FEEDER CATTLE FUTURES: AN ANALYSIS OF A MARKETING ALTERNATIVE FOR FEEDER CATTLE PRODUCERS

D. A. Jenkins
R. D. Carver
D. J. Menkhaus

Department of Agricultural Economics
University of Wyoming
Laramie, WY 82071

Marketing and Price Analysis Selected Papers Session
1986 AAEA/WAEA Meetings

July 27-30, 1986

Reno, Nevada

ABSTRACT

The objective of this study is to provide information to improve the results of feeder cattle hedging programs. On average, February through March is the most favorable time period to place a short feeder cattle hedge. A three-year simple average model provided the most accurate forecast of the basis.

FEEDER CATTLE FUTURES: AN ANALYSIS OF A MARKETING ALTERNATIVE FOR FEEDER CATTLE PRODUCERS

An operation which sells long yearlings in the fall is confronted by two major price problems. First, the manager of this type of operation faces a seasonal price pattern which is generally highest early in the year and declines throughout the summer and fall. The second problem involves the extreme variability of feeder cattle prices, both within and between years. Hedging on the feeder cattle futures contract can help alleviate both of these problems. Hedging provides a rancher more time to price his steers, thus reducing the risk associated with the volatility of feeder cattle prices. The two most significant factors affecting the outcome of a hedge are the futures price at which the hedge is placed, and the basis on the day the hedge is lifted and the cattle are sold on the cash market.

The overall objective of this study is to provide information which will improve the results of feeder cattle hedging programs. Specific objectives include: 1) to determine if there is a criterion which can be used to establish the optimum time period in which to place a short feeder cattle hedge; 2) to determine if there are characteristics of the marketing period basis which could be utilized to hedge more effectively; and 3) to analyze selected methods for their accuracy in predicting the marketing period basis.

Data

For this study, the basis is defined as cash price minus futures price. The livestock operation under consideration is one which has steers on grass over the summer and sells them in the fall. Cash prices are those for medium frame number one 600-700 lb. feeder steers as reported at the Torrington Livestock Auction Market, Torrington, Wyoming. Futures prices are weekly average prices for the October feeder cattle contract, Chicago Mercantile

Exchange. Since the relevant period for the final basis is the time when steers are sold, the marketing period, which is based on rates of gain as well as price (Kearl, 1963), is defined as the seven-week period August 15-October 1. Weekly cash and futures prices for the period 1974-1984 serve as the data for the analyses.

Optimum Time to Place a Short Feeder Cattle Hedge

This section examines whether there is a time period during the year which has historically been a better time to place a short feeder cattle hedge for fall sale. Also examined is whether average returns for the years considered in this study would have been increased by routinely hedging in each particular week of the year.

The analysis is conducted under the assumption that the fall sale cash price and the final basis are the average reported over the entire seven-week marketing period. The analysis is then conducted under three additional marketing scenarios. The seven-week period, mid-August to early October, is divided into three subsets - weeks 1-2, weeks 4-5 and weeks 6-7. The three alternative marketing scenarios use the average cash price and basis from each of these time periods.

The October futures contract price in each week of the year was adjusted by the average final basis under each of the four scenarios to arrive at an effective hedged price. The relevant cash price for each scenario was then subtracted from this adjusted futures price. This gives the gross profit (loss) from placing a hedge in each week.

The results are examined in three separate respects. First, the number of weeks in each year when hedging would have been superior to cash sales was determined. This provides an indication of how many weeks through each

marketing year a stocker operation would have to place a profitable hedge. Next, the frequency that each week over the eleven-year period was a "good" hedging week was examined. Finally, the absolute monetary advantage or disadvantage of routinely hedging in each week was calculated. The total and average benefit received from hedging in each week over the 1974-1984 time period was calculated under each of the four marketing alternatives.

The costs associated with hedging must be subtracted from the gross return to hedging figure to obtain the net return to hedging. One cost incurred by a rancher undertaking a hedging program is the commission paid to a broker for his services in making the futures transaction. The brokerage firm also requires that an amount of money be placed in a margin account to act as a performance bond. The relevant hedging expenses are commission charges and the opportunity cost of the margin money.

