Sources and Structure of Profit Risk in Cattle Feeding

by

Stephen R. Koontz and James N. Trapp

Suggested citation format:

Koontz, S. R., and J. N. Trapp. 1993. “Sources and Structure of Profit Risk in Cattle Feeding.” Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL. [http://www.farmdoc.uiuc.edu/nccc134].

SOURCES AND STRUCTURE OF PROFIT RISK IN CATTLE FEEDING

Stephen R. Koontz and James N. Trapp*

on

rstanding the different sources and structure of risk involved in an
al enterprise is crucial for the development of risk management
. Cattle feeders face production, price, and financial risks. Studies
agement in cattle feeding have focused primarily on price risk (Gorman
yenga et al.; Heifner; Leuthold and Mokler; Leuthold and Peterson;
rice; Purcell and Riffe; Schroeder and Hayenga). In this context, the
modity futures contracts and options on futures contracts have been
e effective risk management tools. However, the problem persists that
few feedlot operators and custom cattle feeders use futures and
uthold et al.).

e are also studies which have examined the affects of production risk
eeding profits (Langemeier et al.; Swanson; Swanson and West; Trapp
and; Weimar and Hallam). Within production risk, cattle feeders face
d quality risk. Quantity risk emerges in that death loss and feeding
e, as measured in rates of gain, are stochastic variables. Stochastic
mance also results in feeding costs having a stochastic component due
animal performance. Quality risk surfaces through stochastic feeding
e and the relationship between fed cattle quality factors and the price
e to those factors. The interaction between stochastic quantity and
iables in the production process may have important implications for
decisions and profit risk management. Further, many of these studies
ggregate prices in at least a portion of the profit calculations.
rices may mask the true extent of risk faced by individuals feeding

is a need to develop a more complete understanding of the sources of
ly faced by cattle feeders. This will be done through modelling the
ps between production and price components of cattle feeding profits.
ine the structure and interaction of profit components including:
ts, feeder animal placement weights, feeder animal prices, days on
ter animal weights, slaughter animal prices, daily rates of gain, and
Once the structure of the profit component system is developed,
methods are used to assess the contribution of production and price
o overall profit risk. Simulation is used to measure how much profit
e reduced by eliminating pen-level production risk and pen-level
price risk. Further, since many previous studies examining cattle
have assumed constant production, this study will assess the impact
umption on estimates of profit risk.

e feeding enterprises can make production decisions to capture
pportunities and to manage risk. Cattle feeders can vary animal
d sale weights in response to variations in feed, feeder animal, and
imal prices. Purchases of feed and feeder animals can be varied
al low-cost alternatives, and components of the feed ration and the
ys an animal is on feed can be changed in response to variations in
oduction decisions can substitute for marketing risk management
s and production decisions may be made to take advantage of marketing
es. This research reveals the tradeoff between production and
ecisions through measuring the relative contribution of price and
isk to total profit risk.

---

authors are assistant professor and professor in the Department of
l Economics at Oklahoma State University.

Results of the research have implications for cattle feeders and economists developing, modifying, and implementing risk management strategies. The findings reveal and rank sources of risk in cattle feeding profits. The relative importance of price and production (quantity and quality) risks are quantified. The contribution of output price to profit risk is the maximum risk that may be transferred through hedging. The simulation identifies the interaction between these risks and management choices.

Data Description

Data were obtained on approximately 22,000 pens of cattle fed in Texas, New Mexico, Oklahoma, and Kansas feedlots from June 1986 through March 1992. The data were made available from Professional Cattle Consultants, Inc. (PCC), which collects pen-level data and provides aggregate summaries to contributing clients. Fifty-six feedlots participated in this service and provide data on at least fifty transactions over the sample period. The total feedlots participating in this service have an average total capacity of approximately 25% of the USDA seven-states cattle-on-feed numbers for this time period. The data set contains pen-level aggregate information including: placement date, total dollars paid at placement, number of head placed, total placement weight, the date the pen was shipped from the feedlot, total dollars from the sale, number of head sold, total sale weight, total pounds gained, number of days on feed, total pounds of feed consumed, and total feed cost.

Cattle feeders purchase feeder animals, incur feeding costs, and sell fed animals. The profit per head for each pen is calculated as follows

$$(1)\quad PROFIT = \{FEDP\cdot SALEWT\cdot(1 - DEATHL) - [FEEDERP\cdot PLACEWT + FEEDP\cdot((SALEWT - PLACEWT)\cdot CR)]\cdot(1 + RATE\cdot DOF/365)\}.$$

where FEDP, FEEDERP and FEEDP denote the slaughter animal, feeder animal and feed average prices, SALEWT and PLACEWT denote the slaughter animal and feeder animal average weights, DEATHL denotes percent pen death loss, CR denotes the average feed conversion rate (pounds of feed per pound of gain), DOF is the number of days the pen of animals is on feed, and RATE is the interest rate.

