Forecasting Crop Basis: Practical Alternatives

by

Kevin C. Dhuyvetter and Terry L. Kastens

Forecasting Crop Basis: Practical Alternatives

Kevin C. Dhuyvetter and Terry L. Kastens[1]

Being able to predict basis is critical for making marketing and management decisions. Basis forecasts can be used along with futures prices to provide cash price projections. Additionally, basis forecasts are needed to evaluate hedging opportunities. Many studies have examined factors affecting basis but few have explicitly examined the ability to forecast basis. Studies have shown basis forecasts based on simple historical averages compare favorable with more complex forecasting models. However, these studies have typically considered only a 3-year historical average for forecasting basis. This research compares practical methods of forecasting basis for wheat, corn, milo (grain sorghum), and soybeans in Kansas. Absolute basis forecast errors vary seasonally for all crops and are highest at critical production time periods. Thus, producers need to realize that in addition to increased price variability during these time periods there is also significantly more basis forecasting risk. Using an historical 4-year average to forecast basis for wheat was the optimal number of years. For corn, milo, and soybeans a longer-term average (5-7 years) was optimal. Incorporating current market information, such as futures price spreads or current nearby basis, into a basis forecast improves the ability to forecast basis 4-12 weeks in advance but for longer time horizons simple historical averages are better.

Introduction

Changes in farm policy have increased producers production flexibility, which requires them to make management decisions based on market conditions. While this flexibility gives producers more opportunities, it also increases their risk and requires them to make production and marketing decisions based more on price forecasts than in the past. The question that arises is, Where do producers get these price forecasts?

There has been considerable debate as to whether or not producers can enhance income by using systematic crop marketing strategies involving the futures and options markets. Zulauf and Irwin conclude that marketing strategies offer little hope of increasing returns over simply selling at harvest. They suggest that, because futures are efficient, the futures market should be used as a source of information rather than as a trading medium. If the current futures market price reflects all information in past prices, it is defined as being weak-form efficient (Fama). Tomek suggests that futures markets are weak-form efficient, implying that other publicly available price forecasts cannot outperform the futures market forecast. He concludes that futures prices can be viewed as forecasts and that structural or time-series econometric models cannot improve on the futures market forecast. Brorsen and Irwin suggest that, rather than forecasting prices, extension economists should rely on the futures market to provide the price forecasts needed in outlook programs.

---

[1] The authors are extension agricultural economist and assistant professor, respectively, Department of Agricultural Economics, Kansas State University.

Several studies have found that producers' price expectations are consistent with futures prices (Eales, et al. and Kenyon). Further, producers have indicated they use the futures market as one of their primary sources of information in forming price expectations to make production and precise buy/sell timing decisions, (Schroeder et al.). However, producers also indicated they used extension outlook meetings for price forecasts. A disadvantage of relying on extension outlook meetings is that the price forecasts may not be timely or location- specific enough to meet the needs of producers. Futures market forecasts, on the other hand, are readily available every day and can be used for any location. Thus, it is appropriate to encourage producers to utilize futures market price forecasts as this is consistent with much of the published research and because they are readily available at a minimal cost.

When producers use the futures market for price forecasts they need to localize the futures price by incorporating an expectation for basis. For that matter, whether producers use the futures market for cash price forecasts or for hedging, the ability to accurately forecast basis is critical. Basis forecasts can be potentially valuable for marketing decisions as they support hedging decisions (Tomek). Numerous people have pointed out that the ability to predict basis is important when hedging (e.g., Hauser, Garcia, and Tumblin; Kenyon and Kingsley; Naik and Leuthold; Tomek). Despite that, in the related futures efficiency debate, basis procedures rarely garner more than cursory footnotes. Typically, basis forecasts are based on simple time series or naive models (i.e., expected basis is assumed to be historical basis). Nonetheless, especially complex models for forecasting basis are probably not relevant for producers, as producers must be able to constantly and quickly translate futures prices to cash price expectations. Structural models requiring ancillary forecasts of explanatory variables are of little value to producers needing to make production decisions based on price forecasts with limited information available. Thus, research designed to improve the efficiency of cash price forecasting with futures prices should focus on simple basis models — especially those that are alternative renditions and extensions of "historical basis is expected basis" models.

The objectives of this research involve comparing practical alternatives for forecasting wheat, corn, milo (grain sorghum), and soybean basis that exist for Kansas producers. Practical alternatives refer to methods of forecasting basis that producers could use with information and methodologies that are readily available to them. Specifically, the first objective of this study is to determine if the number of years used for historical average basis forecasts is important. For example, Is 3-year- or 5-year-average historical basis more accurate as a predictor of future basis? A disadvantage of using historical basis to forecast future basis levels is that current market information is not considered (Jiang and Hayenga). It is hypothesized that incorporating current market information into a basis forecast may improve forecasting accuracy. Thus, a second objective is to determine if the accuracy of basis forecasts can be improved by including additional information. Specifically, Does incorporation of current market information (nearby basis or futures prices) improve basis forecasts? A third objective of this study is to determine if the ability to forecast basis varies by location, crop, and time of year. This could be especially important for those in extension outlook, who must routinely reach a wide audience with their programs. By answering these questions, recommendations can be made to producers regarding basis models that are based on statistically tested basis forecasting methods. Additionally, helping producers forecast basis so they can use the futures market to obtain price forecasts is consistent with the vast amount of research indicating grain futures are efficient.

Background

A number of studies have been conducted examining factors that affect grain basis (e.g., Garcia and Good; Kahl and Curtis; Martin, Groenewegen, and Pidgeon; Tilley and Campbell). These studies generally build on the theory of storage as outlined by Working and include fundamental supply and demand factors. Even though these studies examined factors affecting basis, none of them explicitly examined the ability to forecast basis. While understanding and predicting basis is considered to be important for hedging or using the futures market for price forecasts, there are relatively few studies examining methods of forecasting basis (Jiang and Hayenga; Tomek).