Futures Price Trends

The average weekly October feeder cattle futures prices for the period 1974-1984 are illustrated in Figure 1.[1/] The average prices are generally higher in the spring of the year. Weeks 6-21 (February-May) show much

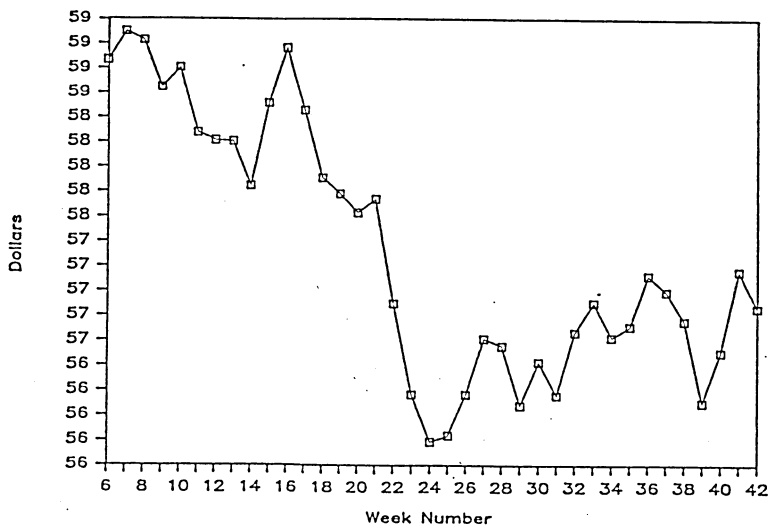

Figure 1. Eleven-Year Average of Weekly Prices, October Feeder Cattle Futures Contract, 1974-1984.

stronger prices on average as compared to the summer period. There is some strengthening of prices again in late August.

Number of Weeks to Hedge

Table 1 displays the number of weeks in each of the past eleven years when hedging would have resulted in increased gross returns as compared to operating strictly in the cash market. Depending upon the year and the marketing period, there was from 1 week to 43 weeks per year in which a hedge would have been placed which would have resulted in a higher gross price than that received in the cash market. The average number of weeks in which a profitable hedge could have been placed ranged from 21.5 weeks for the mid-September marketing period to 26.7 weeks for the late-September to early October marketing period. The latter was primarily due to a stronger basis during this period.

Table 1. Number of Weeks per Year When a Profitable Short Feeder Cattle Hedge Could Have Been Employed, Torrington Market, Four Alternative Marketing Periods, 1974-1984.

	Weeks 1-2	Weeks 4-5	Weeks 6-7	Weeks 1-7
1974	28	33	33	30
75	12	3	1	7
76	29	39	39	37
77	34	34	32	32
78	12	3	3	7
79	29	13	19	18
1980	33	25	31	29
81	28	25	40	28
82	1	7	18	6
83	39	43	38	41
84	9	12	40	18
$\bar{x}$	23.1	21.5	26.7	23.0
σ^2	12.3	14.6	14.4	12.5

Frequency of the Profitable Hedge

In order to better understand which part of the year might yield a higher likelihood for placing a successful hedge, each week was examined across the eleven years of the study. Figure 2 depicts the number of years that routine hedging in each particular week would have resulted in a profitable hedge. A

profitable hedge in this case is defined as one which results in a net hedged price which exceeds the price received had the steers been sold unhedged in the cash market.

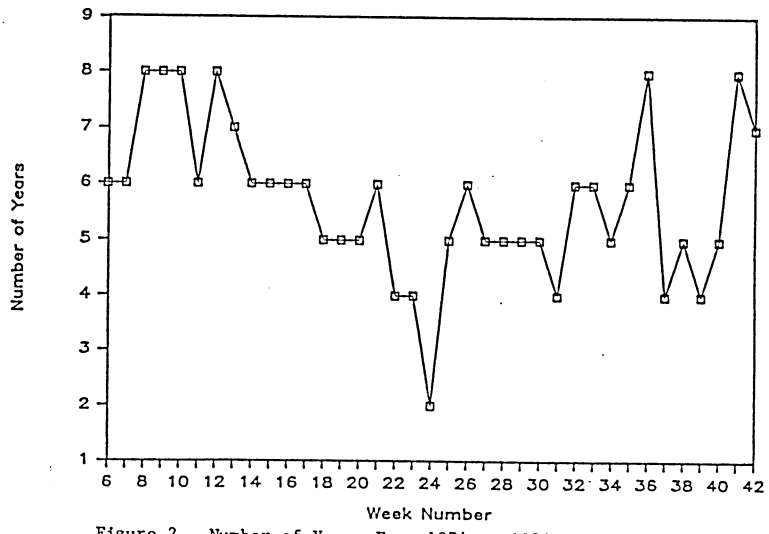

Figure 2. Number of Years From 1974 to 1984 That Routine Placement of a Short Feeder Cattle Hedge in Each Week Would Have Resulted in a Profitable Hedge, Assuming Cash Price and Final Basis are Average From Weeks 1-7 of Marketing Period, Torrington Market.