Table 1 presents means and standard deviations of the component variables in the profit equation (1) and the means and standard deviations of the per head net return to fixed costs (i.e., profit), revenue, feeder animal costs and feed costs for steers and heifers. The balance between the revenue, cost, and net returns figures are interest on feeder animal and feed costs. Statistics indicate that the price, quantity, revenue, and cost characteristics are within industry norms. The mean net return is negative for the sample reflecting the large losses incurred during 1991. Figure 1 presents the average net return by month for the sample period. The losses for 1991 offset the more normal profit/losses figures for the remainder on the sample. This event should not affect the ability to examine the structure and sources of profit risk.

Structure of Cattle Feeding Profits

The pen-level prices and quantities, and market-level live cattle futures prices and interest rates are used to model the system of the production and price components of profit. The system models the dependencies between production decisions and market prices through conditional means. Four prices are treated as exogenous: feed prices, distant live cattle futures contract prices at placement, nearby futures contract prices at marketing, and interest rates. These exogenous prices can be thought of as conditioning information. Given this information, production system choices and individual transaction prices can be described. These prices are largely determined by market forces prior to or outside of the influence of individual feedlot production and marketing decisions. Feed prices are assumed to be exogenous since they are largely determined by supply and demand conditions in grain and forage markets. Price levels of live cattle futures contracts which expire five-to-six months in the future and futures contracts under delivery or one month from delivery are a function of expected market conditions. The interest rate used is the prime rate plus 1.5%. This opportunity cost is indicative of the rate used by banks loaning money to cattle feeding clients (PCC). In essence, cattle feeders observe random draws of these four prices and production decisions are conditioned on the draws.

The production and price system model attempts to capture tradeoffs made by cattle feeders in production decisions, relationships between production decisions and market prices, and is structured as a recursive system. Quadratic and interaction terms are used to capture nonlinear relationships between the conditional means. Steer and heifer models are estimated jointly where a intercept dummy variable is used to identify pens of heifers and slope dummy variables are incorporated on the continuous variables to separate the steer and heifer affects.

Feeder animal placement weights are modelled as a function of feed prices and seasonal factors,

(2) Placement Weight = f(Feed Price, Seasonals) + ϵ_1.

Cattle feeders place animals of different weights during different seasons due to animal size availability. Variation in placement weights due to feed price levels is hypothesized. During high (low) feed prices cattle feeders should place heavier (lighter) feeder animals.

Feeder cattle prices are modelled as a function of the current distant live cattle futures price, average placement weight for an animal in the pen, current feed price, and seasonal factors,

(3) Feeder Price = f(Distant Live Cattle Futures Price, Feed Price, Placement Weight, Seasonals) + ϵ_2.

This specification is similar to hedonic price models and reflects derived demand for feeder cattle; the price of a pen of feeder cattle is a function of a price for the final product at a central market and the transaction price varies around the market price given the weight of the cattle, price of feed, and season of the year. The distant live cattle futures price, which is the market-determined value of animals at finish weights several months in the future, is used as the base price level. Heavier (lighter) weight feeder cattle have lower (higher) prices, and when feed costs are higher (lower) feeder animals are priced lower (higher). The residual from this equation (ϵ_2) is used in the system as an instrument to measure the quality of an individual pen of feeder animals (e.g., Fagan). Positive (negative) residuals indicate pens of higher (lower) quality than average.

The average slaughter weight at which a pen of cattle is modelled as a function of the average placement weight, feeder animal quality, feed price, and seasonal factors,

(4) Slaughter Weight = f(Placement Weight, Feeder Animal Quality(ϵ_2), Feed Price, Seasonals) + ϵ_3.

Increases (decreases) in placement weights and feeder animal quality result in higher (lower) slaughter weights. Increases (decreases) in feed prices result in lower (higher) slaughter weights. In addition, there are variations in slaughter weights due to weather and other seasonal factors.

Slaughter prices are modelled as a function of the nearby live cattle futures contract price, slaughter weight, feeder animal quality, and seasonal factors,

(5) Slaughter Price = f(Live Cattle Futures Price, Slaughter Weight, Feeder Animal Quality(ϵ_2), Seasonals) + ϵ_4.

