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Improving Cattle Basis Forecasting

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Successful risk management strategies for agribusiness firms based on futures and options contracts are contingent on their ability to accurately forecast basis. This research addresses three primary questions as they relate to basis forecasting accuracy: (*a*) What is the impact of adopting a time-to-expiration approach, as compared to the more common calendar-date approach? (*b*) What is the optimal number of years to include in calculations when forecasting livestock basis using historical averages? and (*c*) What is the effect of incorporating current basis information into a historical-average-based forecast? Results indicate that use of the time-to-expiration approach has little impact on forecast accuracy compared to using a simple calendar approach, but forecast accuracy is improved by incorporating at least a portion of current basis information into basis forecasts.

Key words: basis, basis forecasts, cattle prices, current information, hedging

Introduction

The profitability of an agribusiness can be heavily influenced by the timing of when it chooses to price its livestock, or alternatively to purchase its future livestock inventories. Past research suggests returns can be increased and price risk reduced if the futures market is used to hedge sales and purchases of livestock (Schroeder et al., 1989; Kenyon and Clay, 1987; Brandt, 1985; Hayenga et al., 1984; Gorman et al., 1982). Successful hedging requires that hedgers be able to accurately predict basis (difference between the futures market price and the cash market price) at the outset of a hedge (Kastens, Jones, and Schroeder, 1998; Schroeder et al., 1998; Tomek, 1997; Paroush and Wolf, 1989; Brandt, 1985). Specifically, at the time a hedge is initiated, hedgers need to predict within an acceptable range what the basis will be when the cash sale, or purchase, is made and the futures position is offset.

Cash prices and futures prices should converge on the expiration date of the futures contract at the delivery point specified in a given futures contract (Tomek, 1997). However, hedgers are often interested in forecasting basis prior to the delivery period at locations other than delivery points specified in the futures contract, because they plan to sell or buy livestock at a place other than a delivery point. A typical approach to forecasting basis is to average historical basis levels across years for a given calendar date (Dhuyvetter and Kastens, 1998; Hayenga et al., 1984). But this technique fails to account for changes in the days to contract expiration for a given calendar date across

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years, thus masking convergence and potentially reducing basis forecast accuracy. Consequently, to capture the convergence effect when averaging historical basis, it may be important to account for the days remaining until futures contract expiration.

For a better understanding, consider the statement that "feeder cattle basis for the week ending August 12th is expected to be -$3/cwt," where the basis forecast is based on a multi-year average for the week ending August 12th. However, the number of days between "the week of August 12th" and the expiration date of the nearby (August) futures contract varies from year to year. Therefore, it may be more appropriate to use a time-to-expiration technique when making basis predictions using historical multi-year averages. Differences in the time-to-expiration and calendar techniques also arise because, across years, calendar-date basis forecasts are sometimes generated using basis calculations from different futures contracts—i.e., the calendar date of expiration for a given contract varies from year to year, and thus the nearby futures contract in a particular week for a given year may be different from that same week in a previous year. In contrast, a weeks-to-expiration technique always uses the same futures contract to compute basis. Consequently, the weeks-to-expiration technique could potentially improve basis forecasting accuracy compared to the calendar-date technique.

The use of multi-year averages in formulating basis forecasts is a common practice (Jiang and Hayenga, 1997; Dhuyvetter and Kastens, 1998). To evaluate the forecast accuracy of the calendar versus the time-to-expiration technique, a specific number of years to include in the historical-average-based forecast must be chosen so the two techniques can be compared. This raises the question of what exactly is the "best" number of years to include in the basis forecast. Identifying the optimal number of years to include in multi-year average livestock basis forecasts contributes to the literature about basis because this issue has not been discussed or empirically analyzed in previous research.

Using simple historical averages to develop livestock basis forecasts ignores any additional current information about basis levels. For example, it has been noted by Viswanath (1993), Liu et al. (1994), Tomek (1980), and Jiang and Hayenga (1997) that using current information in forecasts may be beneficial in increasing forecasting accuracy. Based on their evaluation of several different forecasting methods, Liu et al. (1994, p. 271) determined that "short-term dynamics were as important as supply and demand factors in forecasting live cattle basis."