From Figure 2 and from similar illustrations of the other three marketing scenarios, weeks 8-12 (late February-late March) and weeks 32-36 (August) appear to be the more favorable periods for hedging. Early May-late June apparently provide a poor chance of placing a profitable hedge. One possible explanation for the poor success of the middle weeks may relate to the underlying annual price trend. When prices trended down over the year, good hedging weeks obviously occurred early in the year. Conversely, good hedging weeks occurred late in the year when prices were trending upward.

Dollar Advantage of Hedging

Figure 3 shows the average increase or decrease in gross revenues which would have resulted from routinely placing a short feeder cattle hedge in each particular week over the eleven-year period. Average cash sales price and basis from the seven-week period August 15-October 1 are used in the

calculations. Similar figures for weeks 1 and 2, weeks 4 and 5, and weeks 6 and 7 of the marketing period were also developed but are not presented.

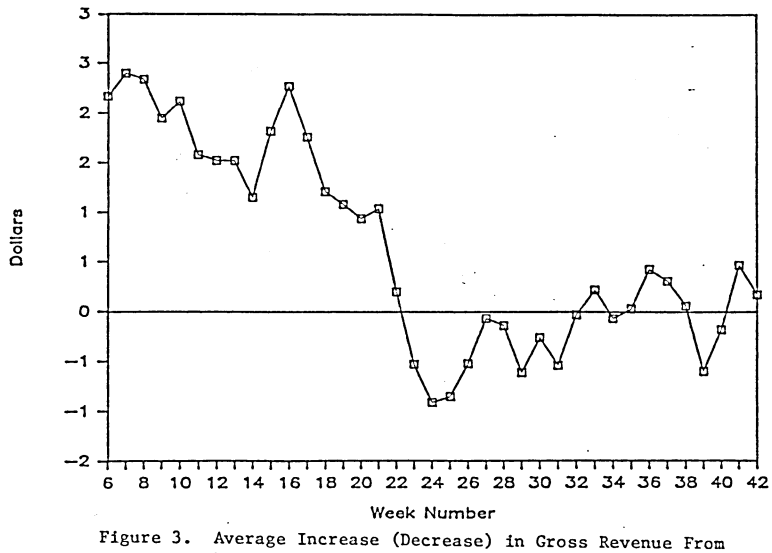

Figure 3. Average Increase (Decrease) in Gross Revenue From Routine Placement of a Short Feeder Cattle Hedge in Each Week of the Year, Torrington Market, 1974-1984, Assuming Cash Price and Final Basis are Average From Weeks 1-7 of Marketing Period.

From the analysis, the implications as to the timing of the placement of a short hedge is consistent with results reported earlier. Generally, the pricing weeks (February-May) show positive hedging returns.

The primary costs of the hedging program are the opportunity costs of the margin money and the commission fee. If the hedge is in place for six months and the current interest rate is 13 percent, the relevant cost of maintaining an interest margin account for the life of the hedge is $.15/cwt (44,000 lbs/contract). If the commission charge is $65 per contract for a round turn trade, this amounts to $.15/cwt, for a $.30/cwt combined expense. This hedging expense is not great enough to alter any conclusions regarding the period of the year with the greatest advantage in hedging.[2/]

The Marketing Period Basis

In this section, the marketing period basis is examined. The basis will first be examined in terms of historical trends and patterns, then in terms of systematic and purely random variation.

Basis Trends

The basic premise in this study is that if the basis narrows, the cash price increases relative to the futures price, a short hedge will show improved results. For each of the seven weeks of the marketing period, the eleven-year basis (1974-1984) was calculated for the Torrington market. This average basis, plus and minus one standard deviation is presented in Figure 4.

