-8	14
October	10	12	-5	7	15	-6	10	14	-7	8	18	-7	11	18	-7	11
November	7	11	-6	5	13	-6	7	12	-6	6	14	-5	9	14	-6	9
December	6	10	-5	5	11	-5	5	10	-5	5	11	-4	7	11	-4	7
January	6	6	-3	3	8	-4	4	7	-4	3	8	-3	5	8	-4	5
February	6	5	-3	3	6	-3	3	6	-4	2	6	-2	4	6	-3	3
March	5	4	-2	2	5	-2	3	5	-2	2	4	-2	3	4	-2	2
April	3	4	-1	2	4	-2	3	4	-2	2	3	-1	2	3	-2	1
May	0	2	-1	1	3	-1	1	2	-1	1	2	-1	1	2	-1	1
June	0	2	-1	1	3	-1	1	2	-1	1	2	-1	1	5	-3	2
Average	6	9	-4	6	10	-4	6	9	-4	5	11	-4	7	11	-5	6

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percent errors from 1980/81 through 2006/07.

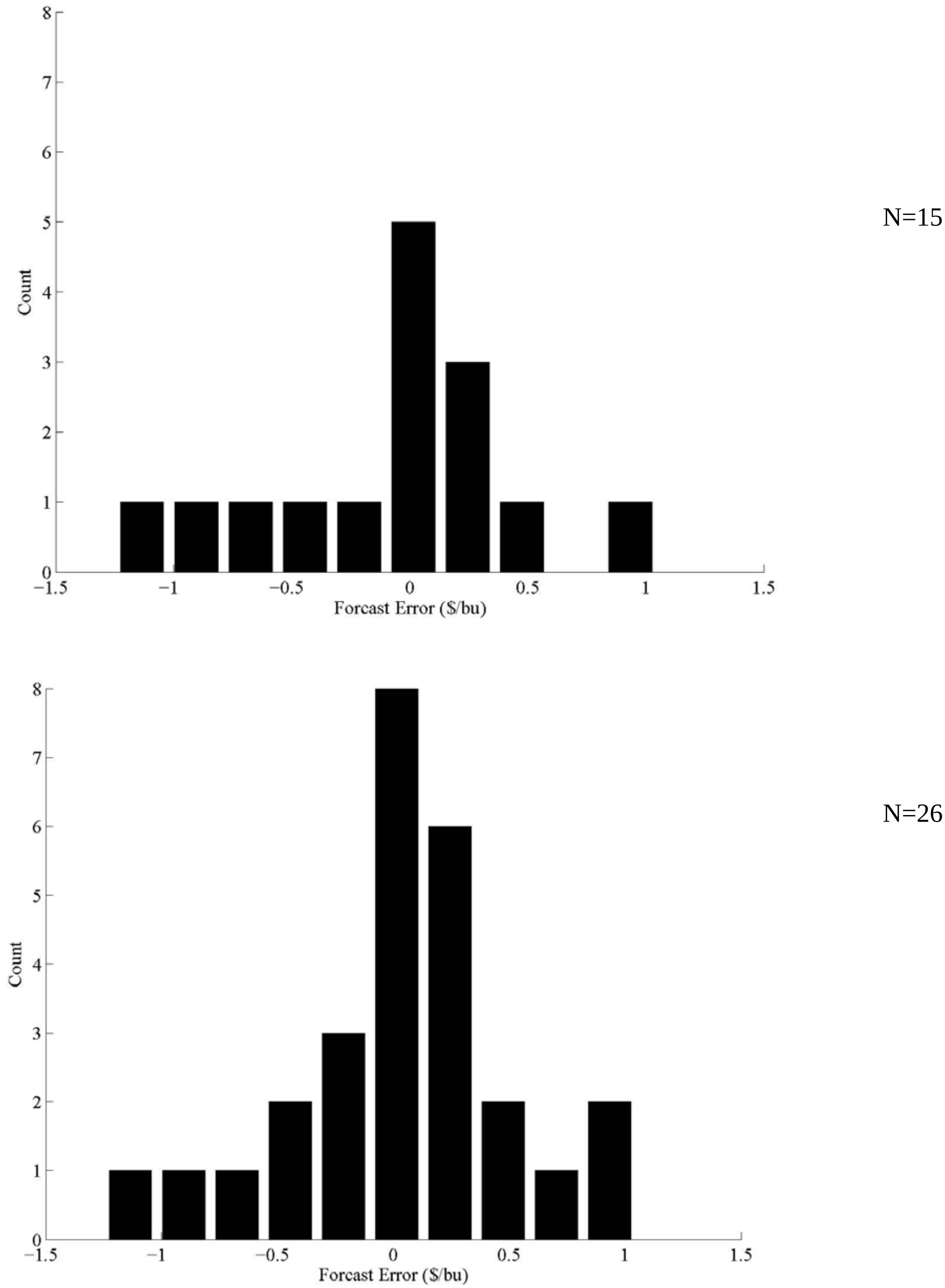

Figure 1. Histogram Estimates for November Soybean Price Forecasts Based on the First 15 and the First 26 observations.

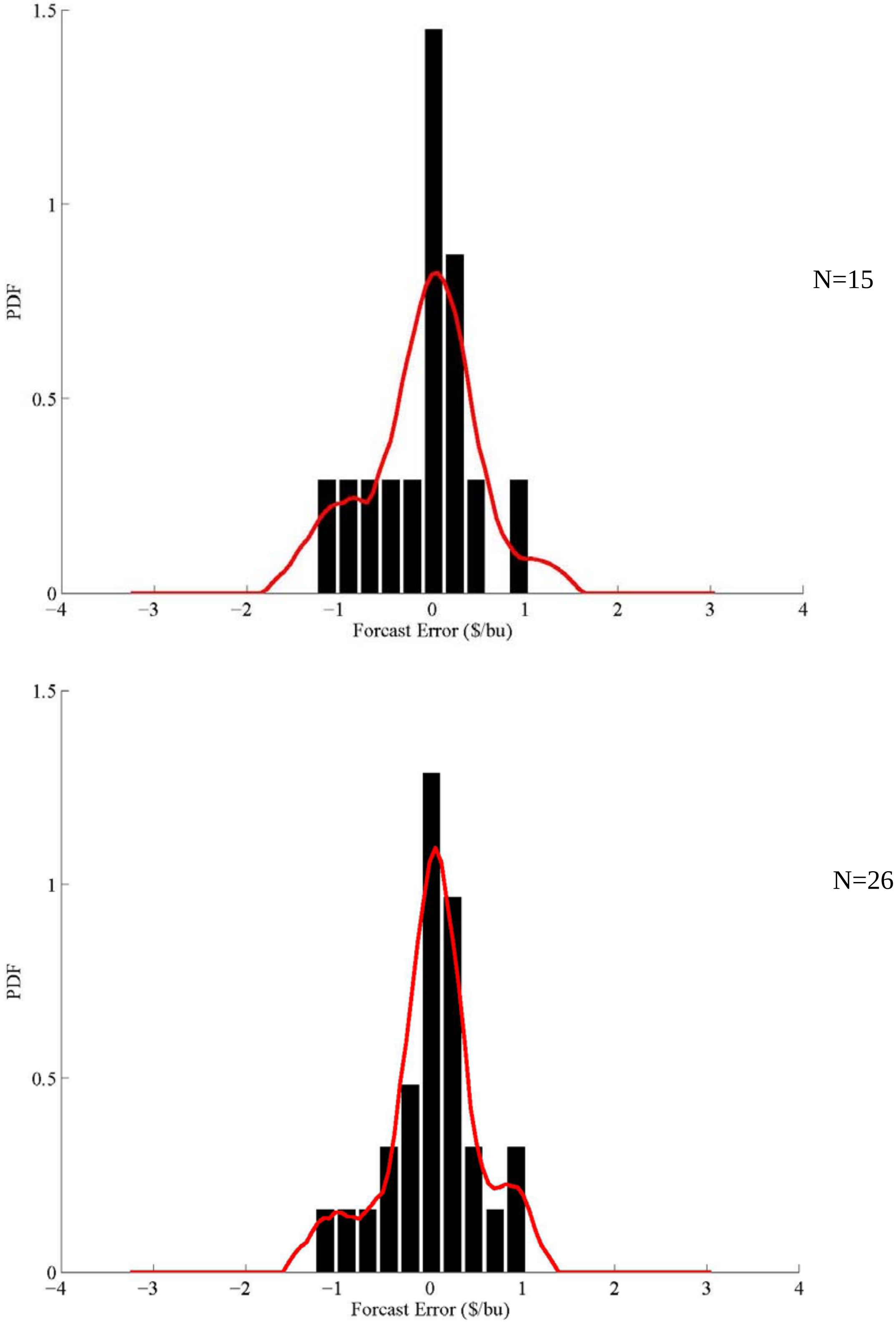

Figure 2. Kernel Density Estimates for November Soybean Price Forecasts Based on the First 15 and the First 26 observations.