Two versions of this equation are modelled. The first includes the live cattle futures price for the contract closest to delivery at the time the cattle are marketed and the second uses a futures price for the contract closest to delivery at the time the cattle were placed on feed. In the first version, the equation captures basis variation and the error term captures basis error. This basis error should be largely due to transaction price risk and quality variation in the pen of fed cattle not measured by the feeder cattle price premium/discount at the time of placement. However, this futures price only becomes known at the time the animals are marketed. When a distant futures price is used in the second version, the error term captures basis error and risk from a change in the level of cattle prices between placement and marketing. Slaughter weight also influences slaughter price. Increases in slaughter weight result in premiums for animals; however, at very heavy weights discounts occur. Higher (lower) quality feeder animals should result in slaughter cattle price premiums (discounts). There are also variations in slaughter prices due to seasonal factors.

The average conversion rate for a pen of cattle is modelled as a function of average slaughter weight, placement weight, animal quality, and seasonal factors,

(6) Conversion Rate = f(Slaughter Weight, Placement Weight, Feeder Animal Quality(ϵ_2), Seasonals) + ϵ_5.

The heavier (lighter) the animal at slaughter the poorer (better) the conversion rate due to lower (higher) marginal feeding gains during the final days of feeding. The heavier (lighter) the animal at placement the poorer (better) the conversion rate due to marginal feeding gains during the beginning of the feeding period. Higher quality animals perform better in the feedlot and should have better conversion rates. Weather, and thus the season of the year, affects feeding performance of cattle and conversion rate.

The number of days on feed for a pen of cattle is modelled as a function of placement weight, slaughter weight, conversion rate, animal quality, and seasonal factors,

(7) Days on Feed = f(Slaughter Weight, Placement Weight, Conversion Rate, Feeder Animal Quality(ϵ_2), Seasonals) + ϵ_6.

Animals which were placed on feed at heavier (lighter) weights spend less (more) time in the feedlot. Also, animals which are sold at heavier (lighter) weights spend more (less) time in the feedlot. Relatively high-performing animals, animals with low conversion rates, spend less time in the feedlot, and higher quality animals should spend less time in the feedlot. Seasonal factors may also influence the number of days a pen of cattle is on feed due to weather and temperature variations.

The death loss for a pen of cattle is modelled as a function of placement weight, animal quality, and seasonal factors,

(8) Death Loss = f(Placement Weight, Feeder Animal Quality(ϵ_2), Seasonals) + ϵ_7.

Whether heavier or lighter animals have more relatively difficulty adjusting to the shipment stress is a testable hypothesis. Higher (lower) quality animals as reflected by the price paid are in better (worse) health and these pens should experience lower (higher) death loss. Seasonal factors reflecting changing weather and temperature influence death loss. The death loss equation is modelled in a two-step process to account for the dependent variable which is truncated at zero (Maddala). The equation is first estimated as a Probit model. A zero-one dependent variable is constructed where an observation is zero if there is no death loss and one if there is positive death loss. The inverse of Mills' ratio is constructed from the Probit model and is used as an independent variable in the least squares model where the truncated death loss series is the

...ent variable. Consistent parameter estimates result from the two-step ...s.

...tion Procedure

The system of components from cattle feeding profits are modelled assuming ...mean affects across individual feedlots (Hsiao). Each model in the system ...uctured as follows

$$y_{it} = \beta_{0i} + \sum_{k=1}^{K} \beta_k x_{kit} + u_{it}$$

... denotes observations over individual feedlots and t denotes observations ...time.[1] The dependent variables (y_{it}) are the production and price ...ents of the system developed above. The independent variables (x_{kit}) are ...ormation upon which the production decisions and transaction prices are ...oned. The residual term captures the random error in prices associated ...dividual transactions and random error in the production process.

...eeding technology is similar across feedlots; there is little if any ...tary information or techniques. However, there may be management biases ...ferences which influence actions by feedlot operators. Likewise, ...tion prices should be largely determined by market conditions. For ..., the relationship between the fed cattle price and slaughter weight ...be independent of the feedlot. However, there may be management biases ...ing bargaining skill or location differences. Use of variable intercepts ...feedlots (β_{0i}) should capture differences in the dependent variables due ...gement biases. Constant slope parameters (β_k) should reflect the portion ...response by the dependent variable to changes in independent variables ...ing the feeding technology or market conditions.

...ion Procedure

...imulation is used to generate dependent variable series where production ...d price and basis risk have been removed. Five scenarios, summarized in ... are simulated. Profits in the actual data are subject to production and ...sk. In the first scenario, predicted values from the structural models ...d for placement weights, feeder animal quality, slaughter weights, ...on rates, days on feed, and death loss across all feedlots to simulate ...when pen-level production risks are eliminated. The feeder and slaughter ...ries are generated using predicted production variable values and the ...eed price, futures price, and interest rates. Randomness in individual ...nd slaughter cattle price transactions is kept by adding the residual ...ck into the prices calculated from the predicted values of the production ...es. In summary, values of production variables are

$$\ldots_{t} = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_k x_{kit}$$

...es of price variables are

$$\ldots_{t} = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_k x_{kit} + \hat{u}_{it}.$$

---

[1] The pooled cross-sectional time-series sample is unbalanced. The data ...e series of pen-level transactions across numerous feedlots. The sample ...from a fixed number of feedlots across a uniform blocks of time. ...e, the dynamics in the error covariance matrix are infeasible to model.