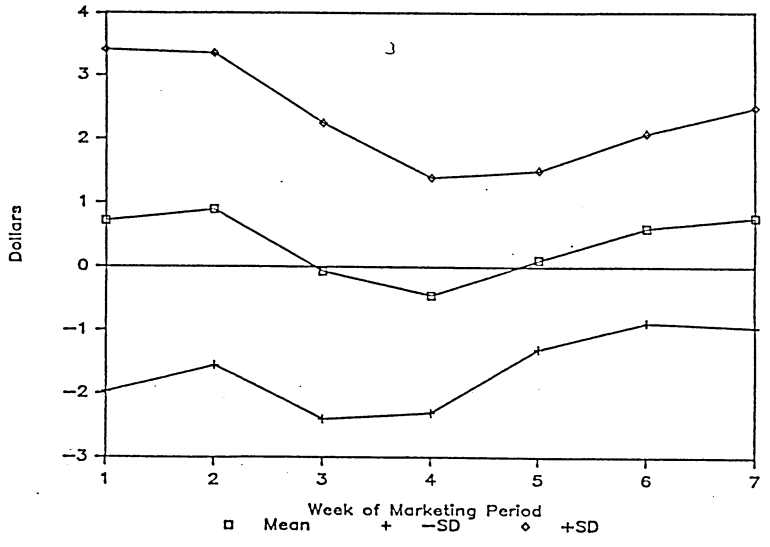

Figure 4. Eleven-Year Average October Contract Basis of Each Week in Marketing Period, Torrington, Wyo., 1974-1984.

On average, the basis is stronger in the first two weeks and last two weeks of the marketing period. The basis average is $.72 in the first week, falling to a negative $.45 in the fourth week. It strengthens through the fifth, sixth and seventh weeks, averaging $.77 at the end of the marketing period. The variation in the basis, as measured by the standard deviation, was lower in the latter half of the marketing period.

It would appear that an offset in the early or late portion of the marketing period would be preferred, with the late period containing less risk. To better determine what was occurring during the marketing period, the

basis was plotted for each year. This analysis reveals that if there is a weak basis in the beginning of the marketing period, there has been a tendency for it to strengthen over the seven weeks. If, on the other hand, the marketing period is entered with a strong basis, there has been a tendency for the basis to weaken over the next few weeks.

Considering only the basis, if there is a weak basis at the start of the marketing period, the hedge should not be offset immediately. If the cash price is greater than the futures price (a strong basis), it might be better to offset the hedge at the earliest possible opportunity. Of course, these decisions may be influenced by the ranching operation - grazing conditions, cash flow considerations, etc.

Basis Risk

Garcia, et al. suggests that basis fluctuation should be viewed in terms of a systematic and an unsystematic, or risk component. Tintner's variate difference method has been applied to analyze the random component of a time series (Garcia, et al.; Tomek, 1979 and 1980; Powers). The variate difference method is applicable when consecutive time periods exhibit a strong positive correlation. The correlation between conservative time periods in the feeder cattle marketing period basis series is 0.67. Thus, the variate difference approach was deemed appropriate for analysis of the marketing period basis.

The variate difference method starts from the assumption that an economic time series consists of two additive components - systematic and random. Since basis risk is of concern here, the random element must be isolated. This is done by a process of successive differencing. The variance of the series should decrease with successive differencing as the mathematical expectation or systematic component is reduced. The variate difference approach provides a statistical method to determine with which difference the systematic component has been eliminated.

The results of the variate difference approach indicate that 26.35 percent of the variation in the marketing period basis series can be attributed to a purely random component. The other 73.65 percent of the variation can be attributed to a systematic component. Thus, a large proportion of the variation in the marketing period basis is due to market forces which are somewhat permanent or reoccurring. This suggests that underlying structural variables should be important in modeling this basis.

Predicting the Marketing Period Basis

A good estimate of the final basis at the time a hedge is placed is imperative for satisfactory use of the futures market as a risk reduction tool. This section examines the forecast accuracy of five selected models for estimating the marketing period basis. Theil's U_2 coefficient is employed to evaluate the forecasting accuracy of the models (Bliemel; Leuthold, 1975).