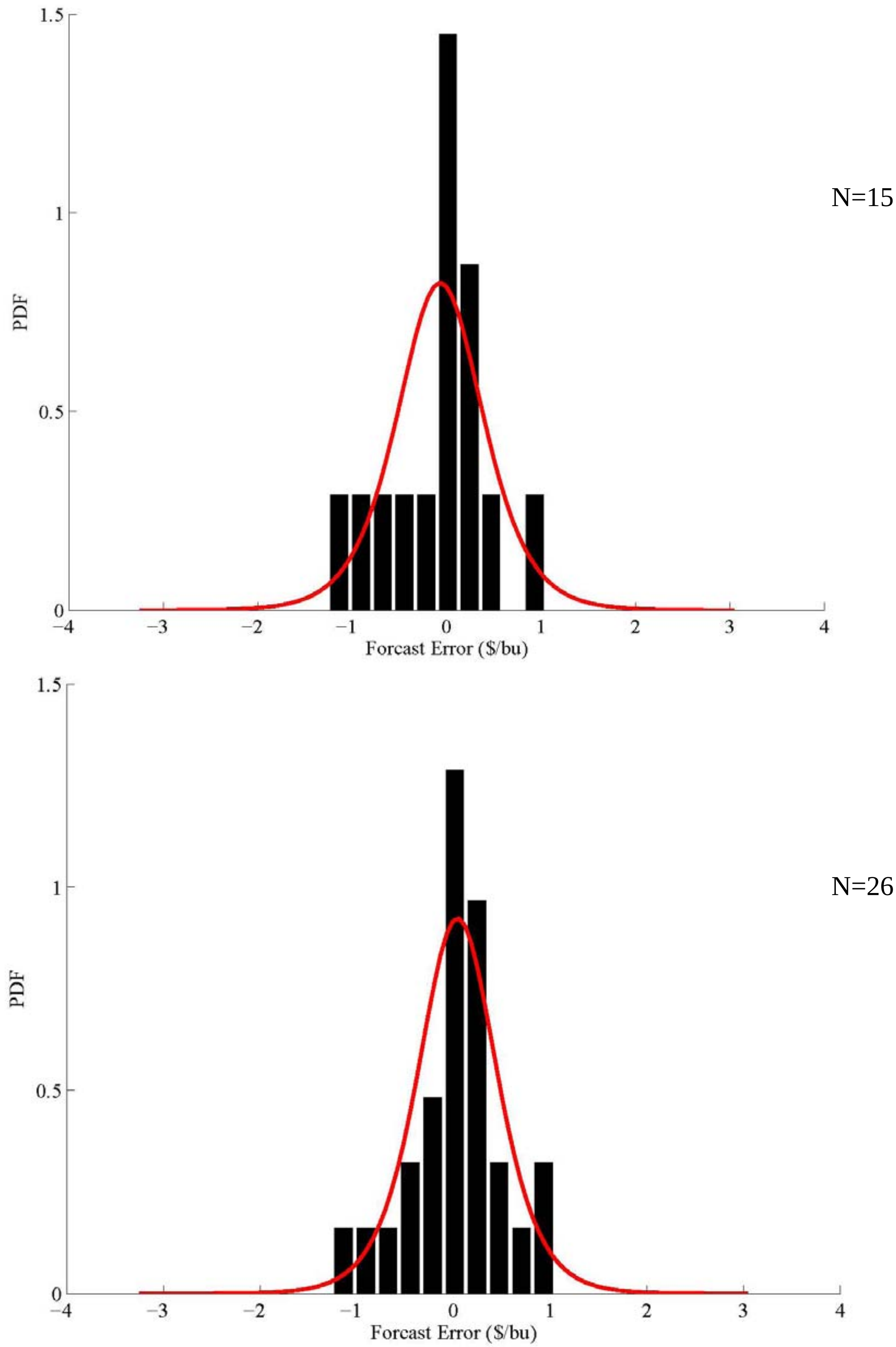

Figure 3. Logistic Distribution Estimates for November Soybean Price Forecasts Based on the First 15 and the First 26 observations.

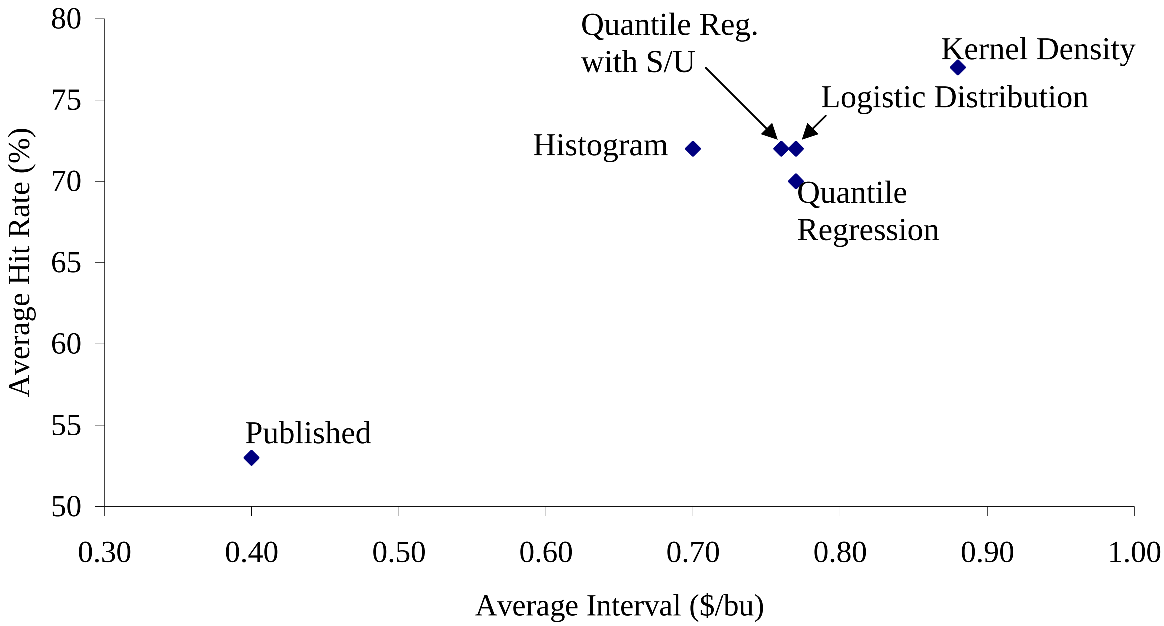

Figure 4. Accuracy-Informativeness Trade-off for Pre-Harvest Empirical Forecast Intervals of Corn Prices over 1995/96 through 2006/07.

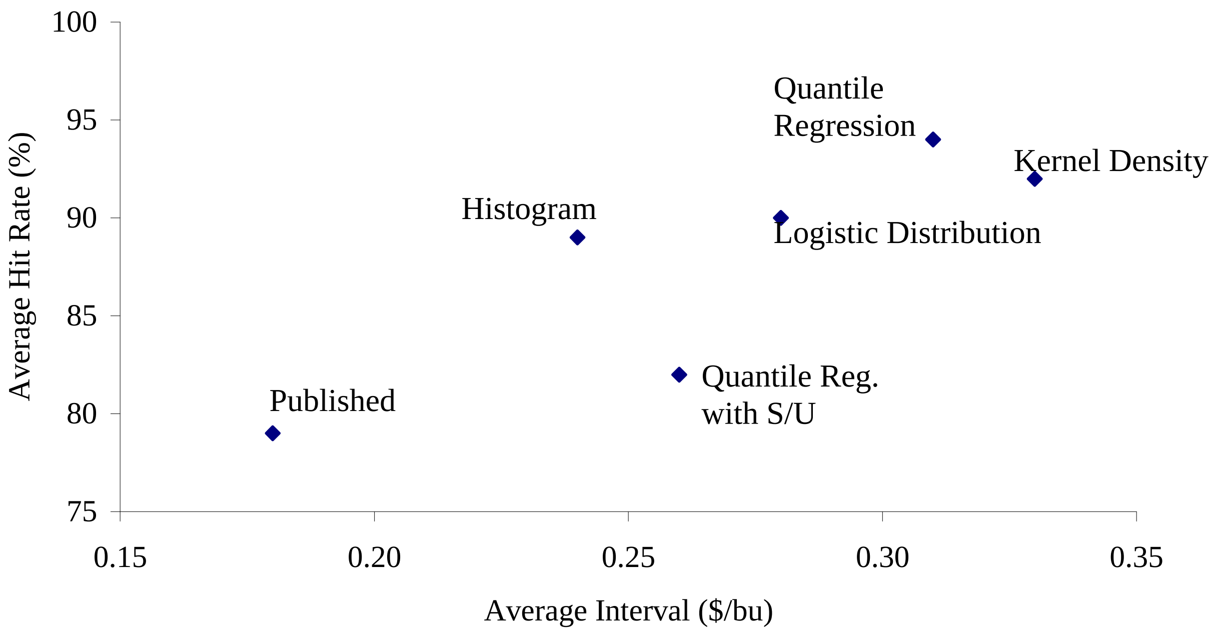

Figure 5. Accuracy-Informativeness Trade-off for Post-Harvest Empirical Forecast Intervals of Corn Prices over 1995/96 through 2006/07.

