Journal of Agricultural and Resource Economics 25(2):669–679

Corn Price Effects on Cost of Gain for Feedlot Cattle: Implications for Breakeven Budgeting

John D. Anderson and James N. Trapp

Elasticities calculated from an econometric model of cost of gain (COG) for cattle in feedlots indicate that COG is considerably less responsive to corn price changes than breakeven budgets assume. This difference in elasticities can lead to substantial errors in COG estimates obtained from budgeting. Size of error will depend upon the initial corn price and the magnitude of corn price change. Given average corn price levels and month-to-month changes, the error in budget-based net revenue projections will be about $3/head.

Key words: cattle, corn price, cost of gain, elasticity, feedlots

Introduction

One of the most useful management tools available to cattle feeders and feeder cattle producers is breakeven budgeting. Feeder cattle producers can use a breakeven budget to determine an expected market price for their cattle at some point in the future and/or to evaluate the choice of retained ownership or sale of their cattle. Likewise, cattle feeders use breakeven budgets to estimate the profit potential of a pen of cattle, to determine the price they can afford to pay for feeder cattle, and to evaluate the effect on expected profit of changes in cattle or feed prices.

The most common application of feeder cattle breakeven budgeting by either feeder cattle producers or cattle feeders is likely that of estimating what a set/pen of feeder cattle are worth at a given point in time. Table 1 illustrates the breakeven budgeting process for calculating the breakeven purchase price for feeder cattle.

The apparent simplicity of budgeting analysis is appealing to producers. However, there are some difficulties with the approach. One notable problem is that key pieces of information needed to calculate the breakeven feeder cattle price (i.e., the expected finished cattle price, expected slaughter weight, and the cost of gain during the feeding period) are not known with certainty. Hence, calculation of a breakeven purchase price for feeders necessarily involves some educated guessing.

One key piece of information that must be estimated in the breakeven budgeting process is the expected cost of gain per pound (i.e., the average cost of each additional pound of weight gained by an animal after it has been placed on feed). A number of popular press and professional publications suggest that understanding the effects of

John D. Anderson is assistant extension professor, Department of Agricultural Economics, University of Kentucky, Lexington, and James N. Trapp is department head, Department of Agricultural Economics, Oklahoma State University, Stillwater.

Table 1. Example Breakeven Feeder Cattle Price Estimate

Description	Breakeven Budget Calculation Formula	Amount
Fed Cattle Value	Slaughter Weight × Slaughter Price (1,150 lbs. × \$0.68/lb.)	= \$782.00
Cost of Gain	Pounds of Gain × Cost of Gain/lb. ((1,150 lbs. – 750 lbs.) × \$0.45/lb.)	= \$180.00
Net Revenue/hd.	Fed Cattle Value - Cost of Gain (\$782 – \$180)	= \$602.00
Breakeven Feeder Price/cwt	Net Revenue/hd. ÷ Purchase Weight/100 (\$602 ÷ 750/100)	= \$ 80.27

changes in corn price is essential to anticipating changes in cost of gain. Though cost of gain includes feeding-related expenses such as yardage fees, veterinary charges, and interest, by far its largest component is feed cost. Corn is, by volume, the most important ingredient in feedlot rations.

Albright, Schroeder, and Langemeier determined that over 60% of the variability in cost of gain in two Kansas feedlots could be attributed to corn price variability. Based on the strong relationship between corn price and cost of gain, popular press articles have routinely suggested that a functionally useful cost-of-gain forecast can be made by assuming the same percentage change will occur in cost of gain as occurs in corn price. That is, they assume that the elasticity of cost of gain with respect to corn price (%Δ cost of gain ÷ %Δ corn price) is equal to 1. This study investigates whether this assumption causes breakeven budget analysis (and management "rules of thumb" that are derived from breakeven budget analysis) to be an inaccurate decision tool.