Jiang and Hayenga compared ten different basis forecasting models for corn and soybeans at various locations in the U.S. Of their ten forecasting models, only one, a simple 3-year historical average, could readily be used by most producers given their informational and statistical limitations. However, based on root mean squared errors (RMSE) the 3-year average forecast method compared favorably to the more complex forecasting methods for corn basis. For soybean basis, the best forecasting method was the 3-year average plus method which incorporated current supply and demand information into the forecast. A seasonal ARIMA model was the second best method and the simple 3-year average forecast was the third best method based on their RMSE criterion. They concluded that forecasting basis using a simple 3-year average method can be outperformed by alternative models, however, they also pointed out that the simple historical average method provided a reasonably good forecast.

Hauser, Garcia, and Tumblin compared five different methods of forecasting soybean basis at ten locations in Illinois. They considered a naive forecast, i.e., expected basis is current basis, forecasts based on the previous year and a 3-year historical average, and an implied basis using the price spread between futures contracts (they used two renditions of this approach). These methods are attractive from a producers standpoint as they are relatively easy to compute and use information that is available at low cost. They also considered regression models that were more "sophisticated" (see Garcia, Hauser, and Tumblin) but concluded the simpler models provided the best basis forecasts. They found that forecasting basis using observable futures price spreads worked well for certain time periods, however, the time horizons in their basis forecasts were relatively short (30 to 60 days). Naik and Leuthold concluded that predicting expected maturity basis one month ahead of the maturity period was possible using current information but the basis predictive ability decreases as the time period increased.

Kenyon and Kingsley compared basis forecasts from a simple 3-year historical average and regression models for corn and soybeans in Virginia. Their regression model predicted a change in basis as a function of the initial basis. They concluded that using regression analysis to predict harvest basis was superior to using an historical average to predict basis. However, their regression equation included variables for delivery point cash price and residual of open interest which may not be readily available to producers. Even if these variables are readily available, the regression approach requires producers to use a statistical technique they may not be familiar with or able to update from year to year.

Our research builds on the work of Hauser, Garcia, and Tumblin; Jiang and Hayenga; and Kenyon and Kingsley. We use out-of-sample forecast accuracy to compare alternative pragmatic models for forecasting basis. Wheat, corn, milo, and soybean basis are forecasted across various time horizons using models based on; (1) alternative historical averages (different numbers of years), (2) current market information, and (3) historical average plus current market information. All forecasting methods rely on data that are readily available to producers and analysis methods that are easily understood by producers. Because local supply and demand conditions vary by crop and location, multiple locations in Kansas are considered for each crop.

Basis Forecast Models

Ten methods are used to forecast basis for wheat, corn, milo, and soybeans for each week of the year. This study consistently uses basis to mean nearby basis, where nearby denotes the futures contract closest to delivery, only avoiding the delivery month. For example, although December corn futures trade, the corn basis observed in December is cash price in December less March corn futures price on the same day. This distinction of nearby is consistent with grain elevators that do not price delivery-month cash prices off of the delivery contract, rather they step out one contract. The first seven forecast methods (*METHOD1 - METHOD7*) are based on historical averages and are given as:

$$\hat{Basis}_{k,j,t,i} = \frac{1}{i} \sum_{t-i}^{t-1} Basis_{k,j,i} \tag{1}$$

where $\hat{Basis}$ represents the nearby basis forecast, *Basis* is observed basis, *k* refers to location, *j* refers to week of the year, *t* refers to year (1992 through 1997), and *i* refers to the number of years included in the historical average (1 through 7). There is no subscript indicating the time horizon over which the basis forecast is made since the forecast for a particular week is the same regardless of when the forecast is made. Previous studies considering historical averages as basis forecasts generally use a 3- or 5-year average. Historical averages up to seven years were used to determine if a longer term average is superior. To maintain as many out-of-sample forecasts as possible, seven years of historical data was the maximum considered.

The eighth method (*METHOD8*) for forecasting basis follows the approach given by Hauser, Garcia, and Tumblin, where futures price spreads are used to calculate a return to storage which gives an implied basis through an expected future cash price. The potential advantage of this method over an historical average is that it incorporates current market conditions into the basis forecast. This basis forecast, implied from the price spread of two futures contracts, is given by:

$$\hat{Basis}_{k,j,h,t} = (1 + ((F2_{j,t} - F1_{j,t})/F1_{j,t}))^{h/w} * Cash_{k,j-h,t} - Futures_{k,j-h,t} \ , \tag{2}$$

where *F1* refers to the nearby futures contract price, *F2* refers to the deferred futures contract price, *w* refers to the weeks between delivery periods of the nearby and deferred futures contracts, and *h* refers to the time horizon over which the forecast is made (i.e., weeks prior to *j*), *Cash* is the cash price of the commodity, and *Futures* is the relevant nearby futures price.[1]

The ninth method (*METHOD9*) of forecasting nearby basis uses the nearby basis at the time of the forecast as the forecast for future nearby basis. This naive forecast is given as:

$$\hat{Basis}_{k,j,h,t} = Cash_{k,j-h,t} - Futures_{k,j-h,t} \ . \tag{3}$$

The tenth method (*METHOD10*) of forecasting basis uses the 3-year historical average and incorporates current information by including an adjustment for how the current nearby basis deviates from its 3-year historical average. The basis forecast for this method is given by:

$$\hat{Basis}_{k,j,h,t} = \frac{1}{3}\sum_{t-3}^{t-1} Basis_{k,j,t} + (Basis_{k,j-h,t} - \frac{1}{3}\sum_{t-3}^{t-1} Basis_{k,j-h,t}) \tag{4}$$

The ten different basis forecasting methods are summarized in Table

Data and Forecasts Developed

Wednesday prices for wheat, corn, milo, and soybeans at various locations in Kansas (Fig. 1) were collected from the first week of 1982 through the last week of 1997. If a Wednesday happened to fall on a holiday, Thursday prices were collected. The number of locations for each of the commodities were; wheat (23), corn (11), milo (17), and soybeans (13).

---

[1] *F1* is the price of the nearby contract (avoiding delivery month) at the time the forecast is made. *F2* is the price of the deferred contract that will be the nearby contract (without avoiding delivery month) for the time period being forecasted. This rule avoids using the price of a futures contract that can be delivered on at the time the forecast is made while maintaining the relevant deferred futures contract price.