Some of the x_{kit} variables in equation (11) are predicted values from equation (10). This prevents the predicted values from the price models from equalling the actual price levels, but makes the simulated prices consistent with the physical attributes of the animals.

In the second scenario, aggregate prices are simulated through removing the individual pen-level transaction price risk. The residual values are not included in the calculation. In addition, pen-level variation in feed price is removed using monthly average prices by each state in the sample. Production variables are simulated incorporating the values of the less risky price variables. Values of production variables are

$$(12)\quad \hat{y}_{it} = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_k x_{kit} + \hat{u}_{it}$$

and values of price variables are

$$(13)\quad \hat{y}_{it} = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_k x_{kit}.$$

Some of the x_{kit} variables in equation (12) are predicted values from equation (13). This prevents the predicted values from the production models from equalling the actual production levels, but makes the simulated production variables consistent with the prices of the animals.

In the third scenario, pen-level production and price risk are both removed by dropping the residuals from both calculations. Again, monthly average feed prices for each state are used to remove pen-level variation in feeding costs. Values of production variables are

$$(14)\quad \hat{y}_{it} = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_k x_{kit}$$

and values of price variables are

$$(15)\quad \hat{y}_{it} = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_k x_{kit}.$$

Some of the x_{kit} variables in each equation are predicted values from the other equation.

In the fourth scenario, production variables are assumed constant while prices are subjected to pen-level transaction risk. Values of production variables are

$$(16)\quad \hat{y}_{it} = \bar{y}$$

and values of price variables are

$$(17)\quad \hat{y}_{it} = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_k x_{kit} + \hat{u}_{it}$$

where some of the x_{kit} variables in equation (17) are constant values from equation (16). If cattle feeders make production decisions to take advantage of marketing opportunities or to manage risk, cattle feeding profits in this constant production scenario would be lower and subject to more volatility.

In the fifth scenario, production is assumed constant and prices have pen-level transaction risk removed. Values of production variables are

(18) $\hat{y}_{it} = \bar{y}$

and values of price variables are

$$(19)\quad \hat{y}_{it} = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_k x_{kit}$$

where some of the x_{kit} variables in equation (19) are constant values from equation (18). Monthly average feed prices by state are used in the simulation. Cattle feeding profits in this scenario are analogous to profit series constructed in other studies which have assumed fixed production and made use of aggregate prices.

Four versions of the five different risk scenarios are simulated. One version where basis risk is captured by the error term in the fed cattle price model and one version where basis and price risk are captured. This allows the indirect measurement of the magnitude of price level risk. Both of these versions of the simulation are run from a long-term and short-term profit risk perspective. In the long-term risk simulation, all of the components of profit are treated as stochastic. In the short-term risk simulation, because feeder cattle prices, weight, and quality are known when the animals are placed on feed, these variables are treated as fixed. In the short-run, there is no feeder animal price, weight, or quality risk, there is only output and performance risk. Short-run versions of scenarios 4 and 5 are run assuming feeder animal price and quality are known and that the placement weight is equal to the sample average. It is not logically consistent to simulate placement of different animal weights and then enforce constant performance and sale weights. The four versions of the simulation are also summarized in table 2.

Modelling Results

Complete model results are not reported because of the large number of models and parameters. However, the results are discussed below; complete results are available from the authors. The system of equations effectively models a large percent of the variation and interaction of the components of cattle feeding profits. Feed prices, the heifer dummy variable, heifer and feed price interactions, and seasonal and feedlot dummy variable explain 32.5% of the variation in placement weights. There is a strong interaction between feed prices and placement weights; higher (lower) feed prices result in the placement of smaller (larger) animals in feedlots. Heifers placed are significantly lighter. There is a seasonal pattern to placement weights with larger animals placed in spring and summer months. There is also some management or location bias affecting feeder animal placement weights.

Distant live cattle futures prices, feed prices, placement weights, and heifer, seasonal and feedlot dummy variables explain 77.0% of the variation in feeder animal prices. Most of the variation in feeder animal prices is explained by futures prices and the feeder animal weight. Heifers are discounted and the discounts are different for different weights. There is also a seasonal pattern and management or location biases affecting feeder animal prices.

Feed prices, placement weights, feeder animal quality, and heifer, seasonal and feedlot dummy variables explain 71.7% of the variation in placement weights. Placement weights and feed prices are the strongest factor affecting sale weights. Higher (lower) quality cattle are fed to heavier (lighter) slaughter weights. Heifers are fed to lighter weights. There are variations in average sale weight across feedlots and a seasonal pattern with heavier animals sold the first half of the calendar year.