One management concept derived from breakeven budgeting often cited in the popular press is the "corn price multiplier," defined as the ratio of the long-term change in feeder cattle prices to a change in corn price (i.e., Δ feeder price ÷ Δ corn price). This concept was heavily cited during the period of high corn prices in 1995–96, and has become a common management rule of thumb in the industry. Fox, for example, reported that a \$1/bushel increase in the price of corn results in a \$7–\$10/cwt decrease in the value of feeder cattle. Similarly, Maday wrote that a \$0.10/bushel increase in corn price would result in a \$0.75/cwt drop in feeder cattle prices.

Corn price multiplier values reported in these popular press articles were derived from a breakeven budget like the one in table 1. Estimation of the corn price multiplier illustrates how the implicit assumption of an elasticity of 1 between corn price and cost of gain can influence budget results. For example, assuming that corn price rose from \$3/bushel to \$4/bushel implies a 33% increase. If the cost of gain is also raised by 33% in table 1 (i.e., from \$0.45/pound to \$0.60/pound), the calculated breakeven price decreases by \$8, to \$72.27/cwt. Thus the implied multiplier is −8.0, which is consistent with the magnitude of the multipliers reported by both Fox and Maday, and by other popular press articles.

The assumption of unit elasticity of cost of gain is critical in deriving the breakeven budgeting result that the corn price multiplier is approximately −8.0 (and to budget results in general). However, based on our review of current literature, no empirical investigation of the magnitude of the elasticity of cost of gain with respect to corn price has been conducted. If a consistent relationship between corn price and cost of gain exists, and in particular if this relationship is not characterized by an elasticity of 1, this would be useful information for cattle feeders and feeder cattle producers. Better knowledge of the relationship would allow individuals to convert corn price forecasts into more accurate feeder cattle breakeven price projections.

The objective of this research is to provide decision makers with information that will help them use breakeven budgets more effectively. Specifically, this research will determine the nature of the relationship between changes in corn price and changes in cost of gain. If cost of gain is not unit elastic (or very nearly so) with respect to corn price, then budgets which assume cost-of-gain changes that are exactly proportional to changes in corn price will lead to inaccurate breakeven estimates. It is hypothesized that the elasticity of the cost of gain with respect to corn price will be considerably less than 1.

Since cattle feeders (and feeder cattle producers) need to rely on breakeven estimates both when making purchasing decisions and formulating marketing strategies, it is important for them to understand the potential for inaccuracy in budget projections. Due to data limitations that will be discussed below, it is not possible to develop a predictor of cost of gain. Nonetheless, results of this study should assist decision makers in using budgets more effectively by allowing them to adjust cost-of-gain figures in response to corn price changes with greater accuracy.

Background and Theory

The calculations presented in table 1 can be condensed into the following equation which calculates profit per head (Π) from cattle feeding:

(1)
$$\Pi = FED * SW - [(FC * PW) + (COG * (SW - PW))],$$

where FED is the price received for finished cattle ($/pound), SW is the slaughter weight of finished cattle in pounds, FC is the price paid for feeder cattle at placement ($/pound), PW is the placement weight of feeder cattle in pounds, and COG is the cost of gain per pound. As noted earlier, some of the variables that comprise this equation are known with certainty, while others must be estimated. Feeder cattle prices and placement weights are observable at the time the decision to place cattle on feed is made; however, fed cattle prices, slaughter weight, and cost of gain must be estimated.[1] Of these, we focus on cost of gain.

As noted, the largest component of cost of gain is feed costs. Ignoring miscellaneous expenses such as yardage, veterinary expenses, and interest, cost of gain (COG) can be expressed by the following equation:

(2)
$$COG = RC * CONV,$$

[1] Fed cattle prices are generally estimated using the futures contract nearest to the expected slaughter date. Slaughter weight is generally predictable from the physical attributes of the animal and/or from recently fed pens of cattle which were similar to the pen in question.