Therefore, we hypothesize that basis forecast accuracy will be enhanced if basis forecasts include information which incorporates the deviation between the current year's basis for the current week and the historical average basis for the same week. Specifically, to improve forecast accuracy, it may be beneficial to "adjust" the historical average to reflect the current basis level (i.e., current market conditions). For further illustration, consider an example where, in addition to knowing the historical average for the forecast week, a hedger knows the current basis is $1/cwt higher than the historical average for this week. Forecast accuracy may be enhanced if forecasts are adjusted by some portion of the deviation in the current basis from its historical level.

There are three main objectives for this study. First, live cattle and feeder cattle basis forecast accuracy are evaluated using forecasts generated by the historical calendar-date technique and forecasts generated by a time-to-futures-contract-expiration technique. Second, the optimal number of years to include in historical multi-year averages for both live cattle and feeder cattle basis forecasts are estimated. Finally, estimates of the optimal amount of current basis information to include in both live cattle and feeder cattle basis forecasts are provided.

Methodology

To address these objectives, cash and futures data series were used to create weekly basis tables for both live cattle and feeder cattle. Out-of-sample absolute basis prediction errors were generated using forecasts incorporating last year's basis and 2- to 5-year averages of prior basis levels, as shown by:

$$(1) \qquad AE_{ijt} = \text{ABS}\left(Basis_{ijt} - \left(\sum_{k=1}^{K} Basis_{ijt-k} \right) / K \right),$$

where AE is the absolute basis prediction error, $Basis$ is cash price minus futures price, ABS is the absolute error command, i differentiates live cattle from feeder cattle, j denotes the year, t denotes week for the calendar method and weeks prior to contract expiration for the time-to-expiration method, and K denotes the number of years used in calculating the historical average basis. This process was repeated for every week for the calendar method tables. For the time-to-expiration method, the process was repeated for each week prior to the expiration of each futures contract in the study time period containing a minimum of five years of data prior to the year for which basis was being forecasted. Sufficient data were available to create absolute basis prediction errors, for both methods, using observations from 1979 to 2002 (24 years) for feeder cattle and from 1981 to 2002 (22 years) for live cattle.

Weeks were defined differently for the calendar and time-to-expiration approaches. For the calendar-based approach, week 1 was defined as the first week of the calendar year that included at least three trading days. Thus, if the first trading day in January fell on either a Thursday or Friday, the following week was defined as week 1. Weeks 2 through 52 were simply the subsequent weeks. Basis calculations made using the time-to-expiration approach required identification of the expiration week for each futures contract for every year. Basis was computed working backwards, sequentially, from the week of expiration until reaching the preceding contract. This process was repeated for every contract month and for each commodity. The difference between the two methods can be summarized as follows: the calendar method defines week 1 of the year and works forward without regard for the contract being used, whereas the time-to-expiration method identifies the actual week of expiration for a specific contract and then works backwards.

The accuracy of making basis forecasts using both the calendar and the time-to-expiration methods was evaluated for a number of different time periods. Because the futures contracts for feeder cattle switched to cash settlement in September of 1986, the entire time period (1979–2002), the physical settlement period, and the cash settlement period were all evaluated separately. Furthermore, the last five years (1998–2002) were examined to see if forecasting accuracy has changed recently, compared to previous time periods.[1] For live cattle, the entire time period (1981–2002) and the last five years

[1] Note that 10 years of data (1993–2002) are needed to analyze the 1998–2002 time period because historical averages of up to five years are considered.

(1998–2002) were compared. Other intermediate time periods were not evaluated for live cattle because the Chicago Mercantile Exchange (CME) live cattle futures contract has not undergone a "structural change" similar to the feeder cattle contract's switch to cash settlement from physical delivery.

Once the basis tables described above were calculated, absolute forecast errors (AEs) were calculated for each forecasting method according to equation (1). Paired t-tests were used to determine whether the differences in absolute errors for the five different multi-year averages (1- to 5-year averages) analyzed within each calculation method were significant. The use of paired t-tests made it possible to determine the optimal number of years to include in basis forecasts.