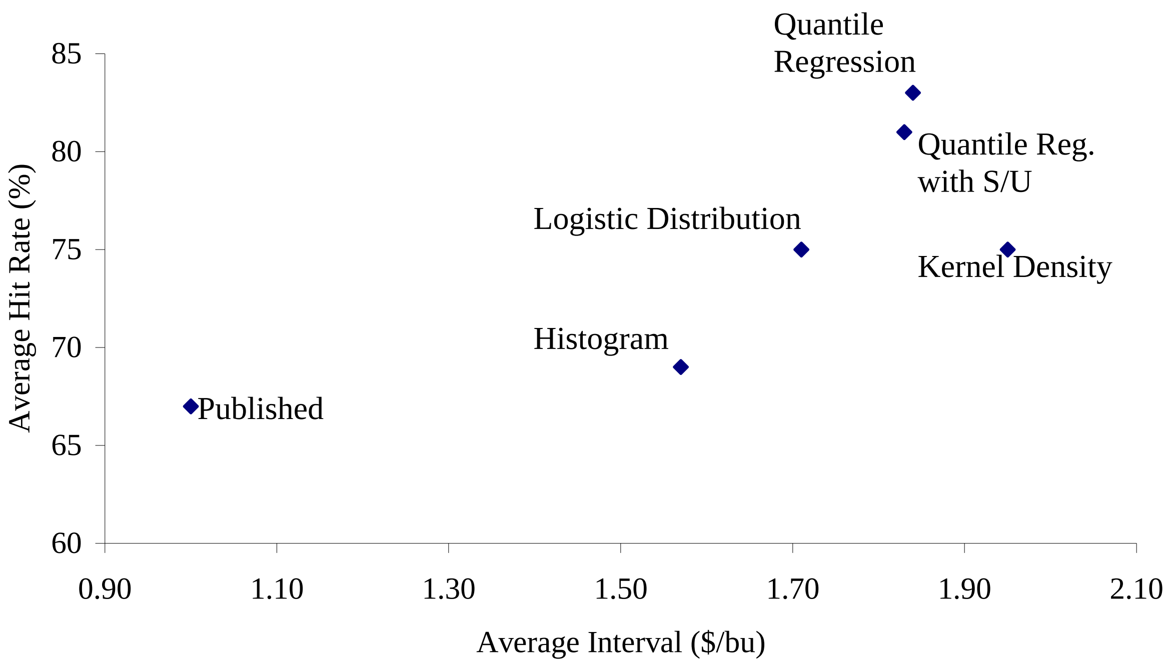

Figure 6. Accuracy-Informativeness Trade-off for Pre-Harvest Empirical Forecast Intervals of Soybean Prices over 1995/96 through 2006/07.

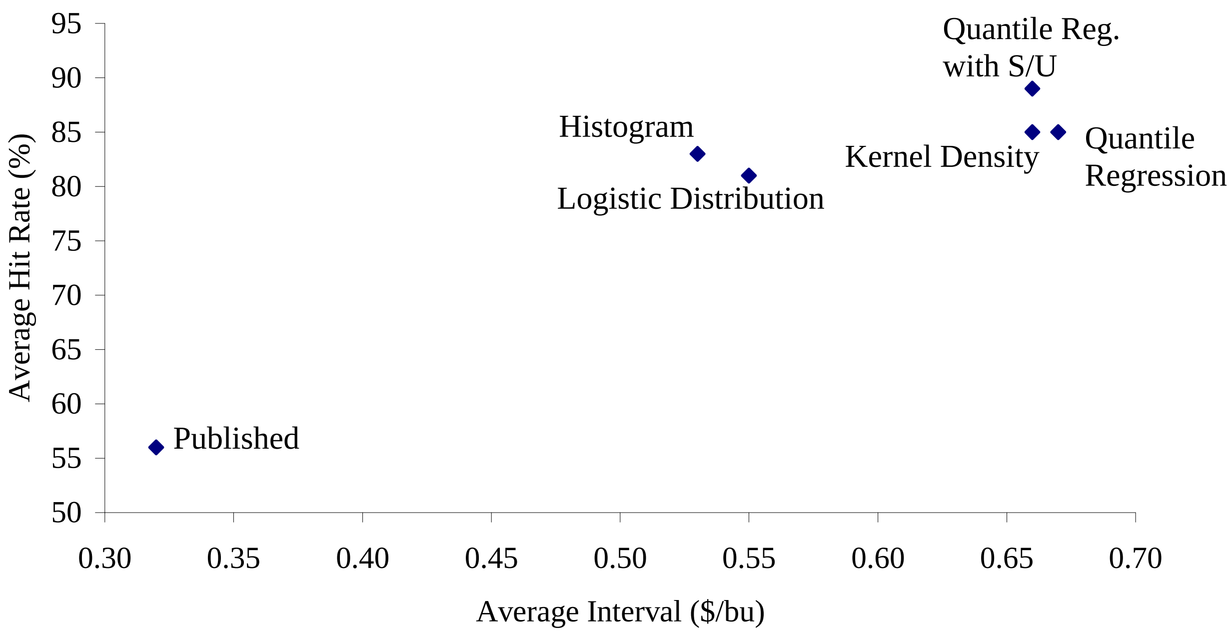

Figure 7. Accuracy-Informativeness Trade-off for Post-Harvest Empirical Forecast Intervals of Soybean Prices over 1995/96 through 2006/07.

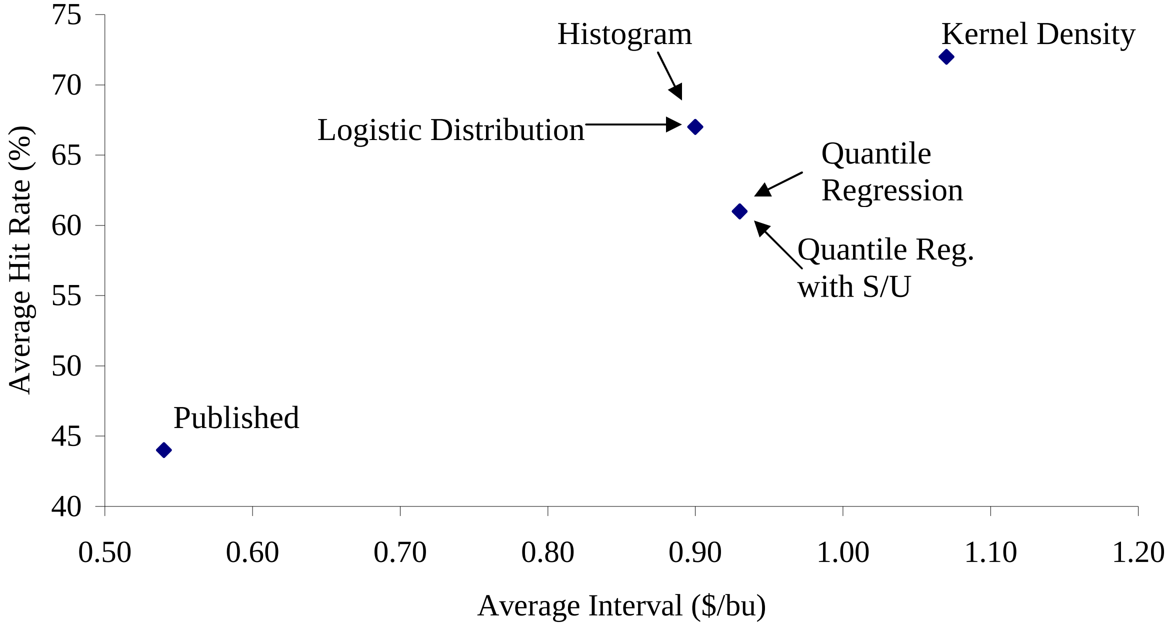

Figure 8. Accuracy-Informativeness Trade-off for Pre-Harvest Empirical Forecast Intervals of Wheat Prices over 1995/96 through 2006/07.