Table 2. Descriptive Statistics for Data Used in Cost-of-Gain Model (1980–96)

Variable Name	Definition	Mean	Std. Dev.
Dependent: *COG*	cost of gain	0.531	0.062
Independent: *CORN*	corn price/bushel	2.839	0.564

Source: Data were obtained from Professional Cattle Consultants, Weatherford, Oklahoma.

where *RC* is ration cost given in dollars per pound, and *CONV* is the feed conversion rate (pounds of feed/pound of beef gain). Estimating cost of gain in budgets is difficult because ration cost and feed conversion rate are not known at the time resources are devoted to feeding cattle. Evidence from the popular press cited earlier seems to indicate that changes in cost of gain are assumed to be exactly proportional to changes in corn price.

The hypothesis that cost of gain should, in reality, be inelastic with respect to corn price is based upon three observations related to the cattle feeding process. First, substitution will occur between corn and other feeds (including forages) as corn prices vary. Second, changes in the price of corn will lead to changes in the weight of cattle being placed on feed (Marsh 1999). Changes in placement weight will, in turn, affect slaughter weight. Such weight changes will influence cost of gain indirectly through their effect on feed conversion efficiency. Finally, if feedlots maintain inventories of corn or if they forward contract a portion of their corn purchases, cost of gain will not be as responsive to corn price changes as budgeting assumes. Marsh (1985) finds evidence of long-term feed contracts which tend to distribute the effects of a corn price change over a much longer time period than the effect of a slaughter price change.

As corn price increases, the net effect of these actions on the part of cattle feeders will be to reduce their use of corn. This statement reflects that under factor price increases, maintaining optimal (cost-minimizing) production requires that adjustments be made to reduce the use of that factor. For this reason, cost functions are assumed to be concave in factor prices (Varian). The assumption of a unit elastic cost of gain is not consistent with this fundamental economic theory, and yet that assumption is often employed in the application of breakeven budgets. Based on economic theory, then, we should expect the traditional budgeted elasticity of cost of gain with respect to corn price (i.e., unit elasticity) to be significantly greater than the true elasticity.

Data and Procedures

Data for this analysis were obtained from Professional Cattle Consultants (PCC), a feedlot consulting firm in Weatherford, Oklahoma. PCC collects information on cattle characteristics and performance from feedlots across the nation which together account for around 25% of U.S. fed cattle production. Data used in this analysis included monthly average cost of gain for all pens of cattle slaughtered in a given month and average corn price paid by feedlots in each month from 1980 through 1996. Table 2 describes the data used in this study.

PCC data do not provide cost of gain for all pens of cattle each month. Rather, the data give average cost of gain for the pens slaughtered in a given month. These values are therefore determined over the entire feeding period, not each month. This gives rise to the data limitation mentioned earlier. All of the cattle slaughtered in a given month were not necessarily placed on feed at the same time. It is, in fact, impossible to determine when pens were placed since aggregate rather than pen-level data are reported. Consequently, a predictor of cost of gain using information at the time of placement could not be estimated. Time of placement cannot be defined from the data available.

Because cost of gain in the PCC data set is determined for the entire feeding period and reported in the slaughter month, it would be inaccurate to match each cost-of-gain entry with a single corn price corresponding to the slaughter month. Forward contracting and/or storage of corn by feedlots will result in past corn prices having some effect on cost of gain. For this reason, several lagged corn prices (i.e., lagged from the current slaughter month) will be used in model estimation.

Since cost of gain is calculated over the entire feeding period, observations on cost of gain for one month will be related to observations from a number of previous months, the exact number depending on the length of time on feed. This structural peculiarity of the data was expected to result in significant autocorrelation. Since time-series data were being used, and given the a priori expectation of fairly pronounced autocorrelation, Dickey-Fuller (D-F) unit root tests were conducted on the cost-of-gain and corn price series to determine if these data were stationary. A first-order autoregressive process, described by

$$y_t = a_1 y_{t-1} + v_t, \tag{3}$$

where v_t is a random disturbance with zero mean and constant variance, can be rewritten as

$$(1 - a_1 L) y_t = v_t, \tag{4}$$

where L is a lag operator. In this simple case, the characteristic equation of a_1 is

$$(1 - a_1 L) = 0. \tag{5}$$

If the root of this equation, $L = 1/a_1$, is equal to 1 (i.e., $a_1 = 1$), then the series is said to have a unit root and is nonstationary. The D-F test is used to determine whether or not a data series is characterized by a unit root (i.e., whether or not $a_1 = 1$).[2]