To test whether the time-to-expiration method was more accurate than the traditional calendar-date approach, the parameters of the model given in (2) were estimated for both feeder cattle and live cattle:[2]

$$(2) \qquad AE = \beta_0 + \beta_1 Year + \beta_2 Technique + \beta_3 5YrAvg + \beta_4 4YrAvg + \beta_5 3YrAvg + \beta_6 2YrAvg + \beta_7 Cash + \beta_8 TechCash + \varepsilon.$$

AE is the absolute forecast error; *Year* is a variable for the calendar year of the forecast; *Technique* is a dummy variable for the technique used (0 if time-to-expiration, and 1 if calendar); *5YrAvg*, *4YrAvg*, *3YrAvg*, and *2YrAvg* are binary variables referring to the different number of years included in the forecast (1-year average is the default); *Cash* is a binary variable for the time period forecasted for feeder cattle (0 denotes physical delivery time period, and 1 denotes cash settlement time period); *TechCash* is an interaction term between *Technique* and *Cash*; and ε is an error term. Given that the live cattle futures are still physically settled, the variables *Cash* and *TechCash* were not included in the live cattle model. Basis predictions made using a time-to-expiration technique are expected to be more accurate than projections made using a calendar-date technique because the time-to-expiration method is not sensitive to year-to-year variation in contract expiration dates and is thus more consistent with basis convergence.

To evaluate the benefit of supplementing historical data with current information, out-of-sample absolute basis prediction errors were generated for both feeder cattle and live cattle basis forecasts based upon the historical average basis for that week, as shown by:

$$(3) \qquad AE_{tk} = \text{ABS}\left[\sum_{t}^{T}\left(Basis_t - \left(HistAvg_t + \left((x) * (Basis_{t-k} - HistAvg_{t-k})\right)\right)\right)\right],$$

where *AE* is the absolute basis prediction error, ABS is the absolute error command, *Basis* is cash price minus futures price, *HistAvg* is the historical average basis (3-year average for feeder cattle and 4-year average for live cattle), x is a variable representing the proportion of the current basis deviation from its historical average included in the forecasts, t denotes the week, and k represents the forecast horizon and is the number of weeks between the date the forecast is made and the week being forecasted ($k = 4, 8, 12, 16, 20$, and 24).[3] This process was repeated for every week and forecast horizon

[2] Similar results were found when this model was estimated separately for each of the different multi-year averages.

[3] These historical average lengths (3-year for feeder cattle and 4-year for live cattle) were chosen as they were found to be optimal over most time periods considered in this analysis.

between 1993 and 2002. Following the creation of these basis tables, the optimal x variable in equation (3) was solved for by minimizing the mean absolute errors over the entire time period, i.e., optimized in-sample. For comparison purposes, forecasts were also examined for values of $x = 0$ (historical) and $x = 1$ (full deviation).[4]

Basis forecasting accuracy was evaluated over different time periods and for different forecast time horizons. The 1993–2002 and 1998–2002 time periods for both commodities were evaluated because they represent the most recent 10 and 5 years of data. Furthermore, the process was repeated for forecasts made 4, 8, 12, 16, 20, and 24 weeks prior to the week being forecasted.

Paired t-tests were used to determine statistically significant differences in AE [equation (3)] of the different models considered and to identify the optimal amount of current information to include in basis forecasts over a variety of time spans. Forecast accuracy is expected to be higher when some proportion of the current basis deviation from historical levels is incorporated into the forecast, as compared to using the simple historical average forecast and ignoring all current-year supplemental information. It is also expected that the value of including current information will decline as the forecast horizon increases in length.

Data

Futures settlement price data were obtained from Bridge Financial Data Center. The data series began on January 4, 1974, and February 28, 1975, for feeder cattle and live cattle, respectively, and continued through December 31, 2002. A nearby futures data series was created for each commodity, where "nearby" denotes the contract closest to expiration. Futures contracts were rolled to subsequent contracts following the last day a contract was traded (i.e., every day that a contract represents the nearby contract, its price is used in calculating the basis).