Nearby and deferred futures price data corresponding to the cash price series (Kansas City wheat, Chicago corn, and Chicago soybeans) were also collected, with nearby defined as being the nearest to delivery but not in the delivery month. Deferred futures prices were consistently available up to 11 months prior to the nearby period for corn and soybeans but only eight months prior to the nearby period for wheat. Milo price was converted to dollars per bushel and milo basis was calculated using the corn futures price. Price data were structured on the basis of four weeks per month. If a month had five Wednesdays, the fourth and fifth weeks' prices were averaged and reported as the fourth week of the month. Missing data were extrapolated to ease the computational burden.[2]

Basis forecasts were developed for each commodity at each location for each week of the year. Because the 7-year average method (*METHOD7*) requires seven years of historical data, all out-of-sample forecasts were for weeks in the years 1989-1997. Due to the large volume of data, basis was only forecasted at selected time horizons. Basis was forecasted for each week of the year from a vantage point of 4, 8, 12, 16, 20, 24, 28, and 32 weeks prior for corn, milo, and soybeans. Wheat basis was only forecasted up to 24 weeks prior, in 4-week increments, due to deferred futures prices not being consistently available further out than that. For example, wheat basis the first week of July was forecasted from time horizons of the first week of June (4 weeks prior), the first week of May (8 weeks prior), ... , and the first week of January (24 weeks prior). This procedure was repeated for wheat basis in each week of the year, for each location, and for each forecasting method.

Forecast Evaluation Procedures

A series of forecasts is associated with a series of forecast errors. For evaluation, the information embodied in a forecast error series is routinely condensed into a single test statistic such as the sum of squared errors or mean absolute error so that alternative forecasts can be compared. The problem with this approach is that it is limited to pairwise comparisons. Because of the large number of pairwise comparisons required, it is hard to generalize results. Another way to compare alternative forecasts is to collapse the information contained in a forecast error series into a regression model where forecast error is the dependent variable. In this framework, forecast errors from the competing methods across time and space can be stacked, allowing partial effects of interest to be isolated using the appropriate independent variables. For examples of this method of forecast comparison see Kastens, Jones, and Schroeder; and Kastens, Schroeder, and Plain.

---

[2] Missing data were less than 1% over the entire 1982-1997 time period and were filled in using proportional changes in corresponding nearby futures prices before and after the missing points. For example, if a cash price in week 2 were missing, but weeks 1 and 3 were present, then the cash price was the average: [(week 2 fut/week 1 fut * week 1 cash) + (week 2 fut/week 3 fut * week 3 cash)]/2. If contiguous cash prices were absent, the adjustment process was iterated until convergence within $0.000001.

Producers forecasting basis are likely interested in how precise their forecasts tend to be, thus, the relevant error series is absolute error. Table 2 lists the mean and maximum absolute error for each of the forecasting methods averaged across location, week of the year, forecast time horizon, and year. Because the number of basis forecasts examined in this study was large, absolute errors were aggregated over years and by month and then the forecast error regression model approach was used to generalize results. Aggregating weekly forecast errors into a monthly absolute forecast error still allows one to determine if basis can be forecasted more accurately at certain times of the year so doing this does not diminish results. Likewise, aggregating over out-of-sample years is not a problem as there is no reason to expect that the ability to predict basis from year to year varies in a systematic manner. The regression approach considers that absolute basis forecast errors (AE) are affected by forecast method, forecast horizon, month of the forecast, and location of the forecast:

$$Absolute\ error = f\,(method, horizon, month, location) \tag{5}$$

A goal of this research was to reach general conclusions about alternative basis forecasting methods. The effect of forecast horizon on the accuracy of basis forecasts is expected to vary widely across forecasting methods. For example, basis forecasts from the historical average methods (*METHOD1-7*) are constant across forecast time horizon; whereas, the basis forecasts for *METHOD8, METHOD9*, and *METHOD10* will vary depending on when the forecast is made. Therefore, it is important to specify (5) so the effects of horizon by method on absolute forecast error can be measured. This indicates the need for an interaction term between forecast method and horizon. To account for the possibility of the effect of horizon being nonlinear, a squared term is also included. It is possible that certain forecasting methods might work better at some locations and at certain times of the year relative to other methods indicating the need for interaction terms between method and location and month. However, in order to be able to generalize results, these interaction terms are not considered. The model estimated separately for wheat, corn, milo, and soybeans is:

$$\begin{aligned} AE = \beta_0 &+ \beta_1 METHOD1 + \beta_2 METHOD2 + \beta_3 METHOD4 + \quad + \beta_9 METHOD10 \\ &+ \beta_{10} M8xH + \beta_{11} M9xH + \beta_{12} M10xH \\ &+ \beta_{13} M8xH2 + \beta_{14} M9xH2 + \beta_{15} M10xH2 \\ &+ \beta_{16} LOC1 + \ldots + \beta_{25} LOC10 + \beta_{26} LOC12 + \ldots + \beta_{37} LOC23 \\ &+ \beta_{38} FEB + \ldots + \beta_{48} DEC + \epsilon\ , \end{aligned} \tag{6}$$

where *AE* is the absolute forecast error; *METHOD1 - METHOD10* are binary variables that refer to the different forecasting methods (*METHOD3* is the default); *M8xH, M9xH*, and *M10xH* are interaction terms for methods 8, 9, and 10 and the forecast time horizon; *M8xH2, M9xH2*, and *M10xH2* are interaction terms for methods 8, 9, and 10 and the forecast time horizon squared;

LOC1 - *LOC23* are binary variables that refer to the different locations (*LOC11* is the default); *JAN* - *DEC* are binary variables that refer to the month of the forecast (*JAN* is the default), and ε is an error. *METHOD3* was chosen as the default method because previous research has typically used a 3-year average. *LOC11* was chosen as the default location as it is centrally located within the state and also because cash prices were available for all four commodities at that location.

Results

The grouped by method mean absolute errors reported in Table 2 indicate that the average forecast error is approximately 10 cents for all commodities using the "best" forecasting method.[3] The mean absolute error in cents per bushel for soybeans tended to be the lowest, which is somewhat surprising given that soybean prices are considerably higher than wheat, corn, and milo. However, the maximum error for soybeans was the highest, which indicates that basis forecasts for soybeans were relatively accurate much of the time but when they were wrong they were off substantially. The average absolute error for wheat basis was only slightly higher than for soybeans and the maximum error was considerably less. Averaged across time horizon, the historical average methods with two or more years of data (*METHOD2-7*) generated lower forecast errors than the methods that incorporated current basis or futures information (*METHOD8-10*). Forecasting basis using a futures implied return to storage (*METHOD8*) had the highest absolute error when averaged across time horizon.