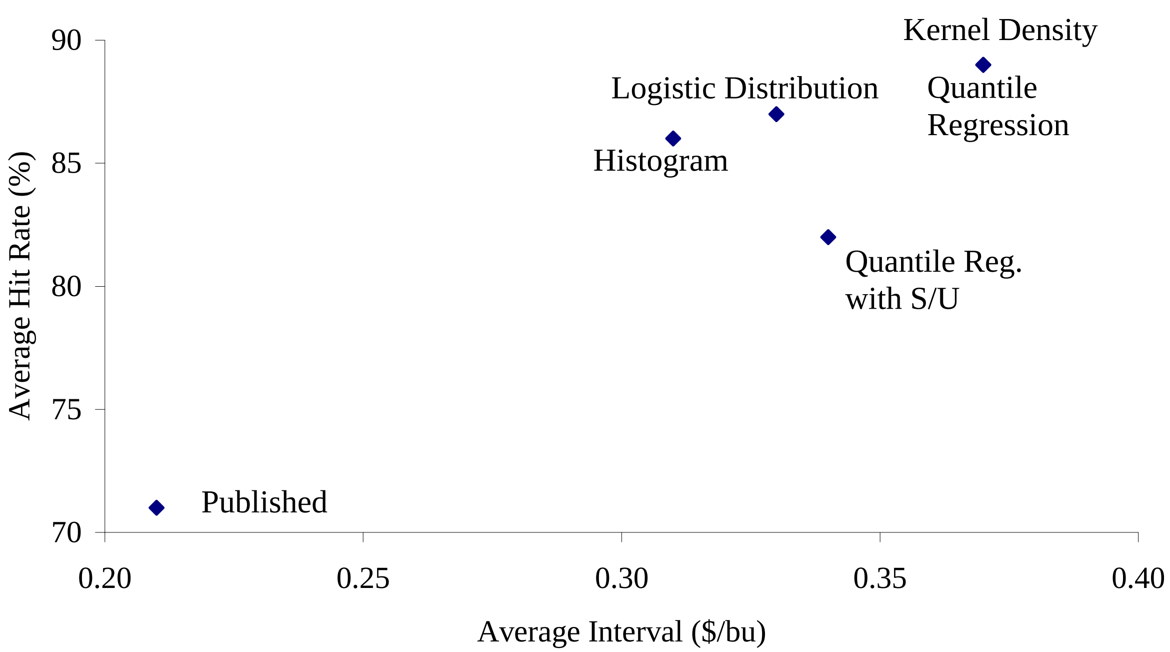

Figure 9. Accuracy-Informativeness Trade-off for Post-Harvest Empirical Forecast Intervals of Wheat Prices over 1995/96 through 2006/07.

APPENDIX

Table A1. Comparison of Error Distributions for WASDE Corn Price Interval Forecasts, 1980/81-1994/95, and 1995/96-2006/07 Marketing Years.

Month	1980/81-1994/95 Mean Forecast Error ($/bu.)	1995/96-2006/07 Mean Forecast Error ($/bu.)	*t*-test	1980/81-1994/95 Forecast Error Variance ($/bu.)	1995/96-2006/07 Forecast Error Variance ($/bu.)	Levene's *F*-statistic
Prior to harvest						
May	0.08	0.09	-0.05	0.15	0.16	0.02
June	0.08	0.04	0.28	0.15	0.15	0.07
July	-0.02	0.07	-0.67	0.12	0.11	0.08
August	-0.03	0.00	-0.26	0.05	0.14	2.32
September	-0.04	0.01	-0.49	0.05	0.11	1.15
October	-0.04	0.03	-0.69	0.04	0.06	0.30
After harvest						
November	-0.03	0.03	-0.83	0.05	0.02	1.99
December	-0.02	0.03	-0.79	0.04	0.01	0.81
January	-0.01	-0.01	-0.07	0.03	0.01	1.38
February	-0.01	-0.01	0.05	0.02	0.01	0.83
March	0.00	-0.02	0.46	0.01	0.01	0.41
April	-0.01	-0.03	0.71	0.01	0.00	0.18
May	-0.01	-0.02	0.35	0.00	0.00	0.00
June	-0.01	-0.01	0.18	0.00	0.00	0.00
July	-0.02	0.01	-2.07 **	0.00	0.00	0.27
August	-0.01	0.01	-2.31 **	0.00	0.00	0.48

Note: Mean forecast error is calculated as the difference between the final (November) estimate and the midpoint of the forecast interval. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table A2. Comparison of Error Distributions for WASDE Soybean Price Interval Forecasts, 1980/81-1994/95, and 1995/96-2006/07 Marketing Years.

Month	1980/81-1994/95 Mean Forecast Error ($/bu.)	1995/96-2006/07 Mean Forecast Error ($/bu.)	*t* -test	1980/81-1994/95 Forecast Error Variance ($/bu.)	1995/96-2006/07 Forecast Error Variance ($/bu.)	Levene's *F* - statistic
Prior to harvest						
May	-0.01	0.53	-1.55	0.92	0.61	0.77
June	0.00	0.50	-1.47	0.92	0.58	0.59
July	-0.04	0.46	-1.67	0.58	0.62	0.02
August	-0.10	0.27	-1.42	0.34	0.60	0.63
September	-0.20	0.22	-1.75 *	0.38	0.38	0.03
October	-0.12	0.20	-1.52	0.38	0.21	0.77
After harvest						
November	-0.10	0.18	-1.45	0.33	0.16	0.62
December	-0.07	0.12	-1.21	0.18	0.14	0.03
January	-0.01	0.08	-0.83	0.07	0.09	0.12
February	0.01	0.09	-0.81	0.05	0.06	0.02
March	0.05	0.08	-0.43	0.03	0.03	0.01
April	0.05	0.04	0.31	0.02	0.02	0.34
May	0.03	0.02	0.38	0.01	0.01	0.08
June	0.02	0.01	0.31	0.01	0.01	0.09
July	0.01	0.00	0.72	0.00	0.01	1.63
August	0.01	-0.01	1.77 *	0.00	0.00	1.43

Note: Mean forecast error is calculated as the difference between the final (November) estimate and the midpoint of the forecast interval. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table A3. Comparison of Error Distributions for WASDE Wheat Price Interval Forecasts, 1980/81-1994/95, and 1995/96-2006/07 Marketing Years.

Month	1980/81-1994/95 Mean Forecast Error ($/bu.)	1995/96-2006/07 Mean Forecast Error ($/bu.)	*t* -test	1980/81-1994/95 Forecast Error Variance ($/bu.)	1995/96-2006/07 Forecast Error Variance ($/bu.)	Levene's *F* -statistic
Prior to harvest						
May	0.02	0.03	-0.06	0.11	0.34	5.18 **
June	0.00	0.03	-0.15	0.10	0.26	4.13 *
July	0.01	0.12	-0.94	0.07	0.12	2.69
After harvest						
August	0.03	0.05	-0.18	0.05	0.08	0.14
September	0.02	0.05	-0.38	0.03	0.04	0.11
October	0.01	0.00	0.08	0.02	0.02	0.06
November	0.01	-0.01	0.36	0.02	0.01	0.26
December	0.00	-0.01	0.46	0.01	0.01	0.29
January	-0.01	-0.01	-0.05	0.01	0.00	0.33
February	-0.01	-0.01	-0.06	0.00	0.00	0.55
March	0.01	0.00	0.66	0.00	0.00	0.07
April	0.01	-0.01	1.51	0.00	0.00	0.27
May	0.00	0.00	0.44	0.00	0.00	0.46
June	0.00	0.00	0.41	0.00	0.00	0.50

Note: Mean forecast error is calculated as the difference between the final (November) estimate and the midpoint of the forecast interval. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table A4. Descriptive Statistics for Empirical Confidence Intervals for WASDE Corn Price Forecasts, 1995/96-2006/07 Marketing Years.