Nearby live cattle futures prices, sale weight, feeder animal quality, and heifer, seasonal and feedlot dummy variables explain 73.1% of the variation in fed cattle prices. The nearby futures price and animal sale weight are the factors influencing fed cattle prices the most. Higher quality cattle do not appear to receive a price premium and heifers do not receive a price discount. There is a seasonal pattern and management or location biases affecting fed cattle prices.

Placement weight, sale weight, feeder animal quality, and heifer, seasonal and feedlot dummy variable explain 70.9% of the variation in conversion rate and 59.0% of the variation in days on feed. Conversion rate is incorporated into the days on feed model. Placement and sale weight are the main factors explaining variation in these production variables. There is little difference between steer and heifer performance. However, high quality animals perform significantly better.

Placement weight, feeder animal quality, and heifer, seasonal and feedlot dummy variables explain 22.2% of the variation in pen-level death loss. Heavier animals have a more difficult time adjusting to placement, while higher quality pens of animals have lower death loss figures. The coefficient associated with the inverse of Mills' ratio variable is significant suggesting there is enough truncation of the death loss random variable to bias a least squares model. The two-step model results in consistent estimates.

Simulation Results

Means and standard deviations of the net returns simulated for the different risk scenarios are reported in table 3. The results across steers and heifers are identical, so the combined steer and heifer feeding results are reported. Actual and simulated net returns are close to being normally distributed. The data are mildly negatively skewed and mildly kurtotic. Summarizing the data in terms of means and variances appears to be appropriate. The dollar per head change in net return means and the percent change in net return variances between the actual data and the simulation are reported in table 4. The net return variances from all of the simulations are significantly different from the variance of the actual net returns. All of the net return means from the simulations are significantly different from the actual net return mean with the exception of the results from scenario 3 under the long-term perspective in both the price and basis risk and the basis risk versions.

Scenario 1 simulation results suggest eliminating pen-level production risk increases the mean net return by $2.35/head and decreases the variance of net returns by 7.4%. Eliminating feeder animal quality risk increases the mean net return by $1.11/head and increases net return variance by 7.3%. Eliminating feeder animal quantity risk increases the mean net return by $1.05/head and decreases net return variance by 14.7%.[2] Thus, cattle feeders use variations in animal quality to help manage profit risk. Quantity risk increases profit risk. In the short-run, eliminating pen-level production risk increases the mean net return by $0.95/head and decreases the variance of net returns by 16.6%. Short-run production risk is greater than long-run production risk. The intuition behind this result is that across many pens of animals there is interaction between feeder animal price, quantity, and quality, which mitigates a portion of the risk faced with any one pen.

Scenario 2 results suggest that eliminating pen-level price and basis risk decreases the mean net return by $2.81/head and decreases the variance of net returns by 47.0%. Eliminating just the pen-level basis risk decreases the mean net return by $2.80/head and decreases the variance of net returns by 35.1%. This implies that removing price risk between placement and marketing would increase the mean return by $0.01/head and decrease 11.9% of the net return variance. This is the maximum amount of profit risk reduction possible through feed, feeder cattle, and live cattle hedging. Pen-level basis and quality risk

---

[2] These two results were generated from separate simulations of subsets of scenario 1 which are not reported. The system was simulated after removing quality variation and then simulated after removing quantity variation. Scenario 1 removes both quantity and quality.

is three times larger than the risk from price changes. In the short-run, eliminating pen-level price and basis risk decreases the mean net return by $2.83/head and decreases the variance of net returns by 26.8%. Eliminating just the pen-level basis risk decreases the mean net return by $2.82/head and decreases the variance of net returns by 14.1%. Thus removing price risk between placement and marketing increases the mean return by $0.01/head and decreases 12.7% of the net return variance. This is the maximum amount of profit risk reduction possible through a, short-term perspective, feed and live cattle hedging program. The overall results suggest that one-quarter to less than half of transaction price risks are due to changes in price levels. The majority of price risk is related to transaction price risk and animal quality.