Equation (6) was estimated using the PROC MIX procedure in SAS and the results are reported in Table 3.[4] Comparing the historical average methods, the absolute basis forecast error for wheat was slightly lower for *METHOD4* relative to the default method (3-year average), indicating 3 or 4 years of historical data may be sufficient for forecasting basis. Forecast errors were lowest with *METHOD7* for corn and soybeans. Milo basis forecast errors were lowest with the 5-year average. Previous studies using historical average basis as a forecast for corn and soybeans have used a 3-year average (Hauser, Garcia, and Tumblin; Jiang and Hayenga; Kenyon and Kingsley) but these results indicate, that for corn and soybeans in Kansas, a longer time period yields a slightly better basis forecast.

---

[3] The mean absolute difference between futures prices in a given week compared to 32 weeks prior was 56.00, 36.56, and 64.72 cents per bushel for wheat, corn, and soybeans, respectively, confirming that basis levels can be predicted more accurately than price levels.

[4] Groupwise heteroscedasticity was tested using the Lagrange multiplier test (Greene, p.450) which indicated heteroscedasticity existed for the forecast method and time horizon groups for wheat, corn, and soybeans. For milo, groupwise heteroscedasticity existed for forecast method, time horizon, and location. The PROC MIX procedure was used to estimate equation (6) while correcting for this groupwise heteroscedasticity. While parameter estimates are unbiased, because we were unable to satisfactorily correct for other problems, such as dependence of errors within methods or within time periods, standard errors of regression estimates may not be strictly appropriate.

Based on the parameter estimates for the binary variables, the forecast methods incorporating current information (*METHOD8-10*) appear to result in significantly lower forecast errors relative to the 3-year average, however, the forecast time horizon also needs to be considered due to the interaction terms. Figures 2 and 3 show the model estimated absolute forecast errors for these methods compared to the best historical average method for wheat and milo (i.e., 4-year average for wheat and 5-year average for milo).[5] While forecasting methods that incorporate current information have considerably higher absolute forecast errors on average, they do provide superior basis forecasts in the near term. The forecast errors from *METHOD8* (futures price spread implied basis) is relatively accurate, compared to the historical average method, 4 to 12 weeks prior to the forecast period. Beyond a 12 week horizon this method is a poor forecaster of future basis levels, especially so for soybeans (figure not shown). The naive forecast that says the basis in the future will equal today's nearby basis (*METHOD9*) and *METHOD10* (3-year historical average adjusted by current nearby basis) have similar absolute forecast errors. As with *METHOD8*, their accuracy degenerates quite rapidly after about 8-12 weeks relative to the simple historical average method. Of the three methods incorporating current market information into the forecast, using futures price spreads to forecast basis (*METHOD8*) has slightly lower errors at an 8-12 week horizon. However, this method is the most difficult of the three computationally, so producers may feel the simpler methods (*METHOD9* and *METHOD10*) are sufficient. Producers wanting a short term basis forecast can improve on the historical average forecast method by incorporating current market information, however, for longer term forecasts the current market information is not useful. This isn't surprising because, even though futures prices may be unbiased forecasts of future prices, they may be poor forecasts because of the length of time involved. As Tomek states (p. 33), "The best available forecast today can be a poor one." Thus, using a poor price forecast to forecast future basis levels results in a poor basis forecast.

Table 3 shows that a number of the location dummy variables are significant, indicating the relative ability to forecast basis accurately varies across the state. The default location (location 11) is located in central Kansas. There is a tendency for locations in northwest and north central Kansas to have slightly smaller absolute forecast errors for wheat (e.g., *LOC2, LOC3, LOC4, LOC10*, and *LOC19*). This could be a random occurrence as no immediate explanation emerges. Of the locations that had cash prices for all four crops, there was no strong pattern indicating they were consistently better, or worse, than the default location. An exception to this is location 12, located on the eastern border of Kansas, where the absolute forecast errors were significantly higher for all four crops. However, location 20, which was the next furthest east location had forecast errors that were significantly lower than the default location for wheat, corn, and milo, only forecast errors for soybeans were higher. Thus, without further analysis, little conclusions can be reached regarding the location effects on forecast errors.

---

[5] Figures are not shown for corn and soybeans, however, the patterns are similar for these crops.

All monthly dummy variables were significant for all four crops, with the exception of October for wheat, April and November for milo, and March for soybeans, indicating the ability to forecast basis varies seasonally. Figure 4 shows the model estimated absolute forecast errors using the 3-year historical average (*METHOD3*) for each of the crops by month. For all crops, the seasonality that exists for basis predictability is closely related to critical production periods. The basis forecast error for corn is very consistent throughout the year with the exception of July and August when it increases significantly. Soybean forecast errors are greatest in July through September. Wheat forecast errors tend to be the highest in late spring which is consistent with the time when the condition of the crop is most uncertain. As expected, milo follows a very similar pattern to corn, however, it is much less exaggerated in July and August. Of the crops considered, forecast errors for milo are the most stable throughout the year. Kenyon, Jones, and McGuirk suggested that planting time futures prices are poor forecasts of harvest prices so producers should not rely on futures prices to make management decisions at planting unless they simultaneously forward price. While this research does not address the ability of planting time futures to forecast harvest prices, it does indicate that harvest time basis forecasts are more reliable than at other times of the year. Therefore, if producers do simultaneously forward price as recommended by Kenyon, Jones, and McGuirk they can be somewhat assured that their basis risk is relatively low.

Summary and Conclusions

Knowing, understanding, and being able to predict basis is critical for making marketing and management decisions. Basis forecasts can be used along with futures prices to provide future cash price projections. Additionally, basis forecasts are needed to evaluate hedging opportunities. Many studies have examined factors affecting basis but few studies have explicitly examined the ability to forecast basis. Producers typically have limited information available in which to make basis forecasts, so complex econometric structural models for forecasting basis are of little use to them. Additionally, a number of studies have shown that basis forecasts using simple historical averages compare favorably with more complex forecasting models for corn and soybeans. However, these studies have only considered a 3-year average. This research compared the mean absolute forecast error of nearby basis from various practical models that utilize information that is readily available to producers.