	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
Month	Average Interval	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above
Prior to harvest								-------------$/bu.---------------								
May	0.40	0.78	-0.31	0.47	1.03	-0.48	0.55	0.90	-0.40	0.50	1.00	-0.55	0.45	0.97	-0.54	0.43
June	0.40	0.76	-0.34	0.41	1.05	-0.51	0.55	0.92	-0.42	0.50	0.91	-0.49	0.41	0.87	-0.49	0.38
July	0.40	0.74	-0.42	0.32	0.93	-0.52	0.40	0.79	-0.41	0.39	0.79	-0.43	0.36	0.74	-0.42	0.32
August	0.40	0.60	-0.38	0.22	0.72	-0.42	0.30	0.63	-0.36	0.27	0.71	-0.38	0.33	0.65	-0.38	0.27
September	0.40	0.56	-0.31	0.25	0.66	-0.36	0.29	0.58	-0.34	0.24	0.61	-0.33	0.28	0.55	-0.32	0.22
October	0.40	0.51	-0.28	0.23	0.57	-0.30	0.27	0.50	-0.29	0.20	0.52	-0.28	0.24	0.46	-0.27	0.19
Average	0.40	0.66	-0.34	0.32	0.83	-0.43	0.39	0.72	-0.37	0.35	0.76	-0.41	0.35	0.71	-0.41	0.30
After harvest																
November	0.40	0.53	-0.29	0.24	0.65	-0.32	0.33	0.59	-0.31	0.27	0.58	-0.28	0.30	0.49	-0.28	0.21
December	0.38	0.37	-0.14	0.22	0.55	-0.24	0.30	0.46	-0.25	0.21	0.50	-0.24	0.26	0.41	-0.24	0.18
January	0.34	0.37	-0.14	0.23	0.49	-0.21	0.28	0.40	-0.22	0.18	0.44	-0.20	0.24	0.34	-0.20	0.14
February	0.28	0.37	-0.14	0.23	0.44	-0.19	0.24	0.34	-0.18	0.16	0.37	-0.16	0.20	0.28	-0.16	0.11
March	0.22	0.31	-0.11	0.19	0.35	-0.14	0.21	0.29	-0.15	0.14	0.31	-0.13	0.18	0.22	-0.13	0.09
April	0.13	0.18	-0.10	0.09	0.23	-0.11	0.13	0.22	-0.12	0.09	0.25	-0.11	0.15	0.18	-0.10	0.07
May	0.11	0.14	-0.08	0.06	0.19	-0.09	0.09	0.18	-0.11	0.07	0.20	-0.08	0.12	0.13	-0.08	0.05
June	0.09	0.13	-0.07	0.06	0.18	-0.09	0.09	0.16	-0.09	0.07	0.16	-0.06	0.09	0.10	-0.06	0.04
July	0.05	0.09	-0.05	0.03	0.11	-0.07	0.04	0.10	-0.06	0.04	0.12	-0.05	0.07	0.08	-0.05	0.03
August	0.00	0.06	-0.04	0.02	0.08	-0.04	0.03	0.06	-0.04	0.02	0.08	-0.04	0.04	0.07	-0.04	0.03
September	0.00	0.05	-0.04	0.01	0.06	-0.04	0.03	0.05	-0.03	0.02	0.06	-0.04	0.02	0.06	-0.04	0.02
Average	0.18	0.23	-0.11	0.13	0.30	-0.14	0.16	0.26	-0.14	0.12	0.28	-0.13	0.15	0.22	-0.13	0.09

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward.

Table A5. Descriptive Statistics for Empirical Confidence Intervals for WASDE Soybean Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
	Average Interval	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above
Prior to harvest								--------------$/bu.----------------								
May	1.09	1.88	-0.96	0.92	2.20	-1.16	1.03	1.87	-0.85	1.02	2.19	-1.21	0.98	2.15	-1.19	0.96
June	1.08	1.87	-0.97	0.91	2.16	-1.14	1.02	1.84	-0.84	1.00	1.93	-1.06	0.87	1.89	-1.04	0.85
July	1.05	1.33	-0.64	0.68	1.76	-0.85	0.91	1.53	-0.77	0.77	1.70	-0.93	0.77	1.66	-0.91	0.75
August	1.03	1.02	-0.61	0.41	1.38	-0.72	0.66	1.22	-0.67	0.55	1.52	-0.82	0.69	1.48	-0.81	0.67
September	0.92	0.94	-0.64	0.30	1.34	-0.78	0.56	1.18	-0.71	0.47	1.31	-0.70	0.60	1.27	-0.70	0.57
October	0.83	0.98	-0.62	0.35	1.35	-0.78	0.57	1.19	-0.66	0.53	1.10	-0.58	0.53	1.07	-0.57	0.50
Average	1.00	1.34	-0.74	0.60	1.70	-0.91	0.79	1.47	-0.75	0.72	1.63	-0.89	0.74	1.59	-0.87	0.72
After harvest																
November	0.81	1.37	-0.73	0.64	1.69	-0.88	0.81	1.45	-0.74	0.70	1.33	-0.62	0.71	1.26	-0.60	0.66
December	0.73	1.15	-0.63	0.52	1.33	-0.70	0.63	1.11	-0.58	0.54	1.15	-0.51	0.64	1.08	-0.49	0.59
January	0.68	0.73	-0.33	0.40	0.90	-0.41	0.49	0.82	-0.43	0.40	0.97	-0.40	0.57	0.90	-0.38	0.52
February	0.59	0.55	-0.22	0.32	0.77	-0.31	0.45	0.68	-0.34	0.34	0.81	-0.31	0.49	0.74	-0.29	0.45
March	0.40	0.36	-0.11	0.25	0.54	-0.16	0.38	0.46	-0.20	0.26	0.65	-0.23	0.42	0.60	-0.21	0.39
April	0.31	0.23	-0.06	0.17	0.36	-0.10	0.26	0.32	-0.13	0.19	0.51	-0.16	0.35	0.47	-0.16	0.32
May	0.00	0.22	-0.07	0.15	0.33	-0.10	0.23	0.27	-0.12	0.15	0.38	-0.10	0.28	0.37	-0.11	0.26
June	0.00	0.20	-0.06	0.14	0.27	-0.09	0.17	0.22	-0.10	0.13	0.27	-0.06	0.21	0.28	-0.08	0.20
July	0.00	0.12	-0.03	0.09	0.15	-0.05	0.10	0.12	-0.05	0.07	0.17	-0.03	0.15	0.20	-0.07	0.13
August	0.00	0.06	-0.01	0.05	0.08	-0.02	0.06	0.06	-0.03	0.03	0.09	-0.01	0.08	0.15	-0.08	0.07
September	0.00	0.04	0.00	0.03	0.05	-0.01	0.04	0.03	-0.01	0.02	0.03	-0.01	0.02	0.11	-0.10	0.01
Average	0.56	0.71	-0.37	0.33	0.93	-0.46	0.47	0.81	-0.42	0.39	0.91	-0.42	0.49	0.87	-0.41	0.46

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward.

Table A6. Descriptive Statistics for Empirical Confidence Intervals for WASDE Wheat Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Published Intervals	Histogram Intervals			Kernel Density Intervals			Logistic Distribution Intervals			Quantile Regression Intervals			Quantile Regression with Stocks/Use Intervals		
	Average Interval	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above	Average Interval	Average Below	Average Above
Prior to Harvest								--------------$/bu.----------------								
May	0.54	0.95	-0.44	0.51	1.15	-0.56	0.59	0.98	-0.53	0.45	1.10	-0.48	0.62	1.11	-0.49	0.62
June	0.54	0.93	-0.44	0.49	1.09	-0.54	0.55	0.93	-0.51	0.42	0.94	-0.41	0.53	0.95	-0.42	0.53
July	0.54	0.64	-0.24	0.40	0.77	-0.31	0.46	0.64	-0.33	0.31	0.78	-0.34	0.44	0.78	-0.34	0.44
Average	0.54	0.84	-0.37	0.47	1.00	-0.47	0.53	0.85	-0.46	0.39	0.94	-0.41	0.53	0.95	-0.42	0.53
After harvest																
August	0.54	0.76	-0.30	0.46	0.88	-0.38	0.51	0.79	-0.38	0.41	0.83	-0.37	0.46	0.82	-0.36	0.46
September	0.44	0.54	-0.18	0.35	0.65	-0.26	0.39	0.59	-0.27	0.31	0.69	-0.30	0.39	0.67	-0.29	0.38
October	0.38	0.41	-0.19	0.23	0.55	-0.24	0.32	0.51	-0.25	0.26	0.56	-0.24	0.32	0.54	-0.23	0.31
November	0.29	0.37	-0.20	0.17	0.48	-0.23	0.25	0.44	-0.21	0.23	0.44	-0.19	0.25	0.43	-0.18	0.25
December	0.23	0.31	-0.15	0.17	0.37	-0.18	0.19	0.33	-0.16	0.17	0.34	-0.14	0.20	0.33	-0.14	0.19
January	0.19	0.20	-0.09	0.11	0.27	-0.13	0.15	0.26	-0.14	0.12	0.26	-0.11	0.15	0.26	-0.11	0.14
February	0.11	0.18	-0.09	0.09	0.23	-0.11	0.12	0.22	-0.12	0.10	0.19	-0.08	0.12	0.20	-0.09	0.11
March	0.10	0.14	-0.06	0.08	0.18	-0.08	0.10	0.17	-0.08	0.09	0.15	-0.06	0.09	0.16	-0.08	0.08
April	0.07	0.12	-0.04	0.08	0.16	-0.06	0.09	0.15	-0.07	0.08	0.12	-0.05	0.07	0.15	-0.08	0.07
May	0.00	0.08	-0.04	0.04	0.10	-0.05	0.05	0.09	-0.05	0.04	0.10	-0.04	0.06	0.15	-0.09	0.06
June	0.00	0.08	-0.04	0.04	0.10	-0.05	0.05	0.09	-0.05	0.04	0.11	-0.05	0.06	0.17	-0.11	0.06
Average	0.21	0.29	-0.12	0.16	0.36	-0.16	0.20	0.33	-0.16	0.17	0.35	-0.15	0.20	0.35	-0.16	0.19

Note: Published intervals are symmetric. Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward.