The results from scenario 3 simulations suggest that eliminating pen-level price and basis risk and production risk has no affect on mean net returns and will decrease net return variance by 61.9%. The difference in the net return variance reduction between the price and basis risk version and the basis risk version of the simulation suggests the risk of price changes between cattle placement and marketing is 12.3% of the total profit risk. This is consistent with the scenario 2 results. In the short-run, eliminating pen-level price and basis risk and production risk decreases the mean net return by $1.35/head and decreases the variance of net returns by 40.1%. Eliminating the pen-level basis risk and production risk decreases the mean net return by $1.23/head and decreases the variance of net returns by 26.9%. Removing price risk between placement and marketing increases the mean return by $0.02/head and decrease 13.2% of the net return variance. As in scenario 2, use of commodity futures contracts in a routine hedging strategy to manage risk will reduce net return variability a maximum of 12% to 13% and will have no affect of the mean net returns.[3]

Scenario 4 of the simulation assumes production components of the profit equation are equal to their sample means. The results suggest eliminating all production variability increases the mean net return by $1.69/head and increases the variance of net returns by 10.3%. The basis risk version of the simulation has similar numbers. Short-run versions of this scenario suggest the mean and variance of net returns are increased slightly less in the shorter time frame. This suggests when production is assumed constant, and when prices are generated consistent with the constant production, that profits and profit risk are overestimated. Cattle feeders manage risk through purchasing different quality cattle and through making quantity adjustments in response to varying market prices. However, the price and quantity combinations work against cattle feeder profit levels.

Scenario 5 uses production variables equal to their sample means and smoothed prices series. Average feed prices are calculated for each month and state in the sample. Average futures prices are calculated for each month. This removes some of the individual transaction price variability and constructs price series which are comparable to regional monthly average prices used in previous risk management studies. The results show that constant production and aggregate prices result in a mean net return which is $0.71/head lower than the actual mean and a net return variance which is 53.6% lower than the actual variance. The difference in the net return variance reduction between the price and basis risk version and the basis risk version of the simulation suggests the risk of price changes between cattle placement and marketing is 16.0% of the total profit risk. This suggests that profit risk is substantially underestimated in constant production aggregate price studies. Further, as revealed in scenario 4, a portion of the risk that is captured is the wrong type of risk. The short-run version of this scenario suggest variance of net returns are decreased by 32.0% in the price and basis risk simulation and by 14.6% in the basis risk simulation. Thus, removing price risk reduces profit risk by 17.4%. This is the only simulation scenario and version where price risk is greater than basis risk.

---

[3] Net returns will be reduced by hedging program costs.

Conclusions

The pen-level variation in cattle feeding net returns is extensive and average net returns are negative over the 1986 to 1992 sample period because of the large losses in late 1991. Large variations in profit are due to variations in animal placement weight, sale weight, quality, performance in the feedlot, and prices of individual transactions. 62% of the total profit risk is due to price and basis risk and production risk. More than one-half of this risk is due to variations in finished animal quality and individual transaction prices that cannot be explained by animal weight, feeder animal quality, and general fed cattle price levels at the time of placement. Cattle feeders appear to have strong incentives to manage this basis risk. Less than one-quarter of the profit risk is due to changes in fed cattle price levels. This suggests trade in commodity futures contracts will have a limited ability to help cattle feeders manage profit risk. Less than one-quarter of the profit risk is due to pen-level production risk which cannot be explained by variations in feed price and other systematic (predictable) variations in performance factors. There is also a small portion of the profit risk which is due to the interaction of the price and basis risk and production risk. Finally, short-run profit risk is 80% the size of long-run profit risk. Thus, variations in feeder cattle price, weight, and quality are 20% of total profit risk.

Table 1. Means and Standard Deviations for Prices, Quantities, Returns and Costs of Feeding Steers and Heifers.

	Steers	Heifers
	Mean (Std Dev)	Mean (Std Dev)
Feed Price ($/cwt.)	6.12 (0.82)	6.18 (0.67)
Placement Weight (lbs.)	713.7 (97.8)	654.1 (90.4)
Feeder Cattle Price ($/cwt.)	82.62 (10.39)	81.05 (9.44)
Sale Weight (lbs.)	1155.3 (75.8)	1044.7 (72.8)
Fed Cattle Price ($/cwt.)	72.71 (5.47)	73.22 (5.53)
Conversion Rate (lbs. of feed per lb. of gain)	8.065 (1.119)	8.440 (1.036)
Days on Feed	150.2 (39.7)	151.3 (44.62)
Death Loss (%)	0.010 (0.014)	0.012 (0.015)
Distant Futures Price ($/cwt.)	70.13 (6.10)	71.48 (5.38)
Nearby Futures Price ($/cwt.)	72.47 (5.31)	73.68 (4.69)
Interest Rate (%)	0.109 (0.011)	0.111 (0.011)
Net Return ($/head)	-6.43 (70.45)	-8.37 (60.93)
Fed Animal Revenue ($/head)	832.08 (85.74)	756.13 (79.49)
Feeder Animal Cost ($/head)	587.29 (96.12)	529.04 (87.84)
Feed Cost ($/head)	215.02 (41.62)	201.68 (36.78)

Table 2. Summary of the Different Risk Reduction Scenarios and the Levels of Information Implied by the Different Versions of the Cattle Feeding Profit Simulations.