The mean absolute forecast error, averaged across all time periods and locations, was lowest for soybeans and highest for milo but the differences among crops were small. The maximum absolute forecast error was highest for soybeans and lowest for wheat. Basis forecast errors were lower than the mean absolute price forecast errors, confirming that basis is easier to predict than prices. The ability to accurately forecast basis varies by location in the state but without further research there is no clear explanation as to what is causing this. Absolute basis forecast errors vary seasonally for all crops and are highest at critical production time periods. Thus, producers need to realize that in addition to increased price variability during these time periods there is also significantly more risk associated with forecasting basis.

The results of this analysis indicate that using a simple 4-year historical average to forecast basis for wheat in Kansas from 1989-1997 was the optimal number of years to include. With corn, milo, and soybeans a longer-term average (5-7 years) was optimal which is a longer term average than typically considered in most research. However, the differences between absolute forecast errors from a 3-year average and longer time periods were relatively small. Incorporating current market information into a basis forecast improves the ability to forecast basis 4-12 weeks in advance but for time horizons longer than that simple historical averages are better. Current information was incorporated using either futures price spreads or current nearby basis. Forecasting basis using the price spread between futures contracts was slightly better than using current nearby basis information but this method is also more difficult computationally. If extension, or some other entity, provides and regularly updates basis forecasts for multiple crops and locations, then it may be appropriate to use more complex structural models to forecast basis. In this case, future research should examine if more complex models can forecast more accurately than the practical models considered here. However, if producers need to update and make their own basis forecasts, pragmatic forecasting models, such as those considered in this research, will continue to be the method of choice.

References

Brorsen, W.B. and S.H. Irwin. "Improving the Relevance of Research on Price Forecasting and Marketing Strategies." *Agricultural and Resource Economics Review*, April 1996, p. 68-75.

Eales, J.S., B.K. Engel, R.J. Hauser, and S.R. Thompson, "Grain Price Expectations of Illinois Farmers and Grain Merchandisers." *American Journal of Agricultural Economics*, 72 (1990): 701-708.

Fama, E. "Efficient Capital Markets: A Review of Theory and Empirical Works." *Journal of Finance,* 25(1970):383-417.

Garcia, P. and D.L. Good. "An Analysis of the Factors Influencing the Illinois Corn Basis, 1971-1981." *NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management*, Ed. M. Hayenga, Ames, Iowa: Iowa State University, Department of Agricultural Economics, 1983, pp. 306-326.

Garcia, P., R. Hauser, and A. Tumblin. "Corn and Soybean Basis Behavior: An Intertemporal, Cross-Sectional Analysis." *NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management*, Ed. M. Hayenga, Ames, Iowa: Iowa State University, Department of Agricultural Economics, 1986, pp. 128-142.

Greene, W.R. *Econometric Analysis*, 2nd ed. Englewood Cliffs, NJ: Prentice Hall, 1993

Hauser, R.J., P. Garcia, and A.D. Tumblin. "Basis Expectations and Soybean Hedging Effectiveness." *North Central Journal of Agricultural Economics*, Vol. 12, No. 1, January 1990. p. 125-136.

Jiang, B. and M. Hayenga. "Corn and Soybean Basis Behavior and Forecasting: Fundamental and Alternative Approaches." *NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management*, Ed. B.W. Brorsen, Stillwater, Oklahoma: Oklahoma State University, Department of Agricultural Economics, 1997, pp. 125-140.

Kahl, K.H. and C.E. Curtis, Jr. "A Comparative Analysis of the Corn Basis in Feed Grain Deficit and Surplus Areas." *Review of Research in Futures Markets*, 5:3(1986):220-232.

Kastens, T.L., R. Jones, and T.C. Schroeder. "Futures-Based Price Forecasts for Agricultural Producers and Businesses." *Journal of Agricultural and Resource Economics* (forthcoming in 1998)

Kastens, T.L., T.C. Schroeder, and R. Plain. "Evaluation of Extension and USDA Price and Production Forecasts." *Journal of Agricultural and Resource Economics* (forthcoming in 1998)

Kenyon, D. "Producer Ability to Forecast Harvest Corn and Soybean Prices." *NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management*, Ed. B.W. Brorsen, Stillwater, Oklahoma: Oklahoma State University, Department of Agricultural Economics, 1997, pp. 285-295.

Kenyon, D. E. Jones, and A. McGuirk. "Forecasting Performance of Corn and Soybean Harvest Futures Contracts." *American Journal of Agricultural Economics*, 75:2(1993):399-407.

Kenyon, D.E. and S.E. Kingsley. "An Analysis of Anticipatory Short Hedging Using Predicted Harvest Basis." *Southern Journal of Agricultural Economics*, 5(1973):199-203.

Martin, L., J.L. Groenewegen, and E. Pidgeon. "Factors Affecting Corn Basis in Southwestern Ontario." *American Journal of Agricultural Economics*, 62:1(1980):107-112.

Naik, G. and R.M. Leuthold. "A Note on the Factors Affecting Corn Basis Relationships." *Southern Journal of Agricultural Economics*, 23:1(1991):147-153.

Schroeder, T.C., J.L. Parcel, T.L. Kastens, and K.C. Dhuyvetter. "Perceptions of Marketing Strategies: Producers vs. Extension Economists." *Journal of Agricultural and Resource Economics* (forthcoming in 1998)

Tilley, D.S. and S.K. Campbell. "Performance of the Weekly Gulf-Kansas City Hard-Red Winter Wheat Basis." *American Journal of Agricultural Economics*, 70:4(1988):929-935.

Tomek, W.G. "Commodity Futures Prices as Forecasts." *Review of Agricultural Economics*, Vol. 19, No. 1, Spring/Summer 1997. p. 23-44.

Working, H. "The Theory of the Price of Storage." *American Economic Review*, 39(1949):1254-1262.