Selected Forecasting Models

The models selected to predict the marketing basis are outlined below along with their estimated coefficients and summary statistics when applicable. Since the forecast model must be useful to producers in predicting the basis, forecast accuracy and simplicity were objectives for model development and selection.[3/]

ARIMA Model - The ARIMA model was developed using 1974 through 1983 data. Data for 1984 were reserved for testing the forecasting ability of the model. In order for the model to be useful for forecasting, it must be able to estimate the basis up to eight months in advance. Thus, models using no lag of less than seven were examined. The following model proved to be best in terms of significance of coefficients and minimum variance of the residual series.

SAR(2)/period=7;

SAR(2)/period=7.

Recalling that there are seven weeks in each year's marketing period, SAR(2)/period=7 indicates that seasonal autoregressive terms from one and two years ago are included. Likewise, SMA(2)/period=7 indicates the inclusion of moving average terms from one year and two years past. The estimates of the coefficients are all significant as shown in Table 2.

Table 2. Results of Model SAR(2)/Period=7, SMA/Period=7.

	Coefficient	t-statistic
SAR = 1	0.385	5.591
SAR = 2	-1.009	-13.736
SMA = 1	-0.419	3.248
SMA = 2	-0.925	-6.564

The variance of the residual series is 2.859. The null hypothesis that the residuals are uncorrelated or white noise was rejected at the 0.01 level of significance. The residual are autocorrelated and the model accounted for only 27.51 percent of the variation in the original series. Still, this was the best model that could be developed given the restriction that no lag could be less than seven weeks.

Other Models - Other, more simplistic models, as compared to the ARIMA model, were evaluated. These included:

Naive Model,

$$Basis_t = Basis_{t-1};$$

Two-Year Average Model,

$$Basis_t = 1/2(Basis_{t-1} + Basis_{t-2});$$

Three-Year Average Model,

$$Basis_t = 1/3(Basis_{t-1} + Basis_{t-2} + Basis_{t-3});$$

Three-Year Weighted Average Model,

$$Basis_t = 1/6(3\ Basis_{t-2} + 2\ Basis_{t-2} + Basis_{t-3});$$

where: $t-k$, $k=1, 2, 3$ is the t^{th} week in the k^{th} previous year.

Forecasting Ability

Theil's Inequality Coefficient, U_2, is used to compare the forecasting accuracy of the models previously presented.

$$U_2 = \frac{[\Sigma(P_i - A_i)]^{\frac{1}{2}}}{[\Sigma A_i^{\,2}]^{\frac{1}{2}}}$$

where P_i and A_i are defined as changes in predicted and actual values, respectively. U_2 has a lower bound of 0 for the case of perfect forecasts. A value of 1 results from the naive no-change extrapolation. A U_2 value less than (greater than) 1 would rank a model as better than (worse than) a naive no-change model.

The appropriate base model for comparison is the naive model which assumes the basis does not change from that which was observed for the same week of the previous year. The calculation of U_2 assumes a naive model where the basis in the current period is the same as the basis last period, rather than the basis last year. The naive model for the 1984 marketing period resulted in a U_2 coefficient of 4.542. To facilitate comparison among forecasting models, each U_2 coefficient derived was divided by 4.542 to arrive at an adjusted inequality coefficient. The adjusted U_2 then has the 0-1 range as previously discussed. The adjusted U_2 coefficients for each model obtained from forecasting the 1984 marketing period basis series is presented in Table 3.

Table 3. Adjusted U_2 Coefficient by Model, 1984 Marketing Period Basis Forecast.

Model	Adjusted Coefficient
Three-year average	0.448
Three-year weighted average	0.597
Two-year average	0.649
Naive	1.000
ARIMA	1.053

Based on the U_2 coefficient, the three-year average model provided the most accurate forecasts of the 1984 marketing period basis. The ARIMA model yielded forecasts worse than the naive model. All models, excluding the ARIMA model, were also used to forecast over the period 1977-1984. The ranking of the adjusted U_2 coefficients for the selected models using these data was identical to that reported in Table 3, which reflects 1984 data.

Summary of Implications

This analysis provides a general set of implications for ranchers undertaking feeder cattle hedging programs. For the years 1974-1984, there were an average 21.5-26.7 weeks per year in which gross income from the sale of feeder steers could have been increased by hedging, depending upon the marketing period used. Historically, the springtime, from late February through March, has provided the most favorable time to place a short feeder cattle hedge. On average, October feeder cattle futures prices were higher during this time period than at other times of the year. There is, however, substantial year-to-year variation in price trends. The springtime also proves to be the most favorable hedging period in terms of average increase in gross revenue when compared to ranch sales at the Torrington market.