Table A7. Accuracy Statistics for Empirical Confidence Intervals for WASDE Corn Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Published Intervals		Histogram Intervals		Kernel Density Intervals		Logistic Distribution Intervals		Quantile Regression Intervals		Quantile Regression with Stocks/Use Intervals	
	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test
Prior to harvest												
May	42	8.46 ***	67	1.17	75	0.18	75	0.18	75	0.18	75	0.18
June	33	12.26 ***	67	1.17	83	0.09	83	0.09	75	0.18	75	0.18
July	50	5.36 **	67	1.17	92	1.24	83	0.09	83	0.09	67	1.17
August	58	2.92 *	67	1.17	75	0.18	75	0.18	75	0.18	75	0.18
September	67	1.17	75	0.18	75	0.18	75	0.18	75	0.18	75	0.18
October	58	2.92 *	83	0.09	83	0.09	75	0.18	83	0.09	75	0.18
Average	51		71		81		78		78		74	
Rank	5		4		1		2		2		3	
After harvest												
November	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04	83	0.50
December	92	0.04	92	0.04	100	n/a	83	0.50	100	n/a	83	0.50
January	100	n/a	100	n/a	100	n/a	100	n/a	100	n/a	100	n/a
February	92	0.04	100	n/a	100	n/a	100	n/a	100	n/a	92	0.04
March	92	0.04	92	0.04	100	n/a	100	n/a	100	n/a	92	0.04
April	67	4.83 **	75	2.22	83	0.50	100	n/a	83	0.50	75	2.22
May	75	2.22	83	0.50	83	0.50	83	0.50	92	0.04	75	2.22
June	75	2.22	75	2.22	83	0.50	83	0.50	83	0.50	67	4.83 **
July	83	0.50	75	2.22	92	0.04	92	0.04	83	0.50	75	2.22
August	42	16.99 ***	92	0.04	92	0.04	92	0.04	92	0.04	75	2.22
September	58	8.20 ***	92	0.04	100	n/a	100	n/a	100	n/a	92	0.04
Average	79		88		93		93		93		83	
Rank	4		2		1		1		1		3	

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Target confidence level is 80% prior to harvest and 90% after harvest. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table A8. Accuracy Statistics for Empirical Confidence Intervals for WASDE Soybean Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Published Intervals		Histogram Intervals		Kernel Density Intervals		Logistic Distribution Intervals		Quantile Regression Intervals		Quantile Regression with Stocks/Use Intervals	
	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test
Prior to harvest												
May	58	2.92 *	75	0.18	83	0.09	75	0.18	75	0.18	75	0.18
June	67	1.17	75	0.18	83	0.09	83	0.09	75	0.18	75	0.18
July	67	1.17	67	0.18	83	0.09	75	0.18	75	0.18	75	0.18
August	75	0.18	67	1.17	75	0.18	75	0.18	75	0.18	75	0.18
September	67	1.17	67	1.17	75	0.18	75	0.18	75	0.18	75	0.18
October	58	2.92 *	67	1.17	75	0.18	75	0.18	75	0.18	75	0.18
Average	65		69		79		76		75		75	
Rank	5		4		1		2		3		3	
After harvest												
November	67	4.83 **	83	0.50	92	0.04	83	0.50	83	0.50	83	0.50
December	75	2.22	83	0.50	83	0.50	83	0.50	92	0.04	75	2.22
January	75	2.22	75	2.22	92	0.04	83	0.50	92	0.04	75	2.22
February	83	0.50	75	2.22	92	0.04	92	0.04	92	0.04	92	0.50
March	83	0.50	83	0.50	92	0.04	92	0.04	92	0.04	92	0.04
April	83	0.50	67	4.83 **	83	0.50	75	2.22	83	0.50	83	0.50
May	17	35.66 ***	75	2.22	83	0.50	75	2.22	92	0.04	92	0.04
June	25	28.58 ***	75	2.22	83	0.50	75	2.22	92	0.04	92	0.04
July	25	28.58 ***	67	4.83 **	83	0.50	75	2.22	75	2.22	83	0.50
August	42	16.99 ***	75	2.22	75	2.22	75	2.22	67	4.83 **	92	0.04
September	42	16.99 ***	67	4.83 **	83	0.50	75	2.22	75	2.22	58	8.20 ***
Average	56		75		86		80		85		83	
Rank	6		5		1		4		2		3	

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Target confidence level is 80% prior to harvest and 90% after harvest. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table A9. Accuracy Statistics for Empirical Confidence Intervals for WASDE Wheat Price Forecasts, 1995/96-2006/07 Marketing Years.

	Published Intervals		Histogram Intervals		Kernel Density Intervals		Logistic Distribution Intervals		Quantile Regression Intervals		Quantile Regression with Stocks/Use Intervals	
Month	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test	Hit Rate (%)	Unconditional Coverage Test
Prior to harvest												
May	33	12.26 ***	50	5.36 **	50	5.36 **	50	5.36 **	50	5.36 **	50	5.36 **
June	33	12.26 ***	42	8.46 ***	67	1.17	58	2.92 *	50	5.36 **	42	8.46 ***
July	67	1.17	58	2.92 *	75	0.18	67	1.17	75	0.18	75	0.18
Average	44		50		64		58		58		56	
Rank	5		4		1		2		2		3	
After harvest												
August	75	2.22	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04
September	83	0.50	92	0.04	92	0.04	92	0.04	92	0.04	92	0.04
October	92	0.04	92	n/a	100	n/a	100	n/a	100	n/a	100	n/a
November	75	2.22	92	0.04	100	0.04	92	0.04	92	0.04	92	0.04
December	75	2.22	83	0.50	83	0.50	83	0.50	83	0.50	83	0.50
January	75	2.22	92	0.50	100	n/a	100	n/a	100	n/a	92	0.04
February	75	2.22	92	0.04	100	n/a	100	n/a	92	0.04	92	0.04
March	83	0.50	83	0.50	100	0.04	100	0.04	92	0.04	92	0.04
April	67	4.83 **	83	0.50	92	0.50	100	0.04	92	0.04	92	0.04
May	42	16.99 ***	92	0.04	100	n/a	100	n/a	100	n/a	100	n/a
June	42	16.99 ***	92	0.04	100	n/a	100	n/a	100	n/a	100	n/a
Average	71		89		96		96		94		93	
Rank	5		4		1		1		2		3	

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Target confidence level is 80% prior to harvest and 90% after harvest. One asterisk indicates significance at 10% level, two asterisks indicate significance at 5% level, three asterisks indicate significance at 1% level.

Table A10. Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Corn Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Histogram Intervals				Kernel Density Intervals				Logistic Distribution Intervals			
	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest												
May	17	17	0.21	0.17	8	0	0.34	0.00	8	8	0.36	0.04
June	17	17	0.21	0.10	8	0	0.29	0.00	17	8	0.19	0.04
July	17	17	0.03	0.15	0	17	0.00	0.07	8	17	0.06	0.11
August	8	17	0.38	0.44	8	17	0.26	0.39	8	17	0.33	0.42
September	8	8	0.25	0.30	8	17	0.09	0.35	8	17	0.12	0.41
October	8	25	0.07	0.09	0	25	0.00	0.11	0	25	0.00	0.18
Average	13	17	0.19	0.21	6	13	0.16	0.15	8	15	0.18	0.20
After harvest												
November	0	8	0.00	0.11	0	8	0.00	0.03	0	8	0.00	0.09
December	0	8	0.00	0.03	0	0	0.00	0.00	0	8	0.00	0.04
January	8	0	0.01	0.00	0	0	0.00	0.00	0	0	0.00	0.00
February	8	0	0.01	0.00	0	0	0.00	0.00	0	0	0.00	0.00
March	8	0	0.06	0.00	8	0	0.01	0.00	8	0	0.01	0.00
April	8	0	0.03	0.00	0	0	0.00	0.00	0	8	0.00	0.01
May	8	8	0.05	0.02	8	0	0.01	0.00	0	8	0.00	0.02
June	17	8	0.04	0.02	8	0	0.02	0.00	0	8	0.00	0.03
July	0	17	0.00	0.03	0	8	0.00	0.02	0	17	0.00	0.03
August	0	8	0.00	0.03	0	8	0.00	0.02	0	17	0.00	0.02
September	0	8	0.00	0.01	0	0	0.00	0.00	0	0	0.00	0.00
Average	5	6	0.02	0.02	2	2	0.00	0.01	1	7	0.00	0.02