Zulauf, C.R. and S.H. Irwin. "Market Efficiency and Marketing to Enhance Income of Crop Producers." *NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management*, Ed. B.W. Brorsen, Stillwater, Oklahoma: Oklahoma State University, Department of Agricultural Economics, 1997, pp. 1-25.

Table 1. Definition of Basis Forecasting Methods

Method	Description of forecast in time period j
METHOD1	Equal to last years basis in time period j
METHOD2	Equal to average of last 2 years basis in time period j
METHOD3	Equal to average of last 3 years basis in time period j
METHOD4	Equal to average of last 4 years basis in time period j
METHOD5	Equal to average of last 5 years basis in time period j
METHOD6	Equal to average of last 6 years basis in time period j
METHOD7	Equal to average of last 7 years basis in time period j
METHOD8	Calculated using current cash price adjusted for return to storage implied
METHOD9	Equal to current nearby basis in time period $j - h$[a]
METHOD10	Equal to average of last 3 years basis in time period j plus deviation in

[a] Refers to the time horizon over which the forecast is being made. Forecast horizons considered are in 4 week increments from 4 to 32 weeks prior to time period j for corn, milo, and soybeans. Forecasts for wheat are made up to 24 weeks in advance.

Table 2. Mean Absolute Errors for Alternative Basis Forecasting Methods.[a]

	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.
	Wheat (23 locations)		Corn (11 locations)		Milo (17 locations)		Soybeans (13 locations)	
METHOD1	13.32	82.00	12.91	147.00	13.08	109.40	12.46	146.50
METHOD2	11.78	64.75	11.23	130.88	12.31	98.74	10.77	148.38
METHOD3	10.21	64.62	11.14	135.33	11.71	97.45	10.43	140.50
METHOD4	10.07	69.28	11.28	135.31	11.51	96.85	10.40	138.63
METHOD5	10.70	68.92	10.97	134.00	10.79	90.86	9.87	138.80
METHOD6	10.67	68.39	10.72	135.13	10.85	95.98	9.62	135.63
METHOD7	10.65	71.35	10.59	135.29	11.15	93.56	9.45	136.21
METHOD8	14.67	125.10	18.82	232.32	16.88	207.83	40.47	510.67
METHOD9	12.13	85.87	12.69	146.50	11.24	157.83	11.50	153.00
METHOD10	11.53	84.93	13.04	145.94	11.68	164.20	12.43	154.50

[a] Means are across location, week of the year, forecast horizon, and year. Numbers of observations in means are wheat 59,616; corn 38,016; milo 58,752; and soybeans 44,928.

Table 3. Parameter Estimates for Determinants of Absolute Errors Associated with Basis Forecast Models for Wheat, Corn, Milo, and Soybeans (1989-1997).[a]

Estimate	Wheat	Corn	Milo	Soybeans
INTERCEPT	10.7142*	7.6923*	10.4352*	7.6841*
	(0.0674)	(0.1136)	(0.0772)	(0.1060)
Forecast method dummy variables: default is 3-year historical average				
METHOD1	3.1158*	1.7725*	1.2496*	2.0242*
	(0.0619)	(0.1429)	(0.0717)	(0.1027)
METHOD2	1.5796*	0.0922	0.5695*	0.3370*
	(0.0440)	(0.0901)	(0.0552)	(0.0790)
METHOD4	-0.1330*	0.1366	-0.2035*	-0.0300
	(0.0373)	(0.0844)	(0.0479)	(0.0711)
METHOD5	0.4932*	-0.1743	-0.9623*	-0.5581*
	(0.0343)	(0.0790)	(0.0462)	(0.0700)
METHOD6	0.4682*	-0.4225*	-0.9235*	-0.8157*
	(0.0376)	(0.0781)	(0.0485)	(0.0723)
METHOD7	0.4469*	-0.5450*	-0.6889*	-0.9838*
	(0.0383)	(0.0780)	(0.0489)	(0.0716)
METHOD8	-2.8160*	-1.3606	-4.3579*	1.7001*
	(0.5411)	(0.7829)	(0.3424)	(0.6276)
METHOD9	-4.0615*	-5.8448*	-6.8286*	-2.9597*
	(0.4363)	(0.6365)	(0.2153)	(0.3541)
METHOD10	-4.3757*	-5.9186*	-6.4054*	-1.9983*
	(0.4104)	(0.5723)	(0.2435)	(0.3390)
Forecast method horizon interactions				
M8xH	0.0376	-0.4442*	-0.1765*	-1.3334*
	(0.1065)	(0.1099)	(0.0539)	(0.1325)
M9xH	0.5829*	0.7282*	0.5378*	0.3771*
	(0.0743)	(0.0856)	(0.0309)	(0.0446)
M10xH0	0.5915*	0.7780*	0.5571*	0.3852*
	(0.0716)	(0.0821)	(0.0345)	(0.0444)
M8xH2	0.0272*	0.0409*	0.0302*	0.1259*
	(0.0045)	(0.0034)	(0.0018)	(0.0055)
M9xH2	-0.0090*	-0.0142*	-0.0091*	-0.0071*
	(0.0026)	(0.0024)	(0.0009)	(0.0012)
M10xH2	-0.0091*	-0.0150*	-0.0096*	-0.0070*
	(0.0025)	(0.0023)	(0.0010)	(0.0012)

[a] Significance at the 0.01 level denoted by *. Standard errors are in parentheses.