It is important when calculating basis that cash and futures prices are for consistent time periods. Therefore, Wednesday's nearby contract settlement futures prices were used to compute feeder cattle basis, because the cash price series was from the Dodge City, Kansas, Wednesday feeder cattle auctions. In contrast, live cattle futures settlement prices for a given week were averaged because the cash price series (*Western Kansas Direct Slaughter Steers* price series) was a weekly average. These two cash price series were chosen as representative cash prices because they experienced relatively heavy trade volume over the sample period of this study. Futures contract specifications, specifically par weight, varied over the time period analyzed. Thus, cash data were organized to make the cash data series reflect approximately the same specifications as that of the futures data over the entire time period analyzed (i.e., the cash data series was created to hold the hedge ratios near 1.0 over the time period studied).[5]

A breakdown of how each contract's specifications have changed since inception was obtained from the Chicago Mercantile Exchange. As cautioned by Tomek (1997), some difficulty was experienced in organizing the cash data because of inconsistent livestock

[4] When $x = 0$, the basis forecast collapses to a simple historical average, and when $x = 1$, the forecast incorporates the entire amount of current information.

[5] Additionally, an analysis was conducted using the Dodge City 500–600 cwt price series to compare with the results reported here. As expected (because the hedge ratio was not 1.0), the mean absolute error (MAE) and optimal amounts of current information were both significantly higher when using Dodge City 500–600 cash prices as compared to using the cash series we created. These results are not reported here, but are available from the authors upon request.

Table 1. Parameter Estimates for Determinants of Absolute Errors in Forecasting Basis

	Coefficient Estimates	
Description	Feeder Cattle	Live Cattle
Intercept	2.3250*	1.3601*
	(0.0511)	(0.0312)
Forecasting Methods (default is 1-year average):		
5YrAvg	-0.0656	-0.1257*
	(0.0384)	(0.0326)
4YrAvg	-0.0977*	-0.1414*
	(0.0395)	(0.0332)
3YrAvg	-0.1056*	-0.1242*
	(0.0399)	(0.0327)
2YrAvg	-0.0739*	-0.1089*
	(0.0384)	(0.0340)
Other Explanatory Variables:		
Year	-0.0789*	-0.0044*
	(0.0033)	(0.0015)
Technique	-0.0377	0.0309
	(0.0500)	(0.0191)
Cash	0.6261*	
	(0.0579)	
TechCash	0.0637	
	(0.0569)	
Adjusted R^2	0.06	0.03
No. of Observations	12,000	11,000

Notes: An asterisk (*) denotes statistical significance at the 0.05 level. Values in parentheses are standard errors. A bootstrapping technique was used to ensure standard errors to be robust from autocorrelation and heteroskedasticity.

price data. The feeder cattle cash series was composed of data reported by the USDA's Agricultural Marketing Service and provided by the Livestock Marketing Information Center (LMIC) for sales at Dodge City, Kansas, beginning on January 4, 1974. From January 4, 1974 to December 27, 1974, the Dodge City 600–700 pound price series was used because the futures contracts' average target weight was 650 pounds for this time span. Subsequent changes in the cash price series reflected changes in the feeder cattle contract's par weight range.[6] The live cattle cash series was composed of data, also obtained from LMIC, for sales in Western Kansas reported by the USDA's Agricultural Marketing Service office in Dodge City, Kansas (*Western Kansas Direct Slaughter Steers* price series, later called the *Kansas Slaughter Steers* price series).

Results

Comparison of Calculation Techniques

Table 1 provides parameter estimates for equation (2). The model was first estimated using ordinary least squares (OLS), but autocorrelation was detected, and therefore bootstrapping techniques were used to estimate the standard errors (Efron, 1979; Greene,

[6] An explicit breakdown of each cash series is not presented here, but is available from the authors upon request.

2000; Veall, 1987).[7] The coefficient estimates for the *Technique* variable are small and statistically insignificant, suggesting the technique selected does not have a significant impact on basis forecasting accuracy. The coefficient estimate on the *Cash* variable in the feeder cattle model indicates that the ability to forecast basis declined following the switch to cash settlement of the futures contract. This finding, however, is partially offset by the negative coefficient estimates for the *Year* variable, implying both feeder cattle and live cattle basis were becoming easier to predict over time.[8] The coefficient on the *TechCash* variable is small and statistically insignificant, indicating no statistically significant difference between the calendar and time-to-expiration methods during cash settlement as compared to their performance during physical settlement.