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A10 (continued). Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Corn Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Quantile Regression Intervals				Quantile Regression with Stocks/Use Intervals			
	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest								
May	8	17	0.23	0.13	8	17	0.18	0.20
June	8	17	0.27	0.12	8	17	0.24	0.20
July	17	17	0.04	0.12	8	17	0.04	0.21
August	8	17	0.31	0.27	8	17	0.27	0.36
September	8	17	0.20	0.27	8	17	0.17	0.37
October	17	25	0.03	0.09	17	25	0.02	0.16
Average	11	18	0.18	0.17	10	18	0.15	0.25
After harvest								
November	0	8	0.00	0.04	0	8	0.00	0.06
December	0	0	0.00	0.00	0	17	0.00	0.02
January	0	0	0.00	0.00	0	8	0.00	0.02
February	0	0	0.00	0.00	0	8	0.00	0.05
March	8	0	0.01	0.00	0	8	0.00	0.13
April	8	0	0.01	0.00	0	8	0.00	0.15
May	0	0	0.00	0.00	0	17	0.00	0.06
June	8	8	0.02	0.01	0	17	0.00	0.08
July	0	8	0.00	0.01	0	17	0.00	0.08
August	0	0	0.00	0.00	0	42	0.00	0.03
September	0	0	0.00	0.00	0	25	0.00	0.02
Average	2	2	0.00	0.00	0	21	0.00	0.07

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A11. Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Soybean Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Histogram Intervals				Kernel Density Intervals				Logistic Distribution Intervals			
	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest												
May	0	17	0.00	0.62	0	8	0.00	1.10	0	8	0.00	1.11
June	0	8	0.00	1.24	0	8	0.00	1.12	0	8	0.00	1.16
July	0	17	0.00	0.82	0	8	0.00	1.45	0	17	0.00	0.81
August	0	25	0.00	0.80	0	25	0.00	0.63	0	25	0.00	0.79
September	0	33	0.00	0.57	0	25	0.00	0.68	0	25	0.00	0.77
October	0	33	0.00	0.26	0	25	0.00	0.34	0	25	0.00	0.32
Average	0	22	0.00	0.72	0	17	0.00	0.89	0	18	0.00	0.83
After harvest												
November	0	8	0.00	0.48	0	8	0.00	0.13	0	17	0.00	0.11
December	0	17	0.00	0.30	0	17	0.00	0.14	0	17	0.00	0.24
January	0	17	0.00	0.22	0	17	0.00	0.10	0	17	0.00	0.22
February	0	17	0.00	0.22	0	8	0.00	0.18	0	17	0.00	0.18
March	0	17	0.00	0.17	0	8	0.00	0.12	0	8	0.00	0.22
April	8	8	0.21	0.21	8	8	0.19	0.13	8	8	0.16	0.12
May	8	8	0.26	0.05	8	0	0.25	0.00	8	8	0.22	0.01
June	8	0	0.26	0.00	8	0	0.26	0.00	8	0	0.24	0.00
July	25	0	0.09	0.00	17	0	0.10	0.00	17	8	0.09	0.01
August	25	0	0.04	0.00	25	0	0.03	0.00	25	0	0.03	0.00
September	25	0	0.01	0.00	25	0	0.01	0.00	0	25	0.00	0.01
Average	9	8	0.08	0.15	8	6	0.08	0.07	6	11	0.07	0.10

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A11 (continued). Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Soybean Price Forecasts, 1995/96-2006/07 Marketing Years.

	Quantile Regression Intervals				Quantile Regression with Stocks/Use Intervals			
Month	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest								
May	0	8	0.00	1.24	0	8	0.00	1.25
June	0	17	0.00	0.70	0	17	0.00	0.72
July	0	17	0.00	0.80	0	17	0.00	0.82
August	0	17	0.00	0.76	0	17	0.00	0.77
September	0	25	0.00	0.41	0	25	0.00	0.43
October	0	25	0.00	0.21	0	25	0.00	0.21
Average	0	18	0.00	0.69	0	18	0.00	0.70
After harvest								
November	0	8	0.00	0.08	0	8	0.00	0.11
December	0	17	0.00	0.05	0	17	0.00	0.07
January	0	8	0.00	0.04	0	8	0.00	0.04
February	0	8	0.00	0.15	0	8	0.00	0.15
March	0	8	0.00	0.10	0	8	0.00	0.10
April	8	8	0.06	0.04	8	8	0.04	0.04
May	8	0	0.17	0.00	8	0	0.16	0.00
June	8	0	0.23	0.00	8	0	0.21	0.00
July	8	0	0.17	0.00	8	0	0.14	0.00
August	33	0	0.03	0.00	17	0	0.01	0.00
September	17	0	0.01	0.00	0	0	0.00	0.00
Average	14	1	0.11	0.01	8	1	0.09	0.01

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A12. Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Wheat Price Forecasts, 1995/96-2006/07 Marketing Years.

	Histogram Intervals				Kernel Density Intervals				Logistic Distribution Intervals			
Month	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest												
May	25	17	0.23	0.48	25	17	0.21	0.39	25	33	0.16	0.36
June	8	17	0.42	0.35	17	17	0.15	0.30	8	25	0.28	0.36
July	8	25	0.04	0.22	0	8	0.00	0.53	0	33	0.00	0.26
Average	14	19	0.23	0.35	14	14	0.12	0.41	11	30	0.14	0.33
After harvest												
August	8	8	0.11	0.40	8	8	0.03	0.24	8	8	0.03	0.37
September	0	8	0.00	0.30	0	8	0.00	0.13	0	8	0.00	0.19
October	0	8	0.00	0.10	0	0	0.00	0.00	0	8	0.00	0.04
November	8	8	0.04	0.05	8	0	0.02	0.00	8	0	0.04	0.00
December	17	8	0.06	0.08	17	8	0.04	0.03	17	8	0.06	0.03
January	0	8	0.00	0.06	0	8	0.00	0.03	0	8	0.00	0.04
February	0	8	0.00	0.01	0	0	0.00	0.00	0	8	0.00	0.01
March	8	8	0.02	0.03	8	0	0.02	0.00	8	8	0.01	0.01
April	8	8	0.01	0.00	8	0	0.02	0.00	8	0	0.01	0.00
May	8	8	0.01	0.01	0	0	0.00	0.00	8	8	0.01	0.01
June	8	8	0.01	0.01	0	0	0.00	0.00	8	0	0.01	0.00
Average	7	8	0.02	0.03	5	3	0.01	0.04	6	6	0.01	0.06

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A12 (continued). Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Wheat Price Forecasts, 1995/96-2006/07 Marketing Years.

	Quantile Regression Intervals				Quantile Regression with Stocks/Use Intervals			
Month	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest								
May	25	17	0.21	0.43	25	17	0.21	0.44
June	25	17	0.16	0.37	25	17	0.16	0.37
July	0	25	0.00	0.17	0	25	0.00	0.17
Average	17	19	0.12	0.32	17	19	0.12	0.33
After harvest								
August	8	8	0.01	0.23	8	8	0.03	0.22
September	0	8	0.00	0.12	0	8	0.00	0.09
October	0	0	0.00	0.00	0	0	0.00	0.00
November	8	0	0.04	0.00	8	0	0.03	0.00
December	17	0	0.05	0.00	17	0	0.05	0.00
January	0	0	0.00	0.00	0	0	0.00	0.00
February	0	0	0.00	0.00	0	0	0.00	0.00
March	0	8	0.00	0.01	8	0	0.01	0.00
April	0	8	0.00	0.01	8	0	0.01	0.00
May	8	8	0.01	0.01	8	0	0.01	0.00
June	8	8	0.03	0.02	8	0	0.02	0.00
Average	5	5	0.01	0.04	6	2	0.01	0.03

Note: Empirical price forecast intervals were calculated using raw (unit) errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A13. Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Corn Price Forecasts, 1995/96-2006/07 Marketing Years.

	Histogram Intervals				Kernel Density Intervals				Logistic Distribution Intervals			
Month	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest												
May	17	17	0.16	0.18	8	17	0.14	0.05	8	17	0.22	0.09
June	17	17	0.15	0.13	8	8	0.12	0.05	8	8	0.20	0.08
July	0	33	0.00	0.10	0	8	0.00	0.16	8	8	0.03	0.17
August	8	25	0.25	0.29	8	17	0.08	0.34	8	17	0.21	0.37
September	8	17	0.08	0.32	8	17	0.01	0.28	8	17	0.06	0.34
October	0	17	0.00	0.13	0	17	0.00	0.12	0	25	0.00	0.13
Average	8	21	0.11	0.19	6	14	0.06	0.16	7	15	0.12	0.19
After harvest												
November	0	8	0.00	0.11	0	8	0.00	0.05	0	8	0.00	0.11
December	0	8	0.00	0.02	0	0	0.00	0.00	0	17	0.00	0.04
January	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
February	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
March	8	0	0.02	0.00	0	0	0.00	0.00	0	0	0.00	0.00
April	25	0	0.02	0.00	17	0	0.01	0.00	0	0	0.00	0.00
May	8	8	0.04	0.03	8	8	0.03	0.01	8	8	0.02	0.01
June	17	8	0.03	0.03	8	8	0.04	0.01	8	8	0.03	0.02
July	8	17	0.01	0.03	0	8	0.00	0.03	0	8	0.00	0.03
August	0	8	0.00	0.03	0	8	0.00	0.02	0	8	0.00	0.02
September	0	8	0.00	0.01	0	0	0.00	0.00	0	0	0.00	0.00
Average	6	6	0.01	0.03	3	4	0.01	0.01	2	5	0.00	0.02

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A13 (continued). Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Corn Price Forecasts, 1995/96-2006/07 Marketing Years.