The marketing period, as defined in this study which, in fact, is the only relevant period of analysis, is the seven weeks which most closely correspond to the August 15 to October 1 period in each year. If the marketing period was entered with a wide basis (less than zero), there has been a tendency for the basis to narrow in coming weeks and a hedger could have profited by delaying the sale of steers and the subsequent offset of the futures position. Conversely, if the marketing period was entered with a narrow basis (greater than zero), there has been a tendency for the basis to widen over the next several weeks. A hedger in this situation could have

profited by the immediate sale of steers and offset of the futures position. Although there is substantial variability in the marketing period basis, the application of the variate difference approach indicated that nearly 74 percent of this variation can be attributed to somewhat permanent or reoccurring market factors.

The analysis also indicates that a three-year simple average model provided the most accurate forecasts of the basis, as compared to other models tested. Based on Theil's U_2 coefficient, the accuracy of forecasts of the models tested ranked as follows (decreasing predictive ability): three-year simple average, three-year weighted average, two-year simple average, no change model and ARIMA model.

It should be noted that this analysis of the timing of the placement and lifting of a feeder cattle hedge has primarily examined routine hedging programs. Implementation of a hedging program should be done in light of previous research which has shown that routine hedging programs are typically the worst type of hedging strategies (Menzie and Archer, McCoy and Price). The information reported here can be used most effectively if it is used as a guide in selective hedging strategies.

FOOTNOTES

1/ Only weeks 6 through 42 are reported. The October contract was trading during these weeks in each of the eleven years of the study. In several years the October contract did not begin until as late as the sixth week of the new year.

2/ It should be recognized that the $1,000 margin considered in this study is an initial margin figure. If adverse price movements are encountered, the equity in the futures position will decline and more money may have to be deposited into the margin account. This could substantially increase the cost associated with maintaining a hedged position.

3/ An economic model based on theory and previous research was tested but was rejected on the basis of a low R^2 (0.33). Independent variables to predict the basis included: consumer price index, corn price, slaughter steer price, farm-to-retail price spread, feedlot placements, changes in cattle inventory (dummy variable), difference between price of slaughter steers and feeder steers, volume of trading in the October feeder cattle contract and the basis lagged 12 months. Variables, other than the basis lagged, were lagged eight months to transform the model into one which would be useful for predictive purposes.

REFERENCES

Bliemel, F. "Theil's Forecast Accuracy Coefficient: A Clarification." Journal of Marketing Research, 10(1973):444-446.

Garcia, P., R. M. Leuthold, and M. E. Sarham. "Basis Risk: Measurement and Analysis of Basis Fluctuation for Selected Livestock Markets." American Journal of Agricultural Economics, 66(1984):499-504.

Kearl, W. G. Cattle-Price Behavior and Ranchers' Decision Making. Agricultural Experiment Station Bulletin 408. University of Wyoming, Laramie. October 1963.

Leuthold, R. M. "On Theil's Inequality Coefficients." American Journal of Agricultural Economics, 57(1975):344-346.

McCoy, J. M. and R. V. Price. Cattle Hedging Strategies. Research Bulletin 591. Agricultural Experiment Station, Kansas State University, Manhattan. August 1975.

Menzie, E. L. and T. F. Archer. Hedging as a Marketing Tool for Western Cattle Feeders. Bulletin 203. Agricultural Experiment Station, University of Arizona, Tucson. May 1973.

Powers, M. J. "Does Futures Trading Reduce Fluctuation in the Cash Market?" American Economic Review. 60(1970):460-464.

Theil, H. Economic Forecasts and Policy. Amsterdam: North Holland Publishing Co., 1961.

Theil, H. Applied Economic Forecasting. Chicago: Rand-McNally and Co., 1966.

Tintner, G. The Variate Difference Method. Cowles Commission Monograph No. 5. Bloomington, Indiana: Principin, Press. 1940.

Tomek, W. G. "Futures Trading and Market Information: Some New Evidence." Food Research Institute Studies, Stanford University, 17(1979-1980):351-357.

Tomek, W. G. "An Analysis of the Cattle Futures - Cash Prices Basis for Live Beef Cattle: Comment." North Central Journal of Agricultural Economics, 2(1980):81-82.