Feeder Cattle Multi-Year Average Evaluation

Table 2 reports the mean absolute errors (MAEs) of the five different multi-year averages for each time period analyzed, as well as the paired t-tests of comparing the MAEs, using the calendar technique for feeder cattle.[9] The 3-year average forecast had the lowest MAE over the entire time span (1979–2002), and was significantly lower than the 1-year average and marginally lower than the 2- and 5-year average forecast MAEs.[10] If a 3-year average were used to forecast basis, the mean absolute basis forecast error would have been, on average, \$0.11/cwt lower than simply using the previous year's basis. This translates to an average gain in basis forecasting accuracy of \$0.83 per head for a 750-pound feeder steer.

When considering only the physical settlement period (1979 to September 1986), the 5-year average MAE was significantly lower than any of the other averages considered. Over the cash settlement period (September 1986 to 2002), the rankings changed considerably, with the 3-year average providing the lowest MAE, which was lower than the MAEs from forecasts based upon 4- and 5-year averages. Finally, the most recent five years of data (1998–2002) were examined, and the 4-year average resulted in the lowest MAE and was significantly lower than the MAE for forecasts derived from the 1-year average forecast and marginally better than the MAE for forecasts based on the 2-year average.

Live Cattle Multi-Year Average Evaluation

Table 3 provides the paired t-tests comparing the mean absolute errors of the five different multi-year averages for each time period analyzed, using the calendar technique, for live cattle. When considering the entire 1981–2002 time period, the 4-year average basis forecast had the lowest MAE (\$1.20/cwt), which was significantly lower than the 1-year forecast and marginally lower than the 2- and 5-year average forecasts.

[7] The bootstrapping-generated standard errors differed little from those obtained via OLS estimation, indicating the detected autocorrelation had little impact on the results.

[8] The model results imply the improvement in forecasting accuracy over time is due to factors other than the switch to cash settlement. A more definitive examination of the change in basis risk since adoption of cash settlement would require examination of basis risk at a number of markets around the United States for different cattle weights, and for heifers as well as steers.

[9] This analysis was also conducted using the time-to-expiration technique, but only the calendar technique results are reported here since use of the time-to-expiration approach did not improve forecast accuracy appreciably.

[10] Here and throughout the rest of the paper, the term "significantly" is used based on p-values less than 0.05, and p-values between 0.05 and 0.15 are referred to as being "marginally significant."

Table 2. Paired *t*-Test Matrices Comparing Five Different Multi-Year Average Forecasts for Feeder Cattle (calendar technique)

A. Entire Time Period: 1979–2002

	5-Year	4-Year	3-Year	2-Year	1-Year
MAE	1.6972	1.6665	1.6642	1.6990	1.7782
5-Year	—	0.0085	0.1019	0.9507	0.0438
4-Year		—	0.8682	0.1974	0.0033
3-Year			—	0.0636	0.0011
2-Year				—	0.0057
1-Year					—

B. Physical Settlement Period: 1979–September 1986

	5-Year	4-Year	3-Year	2-Year	1-Year
MAE	1.7018	1.7562	1.8560	1.9345	2.1261
5-Year	—	0.0057	0.0000	0.0000	0.0000
4-Year		—	0.0001	0.0001	0.0000
3-Year			—	0.0273	0.0001
2-Year				—	0.0008
1-Year					—

C. Cash Settlement Period: September 1986–2002

	5-Year	4-Year	3-Year	2-Year	1-Year
MAE	1.6951	1.6244	1.5740	1.5883	1.6148
5-Year	—	0.0000	0.0000	0.0022	0.0892
4-Year		—	0.0033	0.2320	0.8271
3-Year			—	0.5153	0.3152
2-Year				—	0.4141
1-Year					—

D. Last Five Years: 1998–2002

	5-Year	4-Year	3-Year	2-Year	1-Year
MAE	1.2811	1.2776	1.2896	1.3583	1.5494
5-Year	—	0.8488	0.7881	0.0862	0.0001
4-Year		—	0.6025	0.0527	0.0000
3-Year			—	0.0333	0.0000
2-Year				—	0.0002
1-Year					—

Notes: Unit for mean absolute error (MAE) is $/cwt; *p*-values are associated with the null hypothesis that there is no difference in the MAE of two different multi-year averages.