	Quantile Regression Intervals				Quantile Regression with Stocks/Use Intervals			
Month	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest								
May	8	17	0.05	0.18	8	17	0.06	0.24
June	8	17	0.12	0.14	8	17	0.14	0.22
July	0	17	0.00	0.13	0	33	0	0.13
August	8	17	0.07	0.29	8	17	0.10	0.38
September	8	17	0.03	0.27	8	17	0.05	0.38
October	0	17	0.00	0.14	0	25	0	0.17
Average	6	17	0.05	0.19	6	21	0.06	0.25
After harvest								
November	0	8	0	0.07	0	17	0	0.07
December	0	0	0	0	0	17	0	0.04
January	0	0	0	0	0	0	0	0
February	0	0	0	0	0	8	0	0.03
March	0	0	0	0	0	8	0	0.11
April	17	0	0.02	0	17	8	0.02	0.14
May	8	0	0.03	0	8	17	0.04	0.06
June	17	0	0.03	0	17	17	0.03	0.07
July	8	8	0.01	0.01	8	17	0.01	0.07
August	0	8	0	0.01	0	25	0	0.03
September	0	0	0	0	0	8	0	0.06
Average	5	2	0.01	0.01	5	13	0.01	0.06

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A14. Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Soybean Price Forecasts, 1995/96-2006/07 Marketing Years.

	Histogram Intervals				Kernel Density Intervals				Logistic Distribution Intervals			
Month	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest												
May	0	25	0.00	0.70	0	17	0.00	0.90	0	25	0.00	0.62
June	0	25	0.00	0.68	0	17	0.00	0.92	0	17	0.00	0.93
July	0	33	0.00	0.61	0	17	0.00	1.00	0	25	0.00	0.72
August	0	33	0.00	0.68	0	25	0.00	0.68	0	25	0.00	0.79
September	0	33	0.00	0.61	0	25	0.00	0.61	0	25	0.00	0.69
October	0	33	0.00	0.32	0	25	0.00	0.29	0	25	0.00	0.33
Average	0	31	0.00	0.60	0	21	0.00	0.73	0	24	0.00	0.68
After harvest												
November	0	17	0.00	0.31	0	8	0.00	0.12	0	17	0.00	0.15
December	0	17	0.00	0.40	0	17	0.00	0.16	0	17	0.00	0.25
January	8	17	0.06	0.28	0	8	0.00	0.24	0	17	0.00	0.20
February	8	17	0.01	0.26	0	8	0.00	0.30	0	8	0.00	0.36
March	0	17	0.00	0.19	0	8	0.00	0.23	0	8	0.00	0.28
April	17	17	0.09	0.11	8	8	0.13	0.15	8	17	0.10	0.08
May	17	8	0.12	0.07	8	8	0.20	0.03	8	17	0.16	0.04
June	8	17	0.25	0.03	8	8	0.22	0.02	8	17	0.19	0.03
July	25	8	0.07	0.02	8	8	0.16	0.01	8	17	0.15	0.02
August	25	0	0.04	0.00	25	0	0.03	0.00	17	8	0.03	0.01
September	25	8	0.01	0.01	17	0	0.01	0.00	0	25	0.00	0.01
Average	12	13	0.06	0.15	7	8	0.07	0.11	5	15	0.06	0.13

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A14 (continued). Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Soybean Price Forecasts, 1995/96-2006/07 Marketing Years.

	Quantile Regression Intervals				Quantile Regression with Stocks/Use Intervals			
Month	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest								
May	0	25	0.00	0.66	0	25	0.00	0.68
June	0	25	0.00	0.70	0	25	0.00	0.73
July	0	25	0.00	0.73	0	25	0.00	0.74
August	0	25	0.00	0.62	0	25	0.00	0.64
September	0	25	0.00	0.51	0	25	0.00	0.53
October	0	25	0.00	0.26	0	25	0.00	0.28
Average	0	25	0.00	0.58	0	25	0.00	0.60
After harvest								
November	0	17	0.00	0.08	0	17	0.00	0.18
December	0	8	0.00	0.23	8	17	0.02	0.20
January	0	8	0.00	0.16	8	17	0.03	0.11
February	0	8	0.00	0.25	0	8	0.00	0.25
March	0	8	0.00	0.17	0	8	0.00	0.17
April	8	8	0.05	0.08	8	8	0.04	0.08
May	8	0	0.18	0.00	8	0	0.16	0.00
June	8	0	0.23	0.00	8	0	0.20	0.00
July	25	0	0.10	0.00	8	8	0.13	0.01
August	33	0	0.04	0.00	0	8	0.00	0.01
September	8	17	0.01	0.02	0	42	0.00	0.05
Average	8	7	0.06	0.09	5	12	0.05	0.10

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.

Table A15. Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Wheat Price Forecasts, 1995/96-2006/07 Marketing Years.

Month	Histogram Intervals				Kernel Density Intervals				Logistic Distribution Intervals			
	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest												
May	25	25	0.28	0.45	25	25	0.09	0.27	25	25	0.08	0.46
June	33	25	0.12	0.34	8	25	0.04	0.23	17	25	0.05	0.35
July	17	25	0.08	0.27	0	25	0.00	0.23	0	33	0.00	0.24
Average	25	25	0.16	0.35	11	25	0.04	0.24	14	28	0.04	0.35
After harvest												
August	0	8	0.00	0.41	0	8	0.00	0.17	0	8	0.00	0.29
September	0	8	0.00	0.23	0	8	0.00	0.06	0	8	0.00	0.13
October	0	8	0.00	0.02	0	0	0.00	0.00	0	0	0.00	0.00
November	8	0	0.03	0.00	0	0	0.00	0.00	8	0	0.01	0.00
December	17	0	0.06	0.00	17	0	0.03	0.00	17	0	0.05	0.00
January	0	8	0.00	0.04	0	0	0.00	0.00	0	0	0.00	0.00
February	8	0	0.01	0.00	0	0	0.00	0.00	0	0	0.00	0.00
March	17	0	0.01	0.00	0	0	0.00	0.00	0	0	0.00	0.00
April	17	0	0.01	0.00	8	0	0.01	0.00	0	0	0.00	0.00
May	8	0	0.01	0.00	0	0	0.00	0.00	0	0	0.00	0.00
June	8	0	0.01	0.00	0	0	0.00	0.00	0	0	0.00	0.00
Average	8	3	0.01	0.06	2	2	0.00	0.02	2	2	0.01	0.04

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fel

Table A15 (continued). Additional Accuracy Statistics for Empirical Confidence Intervals for WASDE Wheat Price Forecasts, 1995/96-2006/07 Marketing Years.

	Quantile Regression Intervals				Quantile Regression with Stocks/Use Intervals			
Month	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)	Misses Below (%)	Misses Above (%)	Avg. Miss Below ($/bu.)	Avg. Miss Above ($/bu.)
Prior to harvest								
May	25	25	0.14	0.29	25	25	0.10	0.29
June	25	25	0.11	0.24	33	25	0.06	0.24
July	0	25	0.00	0.18	0	25	0.00	0.18
Average	17	25	0.08	0.24	19	25	0.05	0.24
After harvest								
August	0	8	0.00	0.21	0	8	0.00	0.19
September	0	8	0.00	0.06	0	8	0.00	0.08
October	0	0	0.00	0.00	0	0	0.00	0.00
November	8	0	0.03	0.00	8	0	0.02	0.00
December	17	0	0.05	0.00	17	0	0.05	0.00
January	0	0	0.00	0.00	8	0	0.01	0.00
February	8	0	0.01	0.00	8	0	0.02	0.00
March	8	0	0.01	0.00	8	0	0.01	0.00
April	8	0	0.01	0.00	8	0	0.01	0.00
May	0	0	0.00	0.00	0	0	0.00	0.00
June	0	0	0.00	0.00	0	0	0.00	0.00
Average	5	2	0.01	0.02	5	2	0.01	0.02

Note: Empirical price forecast intervals were calculated using percentage errors from the 1980/81 marketing year forward. Misses above and below describe cases when the final estimate fell above or below the forecast interval.