Table 3. (continued)

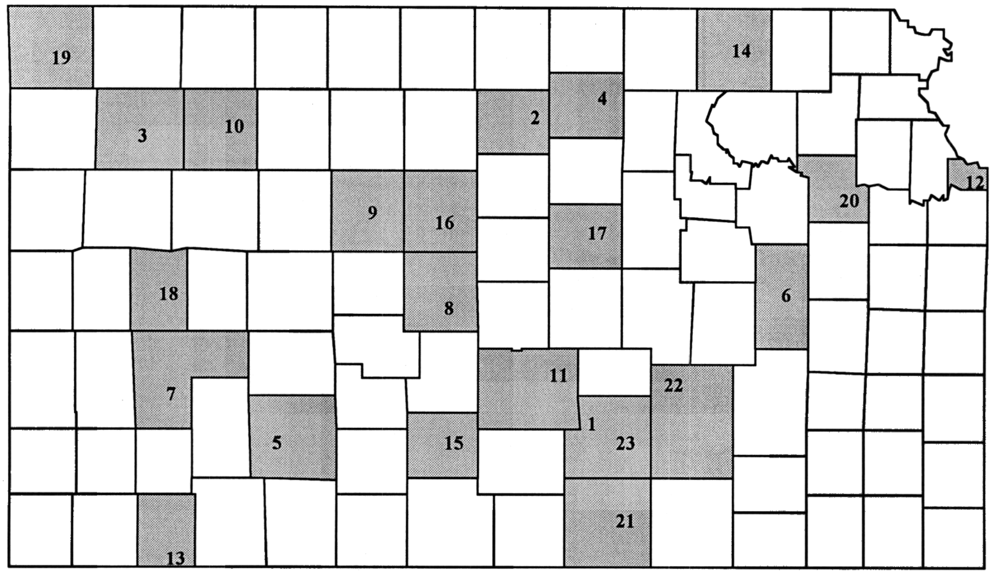
Estimate	Wheat	Corn	Milo	Soybean
Location dummy variables: default is location 11				
LOC1	-0.0212		1.4530*	0.2125
	(0.0740)		(0.0721)	(0.0988)
LOC2	-1.3331*		0.5812*	0.0902
	(0.0740)		(0.0713)	(0.0988)
LOC3	-2.6506*	-0.0233	0.2447	4.7638*
	(0.0740)	(0.0966)	(0.1114)	(0.0988)
LOC4	-1.4324*			
	(0.0740)			
LOC5	-0.3950*	1.2898*	0.3703*	-0.0550
	(0.0740)	(0.0966)	(0.0672)	(0.0988)
LOC6	-1.4874*	0.4405*	-0.6334*	0.7486*
	(0.0740)	(0.0966)	(0.0817)	(0.0988)
LOC7	-0.6137*	0.6676*	1.6750*	-0.2674*
	(0.0740)	(0.0966)	(0.0661)	(0.0988)
LOC8	-0.4625*	-1.8817*	0.3930*	1.4913*
	(0.0740)	(0.0966)	(0.0733)	(0.0988)
LOC9	-0.8785*		1.6366*	
	(0.0740)		(0.0781)	
LOC10	-1.5683*			
	(0.0740)			
LOC12	0.5756*	3.5034*	0.2376*	0.4357*
	(0.0740)	(0.0966)	(0.0830)	(0.0988)
LOC13	-0.3883*		1.0187*	
	(0.0740)		(0.0780)	
LOC14	1.3297*			
	(0.0740)			
LOC15	0.0261	-0.1587	1.3213*	-0.4105*
	(0.0740)	(0.0966)	(0.0786)	(0.0988)
LOC16	-0.5326*			
	(0.0740)			
LOC17	0.2063*		7.5622*	
	(0.0740)		(0.1769)	
LOC18	-1.2415*	0.2598*	0.4328*	-0.2923*
	(0.0740)	(0.0966)	(0.0718)	(0.0988)
LOC19	-1.4802*			
	(0.0740)			
LOC20	-1.4792*	-1.0354*	-0.8588*	1.1026*
	(0.0740)	(0.0966)	(0.0714)	(0.0988)
LOC21	-0.3613*			
	(0.0740)			
LOC22	0.3073*	0.4410*	1.7123*	0.9781*
	(0.0740)	(0.0966)	(0.0698)	(0.0988)
LOC23	-0.2982*		1.4737*	
	(0.0740)		(0.0736)	

[a] Significance at the 0.01 level denoted by *. Standard errors are in parentheses.

Table 3. (continued)

Estimate	Wheat	Corn	Milo	Soybean
Month dummy variables: default is January				
FEB	-3.3398*	0.7084*	-0.6897*	-1.3377*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
MAR	2.8713*	1.7250*	-0.4337*	-0.1990
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
APR	1.3410*	1.4955*	-0.1107	0.5997*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
MAY	2.6841*	1.6685*	-0.9208*	3.2034*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
JUN	-1.7423*	1.9013*	-0.4485*	2.1160*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
JUL	-0.7782*	12.3235*	3.7313*	7.4893*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
AUG	-2.4460*	12.6429*	1.5907*	7.3587*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
SEP	0.4443*	2.5183*	0.9445*	5.1579*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
OCT	0.0545	1.2126*	-1.1319*	0.4998*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
NOV	-1.8255*	0.9897*	0.1452	0.4790*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
DEC	4.0248*	0.3635*	-0.4019*	-0.5181*
	(0.0535)	(0.1009)	(0.0579)	(0.0950)
No. of obs.	16,560	10,560	16,320	12,480
Mean of dep. var. (MAE)	11.5730	12.3390	12.1209	13.7392
R^2	0.4378	0.6464	0.6035	0.7340

[a] Significance at the 0.01 level denoted by *. Standard errors are in parentheses.



Wheat: All locations

Corn: 3,5,6,7,8,11,12,15,18,20,22

Milo: 1,2,3,5,6,7,8,9,11,12,13,15,17,18,20,22,23

Soybean: 1,2,3,5,6,7,8,11,12,15,18,20,22

Figure 1. Cash price locations for wheat, corn, milo, and soybeans, Kansas.