Results of the D-F tests indicate that the cost-of-gain series has a unit root (i.e., is nonstationary). For the corn price series, the results are less certain. The null hypothesis of a unit root for this series is rejected at the 5% level of probability, but not at the 2% level. Thus, at $\alpha < 0.02$, a test for cointegration is in order. Following the two-step approach to cointegration testing suggested by Engle and Granger, a D-F test of the

---

[2] The Dickey-Fuller test is actually a test of the null hypothesis that $(a_1 - 1) = 0$. To see why this is the case, note that text equation (3) can be rewritten as

$$\Delta y_t = (a_1 - 1) y_{t-1} + v_t.$$

Thus, a regression of Δy_t on lagged values of y_t results in a parameter estimate for $(a_1 - 1)$. The associated t-statistic can then be used to determine whether or not the estimated parameter is significantly different from zero by referring to probability values in a Dickey-Fuller table (SAS Institute, Inc.).

Table 3. Results of Dickey-Fuller Unit Root Tests on Cost-of-Gain and Corn Price Data: Monthly Observations, 1980–96

Variable	D-F Statistic (τ)	*P*-Level[a]
Cost of Gain (*COG*)	−2.442	0.133
Corn Price (*CORN*)	−3.271	0.018
$\hat{e}$ [b]	−5.133	< 0.001

[a] The Dickey-Fuller test as presented here tests the null hypothesis that the data series has a unit root (i.e., is nonstationary).

[b] The expression $\hat{e}$ represents the residuals from the regression $COG = \beta_0 + \beta_1 CORN + \hat{e}$.

residuals from a least squares regression of cost of gain on corn price (i.e., $COG = \beta_0 + \beta_1 CORN$) was performed. This test indicated that the residuals are stationary and the data are therefore cointegrated. At $\alpha > 0.02$, a test of cointegration is unnecessary since at that level of significance, the null hypothesis of a unit root in the corn price series is rejected. Complete results of the D-F unit root tests are reported in table 3.

The foregoing discussion is significant because the choice of what type of model to estimate depends upon whether or not the data series are cointegrated. If they are, a model using levels of the data is appropriate; however, if they are not, a model in first differences is appropriate. Given that our results of the D-F tests were somewhat ambiguous (depending upon one's selection of α), both types of models were estimated and compared.

The estimated models had the following general form:

$$COG = f(CORN, COS, SIN), \tag{6}$$

where *COG* is cost of gain per pound, *CORN* is the corn price/bushel, and *COS* and *SIN* represent a set of cosine/sine variables based on 12-month and 6-month cycles to account for the seasonality of cost of gain. It is likely that a major source of seasonality in cost of gain is the seasonality of feed conversion efficiency (which is influenced by the effect of weather conditions on cattle performance). *COS* and *SIN* will therefore account for much of the impact of feed conversion rate changes on cost of gain.

If cost of gain is in fact inelastic with respect to corn price, coefficients on the lagged corn prices should be of a magnitude that would result in a cumulative elasticity of less than 1. In this case, the assumption of a unit elastic cost of gain in breakeven budgets will lead to erroneous cost-of-gain estimates. The degree to which estimates will be erroneous will depend upon the magnitude of the coefficients on the lagged corn prices. If slope parameters on the lagged corn prices result in a cumulative elasticity that is close to 1, then budgeting errors will be economically insignificant.