Scenario	Scenario Conditions
Scenario 1	No individual pen production risk and actual prices.
Scenario 2	Actual production and no individual pen price risk
Scenario 3	No individual pen production or price risk
Scenario 4	Constant production and actual prices
Scenario 5	Constant production and aggregate prices
Version	**Version Conditions**
Long-term Basis and Price Risk	Basis and Price Risk where All Profit Components are Unknown
Long-term Basis Risk	Basis Risk where All Profit Components are Unknown
Short-term Basis and Price Risk	Basis and Price Risk where Feeder Cattle Characteristics and Prices are Known
Short-term Basis Risk	Basis Risk where Feeder Cattle Characteristics and Prices are Known

Figure 1. Average and Two Standard Deviations on Cattle Feeding Profits by Marketing Month.

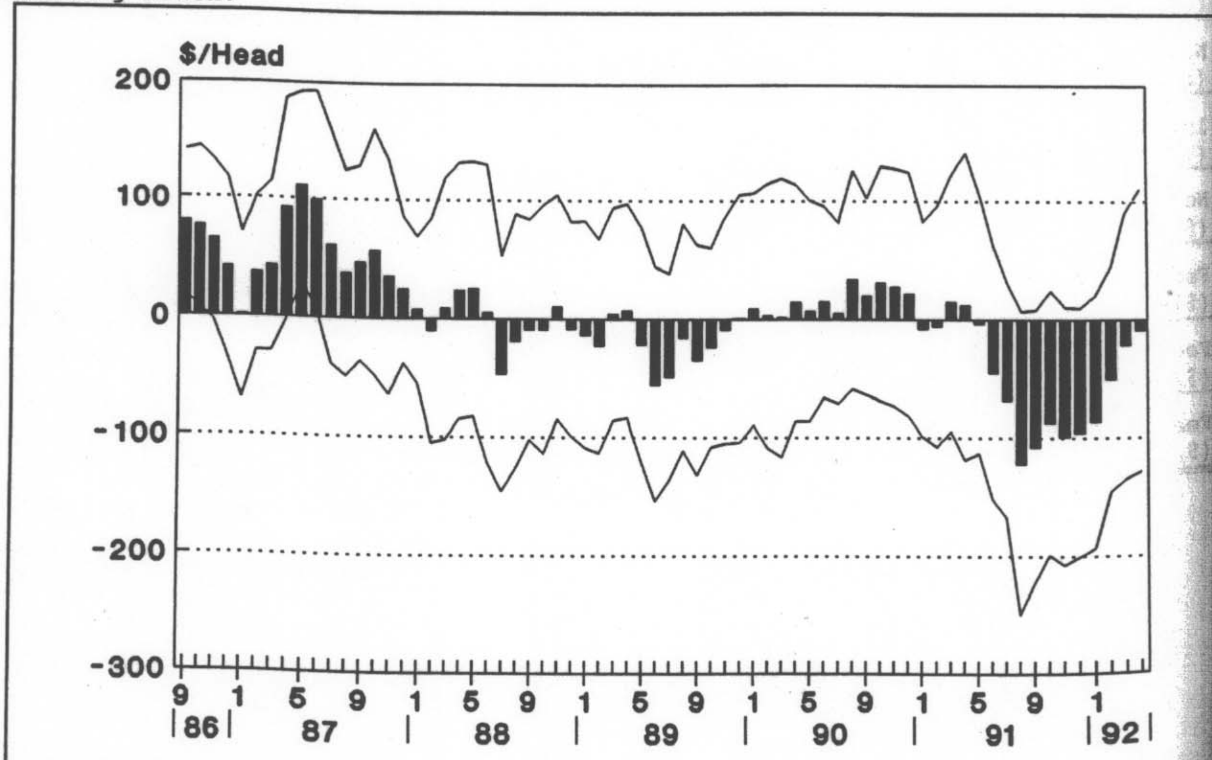

Table 3. Means and Standard Deviation of Net Returns to Cattle Feeding Under the Five Risk Changing Scenarios and Four Versions of the Simulation.

	Scen 1	Scen 2	Scen 3	Scen 4	Scen 5
	Mean (S D)	Mean (S D)	Mean (S D)	Mean (S D)	Mean (S D)
Long-Term Price and Basis Risk Version	-4.44 (66.17)	-9.60 (50.06)	-6.65 (42.46)	-5.10 (72.24)	-6.08 (46.83)
Long-Term Basis Risk Version	-4.73 (65.78)	-9.59 (55.41)	-6.94 (48.83)	-5.06 (72.79)	-6.18 (54.33)
Short-Term Price and Basis Risk Version	-5.84 (62.80)	-9.62 (58.84)	-8.14 (52.87)	-6.23 (70.41)	-7.20 (56.72)
Short-Term Basis Risk Version	-5.69 (62.89)	-9.61 (63.73)	-8.02 (58.78)	-5.97 (71.39)	-7.08 (63.56)

Table 4. Change in Mean Net Return and Percent Change in Net Return Variance between the Actual Net Return Series and the Simulated Net Return Series.