If a 4-year average were used to forecast basis, the mean absolute basis forecast error would have been (on average) $0.14/cwt lower than simply using the previous year's basis to forecast live cattle basis. This translates to an average gain in basis forecasting accuracy of $1.68 per head for a 1,200-pound slaughter steer. During the most recent five years (1998–2002), the forecasts based upon the 2-year average resulted in the lowest MAE, but did not provide forecasts that were significantly better than any of the alternative averages.

Table 3. Paired t-Test Matrices Comparing Five Different Multi-Year Average Forecasts for Live Cattle (calendar technique)

A. Entire Time Period: 1981–2002

	5-Year	4-Year	3-Year	2-Year	1-Year
MAE	1.2109	1.1966	1.2113	1.2326	1.3390
5-Year	—	0.1065	0.9774	0.3174	0.0000
4-Year		—	0.1877	0.0613	0.0000
3-Year			—	0.1452	0.0000
2-Year				—	0.0000
1-Year					—

B. Last Five Years: 1998–2002

	5-Year	4-Year	3-Year	2-Year	1-Year
MAE	1.2316	1.2177	1.2236	1.1960	1.2175
5-Year	—	0.4315	0.7842	0.4375	0.8139
4-Year		—	0.7996	0.5811	0.9965
3-Year			—	0.3650	0.9066
2-Year				—	0.6467
1-Year					—

Notes: Unit for mean absolute error (MAE) is \$/cwt; p-values are associated with the null hypothesis that there is no difference in the MAE of two different multi-year averages.

Current Information Evaluation

The benefit of incorporating current information into feeder cattle and live cattle basis forecasts was evaluated over the 1998–2002 time period, across different forecast horizons (4, 8, 12, 16, 20, and 24 weeks out).[11] Paired t-tests were used to identify the value of including different weights of current information ($x = 0$, $x =$ optimal, and $x = 1$). Table 4 presents the paired t-tests and the mean absolute errors (MAEs) from the "historical" ($x = 0$), "optimal" (x solved for in-sample), and "full deviation" ($x = 1$) forecasts for each forecasting horizon for both feeder cattle and live cattle.

When forecasting basis four weeks into the future, the optimal weight of current basis information [i.e., the "x" variable in equation (3)] to include in basis forecasts was 32% (table 4A, upper left panel). This optimal weight was found by solving for the "x" value of equation (3) that minimized the mean absolute errors of a forecasting model over the period of interest. When forecasting feeder cattle basis four weeks out, including 32% of the basis deviation from its historical average in the forecast yielded an MAE of \$1.23/cwt, which was significantly lower than the \$1.29/cwt MAE for forecasts excluding current basis information in the forecasts [simply using the historical average for the week being forecasted, in which case the "x" in equation (3) equals zero]. This lower MAE results in approximately a \$0.45 per head gain in basis forecasting accuracy for a 750-pound feeder steer, as compared to omitting current information from the forecast.

[11] The 1993–2002 period was also evaluated, and the optimal amount of current information tended to be greater than the "optimal" amount over the 1998–2002 period. These additional results are not reported here, but are available from the authors upon request.

Table 4. Current Information Evaluation for Feeder Cattle and Live Cattle (1998–2002)

— A. FEEDER CATTLE —

4 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.29	0.0407
Optimal	0.32	1.23	—
Full Deviation	1.00	1.52	0.0000

8 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.29	0.0728
Optimal	0.26	1.24	—
Full Deviation	1.00	1.55	0.0000

12 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.29	0.1228
Optimal	0.24	1.25	—
Full Deviation	1.00	1.65	0.0000

16 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.29	0.4024
Optimal	0.10	1.28	—
Full Deviation	1.00	1.76	0.0000

20 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.29	0.3213
Optimal	0.09	1.28	—
Full Deviation	1.00	1.70	0.0000

24 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.29	0.3566
Optimal	0.07	1.28	—
Full Deviation	1.00	1.83	0.0000

— B. LIVE CATTLE —

4 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.22	0.0001
Optimal	0.45	1.07	—
Full Deviation	1.00	1.24	0.0001