Modeling Results

Initially, a model using data levels containing the current and five lagged corn prices (i.e., the corn price during the month of slaughter and the five previous months) was estimated using ordinary least squares (OLS). Autocorrelation was found to be a significant problem with a Durbin-Watson test (DW = 0.211, P-value < 0.001). In addition, a Lagrange multiplier (LM) test for an autoregressive conditional heteroskedasticity (ARCH) process in the residuals was highly significant at each lag (P-level < 0.001) out to a 12-period lag.

A second model was estimated using first differences of cost-of-gain and corn price data. Following the format of the first model, a five-period lag of corn price differences was initially used. In other words, the model initially estimated was

$$(7) \qquad COG_t - COG_{t-1} = \beta_0 + \sum_{i=0}^{5} \beta_{i+1}\left(CORN_{t-i} - CORN_{t-(i+1)}\right) + \beta_7 COS_{12} + \beta_8 COS_6 + \beta_9 SIN_{12} + \beta_{10} SIN_6 + \varepsilon_t,$$

where all variables are as previously defined, with subscripts on COS and SIN variables representing the length of cycle (in months) for those variables.

As with the model in levels, this model was estimated using OLS. The statistical properties of the model were greatly improved; however, a slight problem with autocorrelation did persist. A Durbin-Watson test indicated significant (though greatly reduced) autocorrelation (DW = 1.744, P-level = 0.02). A Lagrange multiplier test of the residuals indicated that differencing the data had eliminated the ARCH process in the residuals. To correct for autocorrelation, the model was reestimated as a second-order autoregressive model using unconditional least squares estimation.

The general form of an autoregressive model is as follows:

$$(8) \qquad y_t = \mu + \gamma_1 x_1 + \gamma_2 x_2 + \dots + \gamma_k x_k + v_t,$$

$$(9) \qquad v_t = -\varphi_1 v_{t-1} - \varphi_2 v_{t-2} - \dots - \varphi_m v_{t-m} + \varepsilon_t,$$

$$(10) \qquad \varepsilon_t \sim N(0, \sigma^2),$$

where the dependent variable y_t in this case corresponds to the differenced cost-of-gain variable, and the independent variable x_t corresponds to the differenced corn price variable. The subscript m in equation (9) denotes the order of the autoregressive process, and equation (10) indicates that ε_t is normally distributed with zero mean and constant variance.

A Breusch-Godfrey Lagrange multiplier test for autocorrelation was not significant. This test consists of a regression of the residuals on all explanatory variables plus several lagged residuals. That is,

$$(11) \qquad e_t = f(x_{1t}, x_{2t}, \dots, x_{nt}; e_{t-1}, e_{t-2}, \dots, e_{t-P}).$$

The test statistic is calculated as NR^2, and is distributed as χ^2 with P degrees of freedom. This is a joint test of the first P autocorrelations of e_t (Greene). In this case, four lagged errors were used in the regression. The calculated test statistic of 6.421 (based on R^2 = 0.0367 and N = 194) is not significant at the 0.05 level, indicating that autocorrelation up to at least the fourth order is not present in the AR(2) model.[3]

[3] Initially, an AR(1) model was estimated to correct for autocorrelation. A Durbin-Watson test of the residuals of the AR(1) model indicated no significant autocorrelation; however, a Breusch-Godfrey test indicated significant second-order autocorrelation. This is the justification for the AR(2) model presented here. We test for autocorrelation out to the fourth lag due to the a priori expectation (discussed previously) that autocorrelation would be related to overlapping feeding periods. Four months is approximately equal to the feeding period.

Table 4. Parameter Estimates from Autoregressive Model of Changes in Cost of Gain

Independent Variable	Estimated Coefficient	t-Statistic
$\Delta CORN_{t-1}^{t-2}$	0.020	3.370
$\Delta CORN_{t-2}^{t-3}$	0.022	3.664
$\Delta CORN_{t-3}^{t-4}$	0.024	3.732
$\Delta CORN_{t-4}^{t-5}$	0.018	2.698
$\Delta CORN_{t-5}^{t-6}$	0.015	2.333
COS_{12}	0.017	15.714
COS_6	-0.004	-2.989
SIN_{12}	-3.200×10^{-4}	-0.288
SIN_6	0.005	4.874
$AR(1)$	-0.148	-2.050
$AR(2)$	0.177	2.425
Constant	3.519×10^{-5}	0.055

Note: $\Delta CORN_{t-i}^{t-(i+1)}$ refers to the change in corn price from period $t-(i+1)$ to period $t-i$.