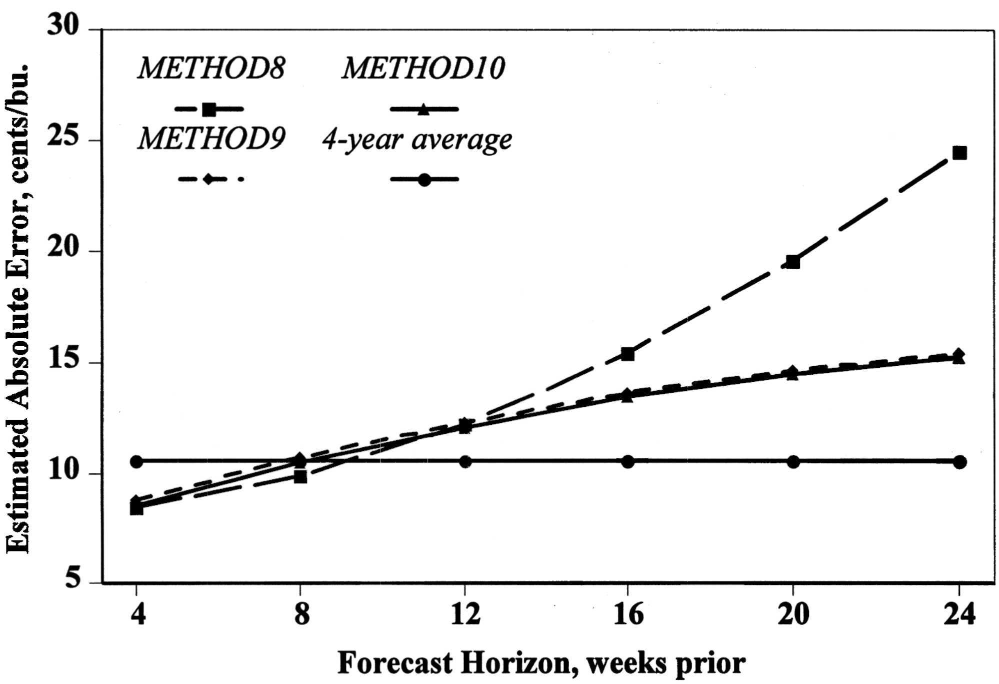


Figure 2. Model estimated absolute basis forecast errors for wheat in January in Hutchinson, Kansas (location 11).

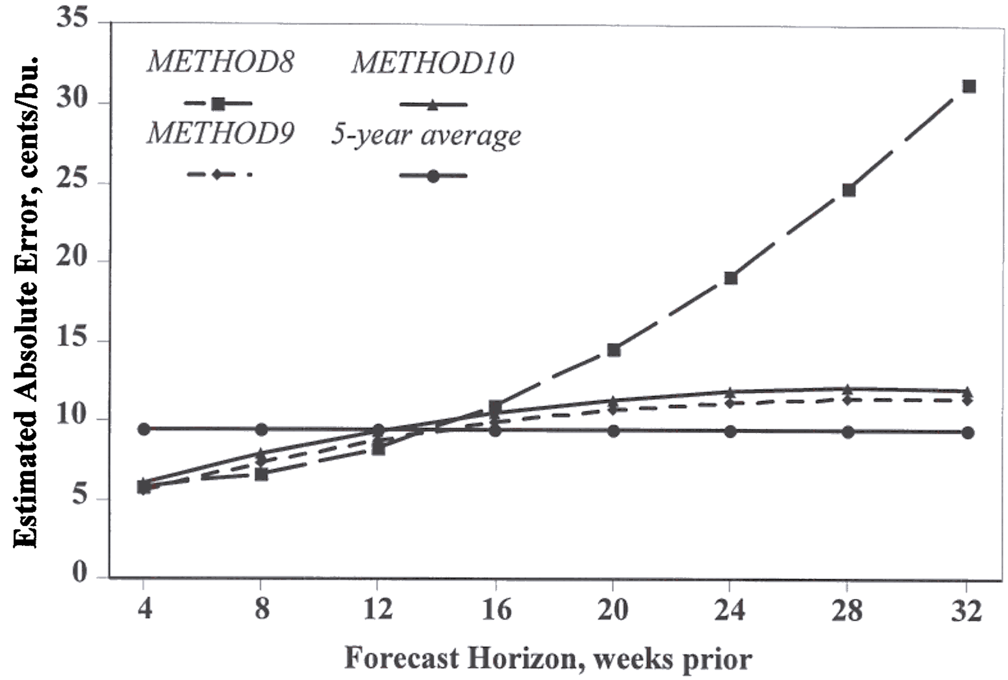


Figure 3. Model estimated absolute basis forecast errors for milo in January in Hutchinson, Kansas (location 11).

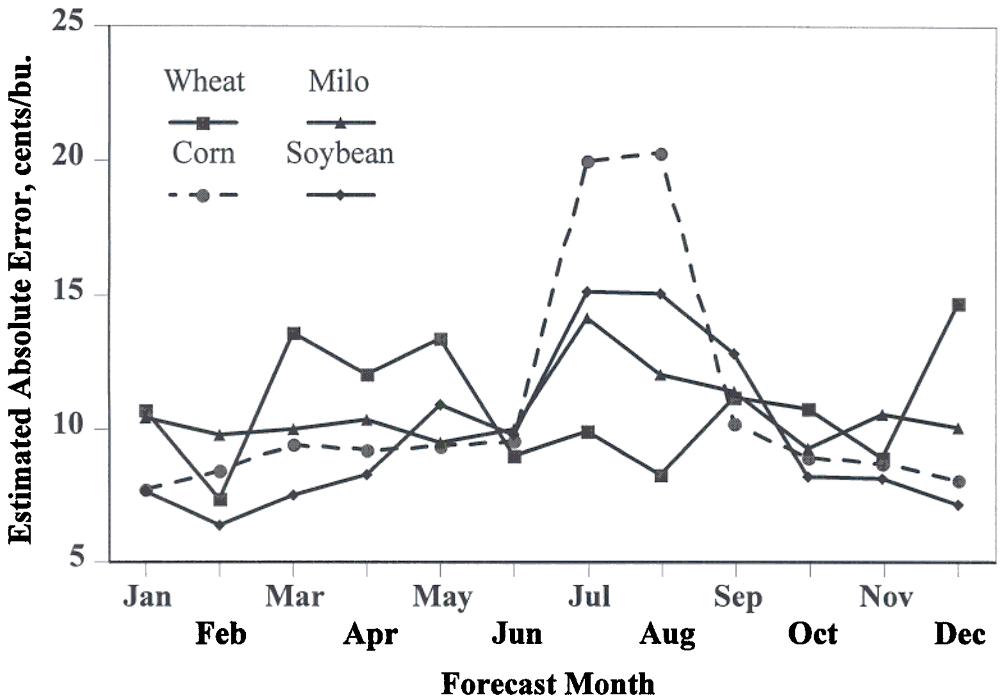


Figure 4. Model (3-year average) estimated absolute basis forecast errors in Huchinson, Kansas (location 11).