8 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.22	0.0502
Optimal	0.32	1.16	—
Full Deviation	1.00	1.22	0.0002

12 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.22	1.0000
Optimal	0.00	1.22	—
Full Deviation	1.00	1.66	0.0000

16 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.22	1.0000
Optimal	0.00	1.22	—
Full Deviation	1.00	1.81	0.0000

20 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.22	1.0000
Optimal	0.00	1.22	—
Full Deviation	1.00	1.87	0.0000

24 Weeks Out Forecasts

Forecast	"x"	MAE	p-Value
Historical	0.00	1.22	1.0000
Optimal	0.00	1.22	—
Full Deviation	1.00	1.87	0.0000

Notes: The p-values are associated with the null hypothesis that there is no difference in the MAE of the "optimal" forecasting model, the "historical" ($x = 0$), and the "full deviation" ($x = 1$) forecasting models. The "x" values refer to the x in equation (3).

If 100% of current information were included (i.e., $x = 1$), the MAE increased to $1.52/cwt. This finding suggests that a combination of historical and current information should be used when forecasting feeder cattle basis four weeks out.

Between 1998 and 2002, the optimal weight for current feeder cattle basis information to include in basis forecasts eight weeks ahead was 26%, yielding MAEs $0.05/cwt and \$0.31/cwt lower than forecasts made excluding current basis information ($x = 0$) and forecasts including the entire amount of current information ($x = 1$), respectively. When the forecasting horizon was extended to 12 weeks, the optimal weight of current basis information declined to 24%. Forecast accuracy (in terms of MAE) increased by \$0.04/cwt (as compared to excluding current basis information) as a result of including the current basis information in the forecast model, but this difference was only marginally significant.

The optimal amount of current feeder cattle basis information to include in forecasts made for 16, 20, and 24 weeks into the future was also evaluated. The forecast accuracy (MAE) did not significantly improve when current basis information was included in forecasts at these time horizons. This finding suggests forecast accuracy over the 1998–2002 time period would not have been improved by incorporating current information in basis forecasts 16, 20, or 24 weeks into the future.

When forecasting live cattle basis four weeks into the future (table 4B), the optimal percentage of current information to include in forecasts was 45%. Forecasts including 45% of the basis deviation from its historical average resulted in an MAE \$0.15/cwt lower than forecasts excluding current basis information (i.e., $x = 0$) and an MAE \$0.17/cwt lower than forecasts including 100% of this current information (i.e., $x = 1$). The forecast error for the optimal forecast was significantly lower than the error associated with both alternative models. Incorporating 45% of current information into live cattle basis forecasts four weeks forward resulted in a forecast accuracy improvement of \$1.80 per head for a 1,200-pound slaughter steer (\$0.15/cwt), as compared to a forecast relying solely on the optimal multi-year average.

Between 1998 and 2002, the optimal weight of the current live cattle basis information to include in basis forecasts made eight weeks ahead was 32%. These forecasts yielded an MAE \$0.06/cwt lower than forecasts made excluding current basis information and an MAE \$0.06/cwt lower than forecasts including 100% of the current basis information. When the forecast horizon was extended to 12 weeks and further, the optimal weighting of current basis information was 0%—suggesting that forecasting accuracy over the 1998–2002 period would not have been improved by incorporating current information into forecasts for basis 12 weeks or more into the future.

In summary, as the forecasting interval (i.e., the length of time between the forecast and the week being forecasted) increased, the optimal weight of current basis information to include in the forecast generally declined. This finding was expected because, as the amount of time between when the forecast is made and the week for which the basis is being forecasted increases, the more likely it is that the basis will revert to the mean. Longer forecasting time horizons are characterized by more uncertainty with an increased likelihood of unforeseeable occurrences; consequently, including information known at the time of the forecast loses its forecasting accuracy benefits as the time horizon expands. The relationship between the optimal amount of current information to include (i.e., x) and the forecast horizon for both feeder cattle and live cattle for the most recent 5- and 10-year periods is depicted in figure 1.