Results of the AR(2) model using first-differenced data are presented in table 4. Using the parameter estimates from table 4 along with the means of corn price and cost of gain, the elasticity of cost of gain with respect to each of the five lagged corn prices can be calculated. Since the model uses differenced data, the calculation of these elasticities is not as straightforward as if levels of the data had been used. To calculate the elasticity at the means, a 1% change in corn price from the mean was used in the estimated equation to calculate the corresponding change in cost of gain. That change in cost of gain was then divided by the mean cost of gain to obtain a percentage change. The percentage change in cost of gain associated with a 1% change in corn price at each of the five lags can be considered, as can a cumulative percentage change (i.e., a cumulative elasticity). The calculated elasticities are presented in figure 1.

Implications

The cumulative elasticity of 0.533 (figure 1) indicates that cost of gain will be considerably less responsive to changes in corn price than suggested by breakeven analysis. This can lead to significant differences in cost-of-gain estimates. Table 5 illustrates the differences in value per head implied by using the cost-of-gain/corn price relationship found in this study versus the standard one-to-one relationship typically assumed in budget analyses. Base COG figures were calculated using the estimated parameters presented in table 4. Change in cost of gain was calculated based on the indicated change in corn price from the mean (i.e., the difference between the corn price in the first column of table 5 and the mean corn price reported in table 2). This value was added to the mean cost of gain (from table 2) to determine the base COG reported in the last column of table 5. The amount of gain is assumed to be 400 pounds. The figures reported in table 5 represent the difference between the change in cost of gain calculated first assuming unit elasticity, and then using the estimated elasticity of 0.533. In short,

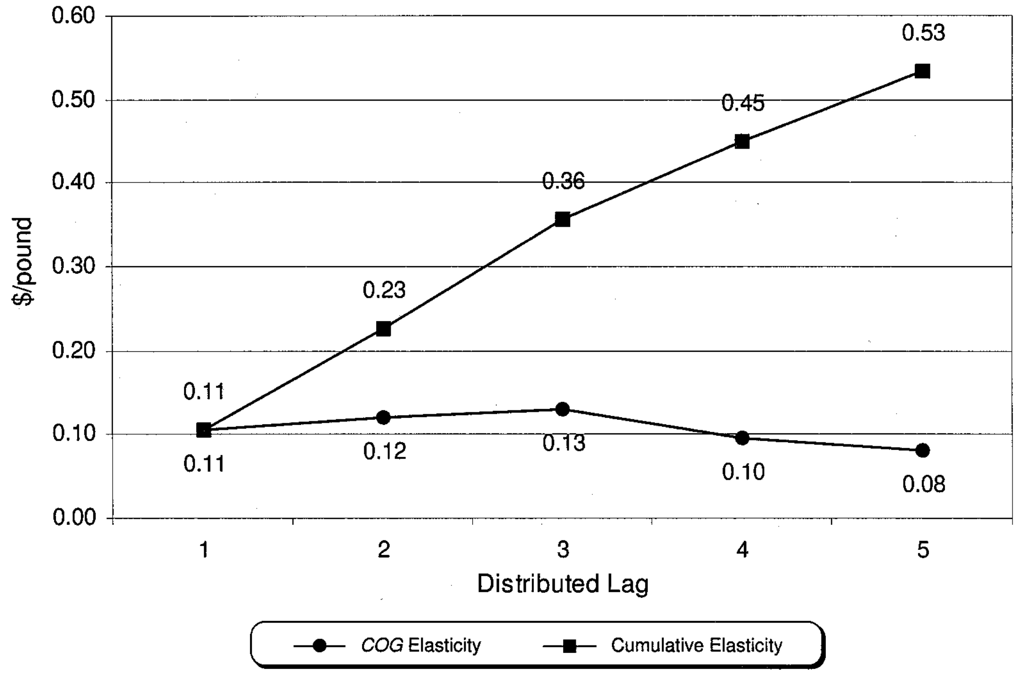

Figure 1. Distributed lag of cost of gain (*COG*) elasticity with respect to corn price