	Scen 1	Scen 2	Scen 3	Scen 4	Scen 5
	$\$\Delta\mu$ $\%\Delta\sigma^2$	$\$\Delta\mu$ $\%\Delta\sigma^2$	$\$\Delta\mu$ $\%\Delta\sigma^2$	$\$\Delta\mu$ $\%\Delta\sigma^2$	$\$\Delta\mu$ $\%\Delta\sigma^2$
Long-Term Price and Basis Risk Version	+$2.35 -7.4%	-$2.81 -47.0%	+$0.14 -61.9%	+$1.69 +10.3%	-$0.71 -53.6%
Long-Term Basis Risk Version	+$2.06 -8.5%	-$2.80 -35.1%	-$0.15 -49.6%	+$1.73 +12.2%	-$0.61 -37.6%
Short-Term Price and Basis Risk Version	+$0.95 -16.6%	-$2.83 -26.8%	-$1.35 -40.1%	+$0.56 +4.8%	+$0.41 -32.0%
Short-Term Basis Risk Version	+$1.10 -16.5%	-$2.82 -14.1%	-$1.23 -26.9%	+$0.82 +7.8%	-$0.29 -14.6%

References

Gorman, W.G., T.R. Schuneman, L.B. Catlett, N.S. Urquhart, and G.M. Southward. "Empirical Evaluation of Selected Hedging Strategies for Cattle Feeders." Western Journal of Agricultural Economics 7(1982): 199-209.

Hayenga, M.L., D.D. DiPietre, J.M. Skadberg, and T.C. Schroeder. "Profitable Hedging Opportunities and Risk Premiums for Producers in Live Cattle and Live Hog Futures Markets." Journal of Futures Markets 4(1984): 141-154.

Heifner, R.G. "Optimal Hedging Levels and Hedging Effectiveness in Cattle Feeding." Agricultural Economics Research 24(1972): 25-36.

Hsiao, C. Analysis of Panel Data. Cambridge: Cambridge University Press, 1986.

Judge, G.G., R.C. Hill, W.E. Griffiths, H. Lütkepohl, and T.-C. Lee. The Theory and Practice of Econometrics, 2nd ed. New York: John Wiley and Sons, Inc., 1985.

Langemeier, M., T. Schroeder, and J. Mintert. "Determinants of Cattle Finishing Profitability." Southern Journal of Agricultural Economics 24(1992): 41-47.

Leuthold, R.M., J.C. Junkus, and J.E. Cordier. The Theory and Practice of Futures Markets. Lexington, MA: Lexington Books, 1989.

Leuthold, R.M. and R.S. Mokler. "Feeding Margin Hedging in the Cattle Industry." Proceedings of the International Futures Trading Seminar of the Chicago Board of Trade 6(1979): 56-68.

Leuthold, R.M. and P.E. Peterson. "A Portfolio Approach to Optimal Hedging for a Commercial Cattle Feedlot." Journal of Futures Markets 7(1987): 119-133.

Maddala, G.S. Limited-Dependent and Qualitative Variables in Econometrics. Cambridge: Cambridge University Press, 1983.

McCoy, J.H. and R.V. Price. Cattle Hedging Strategies, Kansas Agricultural Experiment Station Bulletin No. 591, August 1975.

Pagan, A. "Econometric Issues in the Analysis of Regressions with Generated Regressors." International Economic Review 25(1984): 221-247.

Purcell, W.D. and D.A. Riffe. "The Impact of Selective Hedging Strategies on the Cash Flow Position of Cattle Feeders." Southern Journal of Agricultural Economics 12(1980): 85-93.

Schroeder, T.C. and M.L. Hayenga. "Comparison of Selective Hedging and Options Strategies in Cattle Feedlot Risk Management." Journal of Futures Markets 8(1988): 141-156.

Swanson, E.R. "Sources of Profit and Decision Making in Cattle Feeding." Journal of Farm Economics 41(1959): 640-644.

Swanson, E.R., and I.V. West. "Statistical Analysis of Feeder Cattle Returns." Journal of Farm Economics 45(1963): 146-150.

Trapp, J.N. and S.D. Cleveland. "An Analysis of the Source of Profit Volatility in Cattle Feeding." Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, Chicago, April 1989.

Weimar, M.R. and A. Hallam. "Risk Sharing in Custom Cattle Feeding." North Central Journal of Agricultural Economics 12(1990): 279-291.