Conclusion

A sound understanding of basis and the ability to make accurate basis forecasts is vital to price risk management. Much research has been done evaluating the use of price and

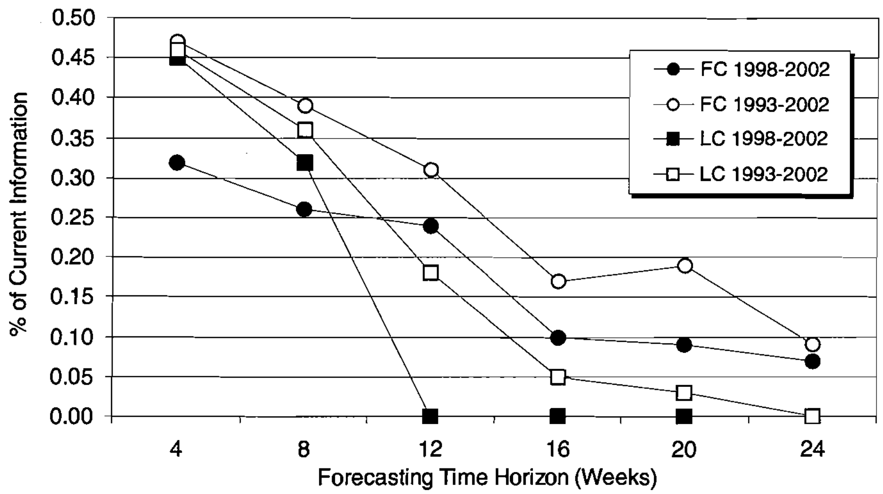

Figure 1. Forecasting horizon vs. optimal percentage of current information for feeder cattle (FC) and live cattle (LC)

basis forecasts, but little research has focused on the practical procedures of making livestock basis forecasts. This study used basis forecast errors in an out-of-sample framework to evaluate whether or not the use of a time-to-expiration method, compared to a calendar-based method, would improve the accuracy of livestock basis projections. Furthermore, the optimal number of years to include in forecasting feeder cattle and live cattle basis was evaluated, and finally the benefit of including current information into the forecasts was examined.

The optimal number of years to include in an historical-average-based basis forecast depends on the particular time period analyzed. As a general rule, the results of this research indicate that basis forecasters should consider using 3-year averages of historical basis data for feeder cattle and 4-year averages for live cattle. If these suggested averages were used, the mean absolute basis forecast error would have been (on average) $0.11/cwt and $0.14/cwt lower than simply using the previous year's basis to forecast feeder cattle and live cattle basis, respectively. On a per head level, this translates to an average gain in basis forecasting accuracy of $0.83 for a 750-pound feeder steer and $1.68 for a 1,200-pound slaughter steer.

While the use of a time-to-expiration method is intuitively appealing compared to the calendar method, it had little statistical effect on the accuracy of basis projections over the time periods studied. Results also indicate that absolute basis forecasting errors have been declining over time for both commodities. Finally, our results suggest livestock basis forecasters should consider supplementing historical averages with additional basis information known at the time of the forecasts (i.e., current information) when forecasting basis up to about 12 and 8 weeks into the future for feeder cattle and live cattle, respectively. Incorporating current information into basis forecasts four weeks ahead resulted in basis forecasting accuracy improvements of $0.06/cwt and $0.15/cwt, respectively, for feeder cattle and live cattle, as compared to ignoring the current information component. On a per head level, this amounts to a forecast accuracy improvement of $0.45/head for a 750-pound feeder steer and $1.80/head for a 1,200-pound slaughter steer. However, the value of incorporating current information in basis forecasts declined rapidly as the forecasting horizon increased. When current information was incorporated, basis forecasts made 16 or more weeks into the future for feeder cattle, and 12 weeks or more for live cattle, were not significantly more accurate than basis forecasts based solely on historical information.

Hedgers who take advantage of these improved basis forecasting techniques can expect to realize a significant improvement in basis forecasting accuracy. Combining gains in forecast accuracy derived from using the optimal multi-year average and the optimal amount of current basis information, compared to simply using last year's basis without incorporating any additional current information as the forecast for the upcoming year, resulted in basis forecasting accuracy gains of $1.28/head and $3.48/head for a 750-pound feeder steer and 1,200-pound slaughter steer, respectively.

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