$$(12) \qquad Budget\ Error = 400\big((\%\Delta CORN * COG) - (\%\Delta CORN * 0.533 * COG)\big),$$

where $\%\Delta CORN$ is the percentage change in corn price indicated by the respective column headings in table 5, *COG* is the base cost of gain from the last column in table 5, and 400 represents the total pounds gained on feed.

The magnitude of error in evaluating feeding opportunities increases in absolute value as the price of corn rises and as the percentage change in corn price increases. The average month-to-month change in corn prices in the PCC data set in percentage terms was 3.2%, with a maximum percentage change of 32.3%. Corn prices during 1996 were as high as $4.81/bushel.

Table 5 implies that given typical corn prices of a little less than $3/bushel and month-to-month variation in corn prices of a little more than 3%, breakeven budget analysis typically generates errors in estimated returns to cattle feeding of about $3/head. Feedlot records indicate that in the long run (i.e., over the course of a complete cattle cycle) feedlot profits average about $10/head, so the $3 figure estimated here, while small in absolute terms, is quite significant in percentage terms (Trapp). Perhaps as important as the magnitude of this error is its systematic bias. This systematic bias suggests that numerous incorrect decisions are likely being made in response to corn price changes.

The effect of these incorrect decisions on the feeder cattle market is not entirely clear. If all participants in the market were making decisions based upon breakeven budget estimates, the effect would almost certainly be to destabilize the feeder cattle market. In other words, the impact of a corn price change on feeder calf prices would be

Table 5. Estimated Errors in Budgeted Cattle Feeding Net Returns Due to Assuming a 1:1 Relationship Between Corn Price and Feeding Cost of Gain

Corn Price ($/bu.)	Percentage Change in Corn Price and Cost of Gain							Base COG
	1%	2%	3%	5%	10%	15%	20%	
2.00	0.84	1.68	2.51	4.19	8.38	12.57	16.76	0.4486
2.50	0.93	1.86	2.79	4.65	9.31	13.96	18.61	0.4981
3.00	1.02	2.05	3.07	5.12	10.23	15.35	20.46	0.5476
3.50	1.12	2.23	3.35	5.58	11.16	16.73	22.31	0.5971
4.00	1.21	2.42	3.62	6.04	12.08	18.11	24.16	0.6466
4.50	1.30	2.60	3.90	6.50	13.00	19.51	26.01	0.6961

exaggerated. In reality, not all market participants make their decisions based on budget projections. Cattle buyers/feeders will have fairly complete information regarding their own access to alternative feeds and the prices they must pay. Given this more detailed information, they may also be able to use more sophisticated decision-making tools such as (in the case of feedlot operators) least-cost ration programs. Feeder calf producers, on the other hand, will not have this feed price/availability information. They will be more likely to rely on budget projections based on limited information or on simple rules of thumb (e.g., corn price multipliers). Thus, the effect of systematic errors in budget estimates could be to transfer profits from cattle producers to cattle buyers/feeders by incorrectly influencing retained ownership/marketing decisions on the part of producers.

To see how this transfer would come about, consider the decision that a producer faces regarding retained ownership. Producers must determine whether or not retaining ownership will be profitable based on the price for feeder cattle and expected feeding costs. If expected feeding costs are overestimated (due to incorrect assumptions implicit in the budget), then profit projections will be lower than they should be. The price which feeder calf buyers can actually afford to pay will be higher than what feeder calf producers believe is a breakeven purchase price. Thus feeder calf producers, due to their information disadvantage, may make retained ownership or marketing decisions that will result in some level of potential profits being passed on to feeder calf buyers. On average, the amount of this transfer will be some fraction of the $3/head figure determined above—a rather small amount. However, during periods of high or volatile corn prices, the number of incorrect decisions and the magnitude of budgeting errors could lead to significantly larger transfers (see table 5).

Summary and Conclusions

A model was developed to quantify the relationship between changes in corn price and changes in cost of gain. It was hypothesized that adjustments to feeding programs in response to corn price changes would result in cost of gain being considerably less responsive to corn price than is often assumed in breakeven budgets. Results of the cost-of-gain model provide strong support for this hypothesis. Changes in cost of gain were estimated to be a linear function of changes in corn price. Changes in corn prices for the last five periods were shown to have a significant impact on changes in cost of gain, with the third-period lagged corn price change having the largest impact. This is perhaps evidence of the fact that cattle feeders are storing corn and/or forward pricing the corn that will be fed to animals shortly after the animals are placed on feed (i.e., within one or two months after placement).

The responsiveness of cost of gain to corn price as measured with the cumulative elasticity was shown to be less than that implied by breakeven budgets which implicitly assume an elasticity of 1 between corn price and cost of gain. Based on the results of this study, budgeting such a relationship will exaggerate the impact of corn price changes on cost of gain. The amount of discrepancy between budget and model cost-of-gain estimates depends upon the magnitude of corn price changes as well as the level of corn prices. When corn prices are high or changes in price are great, quite large errors in cost-of-gain estimation may occur in budgeting calculations. These errors can be of sufficient magnitude to influence the retained ownership/marketing decisions of feeder cattle producers who are likely to have only limited access to specific feedlot cost-of-gain information and to the tools (e.g., least-cost ration programs) for analyzing such information.

This study indicates that quite substantial differences between budget estimates of cost of gain and actual cost of gain may exist; however, there is some reason to suspect that differences may actually be greater than this study reports. Data used in this study were highly aggregated. As noted, these data were compiled from feedlots all over the nation. At a local or even regional level, the availability of substitutes may be a bigger factor relating corn price to cost of gain than the aggregate data suggest. Given a more detailed data set, these regional differences could be modeled; however, the national aggregate data used here do not permit the estimation of such a model.

[*Received February 1999; final revision received May 2000.*]

References

Albright, M., T. Schroeder, and M. R. Langemeier. "Determinants of Cattle Feeding Cost of Gain Variability." *J. Production Agr.* 7(1994):206–10.

Engle, R., and C. Granger. "Co-integration and Error Correction: Representation, Estimation, and Testing." *Econometrica* 35(1987):251–76.

Fox, B. "Why Worry About $5 Corn?" *National Cattlemen* 11(1996):24–27.

Greene, W. H. *Econometric Analysis*, 2nd ed. New York: Macmillan Publishing Co., 1993.

Maday, J. "Living in a Weather Market." *Drover's J.* 124(1996):24–26.

Marsh, J. M. "Economic Factors Determining Changes in Dressed Weights of Live Cattle and Hogs." *J. Agr. and Resour. Econ.* 24,2(1999):313–26.

———. "Monthly Price Premiums and Discounts Between Steer Calves and Yearlings." *Amer. J. Agr. Econ.* 67(1985):307–14.

Professional Cattle Consultants. *PCC Newsletter.* PCC, Weatherford OK. Various issues, 1980–96.

SAS Institute, Inc. *SAS/ETS User's Guide, Version 6*, 2nd ed. Cary NC: SAS Institute, Inc., 1993.

Trapp, J. N. "Seasonal Aspects of Cattle Feeding Profits." *Oklahoma Current Farm Economics* 62(1989): 19–30.

Varian, H. R. *Microeconomic Analysis*, 3rd ed. New York: W. W. Norton and Co., 1992.