Output Uncertainty in Fed Cattle Hedging

by

Brian D. Adam, Stephen R. Koontz, and James N. Trapp

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Introduction

Cattle feeding enterprises face considerable price risk (Purcell and Riffe). This risk places financial burdens upon cattle feeders given the unanticipated variations in prices and profits. Cash flow management is difficult and rapid devaluation of assets is a possibility in this environment.

Most research on the management of risk by cattle feeders has examined alternative forward pricing strategies using market prices. Research commonly examines marketing alternatives through the use of commodity futures and, more recently, options strategies. Most research finds these forward pricing strategies to be effective in managing price risk.

This research addresses three issues, expanding on previous fed cattle hedging research. First, the prices received by individual producers are likely more variable than aggregate regional prices. Therefore, individuals are exposed to more basis risk than may be typically captured in studies which use regional prices. Unique pen level data are used to examine the effect of individual transaction basis risk on the effectiveness of hedging.

Second, and related to the first issue, the effect that output uncertainty has on hedging by cattle feeders is examined. Rolfo has shown that uncertainty in the final quantity of output reduces the optimal hedge ratio. Market prices and the quantity an individual firm has available for sale in general are negatively correlated. This negative correlation inhibits the ability of the hedger to offset changes in the value of the cash position with a futures contract position. Revenue for fed cattle sales varies due to variations in animal weight and animal quality. These variations are likely correlated with the price received and therefore affect the degree of hedging necessary to manage price risk. The effect of this uncertainty on hedging recommendations for cattle feeders is examined with pen level data.

Third, cattle feeding enterprises have the ability to manage risk through production decisions and make production decisions based on marketing opportunities. Cattle feeders can vary animal placement and sale weights in response to variations in feed, feeder animal, and slaughter animal prices. They often vary purchases of feed and feeder animals among seasonal low-cost alternatives, and they have the ability to vary components of the feed ration and the number of days an animal is on feed in response to variation in relevant prices. Production decisions may be made to substitute for risk management through marketing decisions or production decisions may be made to take advantage of marketing opportunities. This research examines the tradeoff of production and marketing alternatives.

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As a final motivating point, researchers are faced with a dilemma in that the use of futures contracts by agricultural producers, including cattle feeders, is less than what would be expected given results of forward pricing studies. This suggests cattle feeders are less risk averse than assumed or that risk is managed through other methods. This research produces optimal hedge ratios for cattle feeding enterprises when production system flexibility and output uncertainty are considered. We anticipate that risk can be managed through variations in production decisions and that this is a substitute for risk management through hedging, and that output uncertainty inhibits the effective use of commodity futures for hedging. Because of these factors, optimal hedge recommendations may be lower than those from previous research and more consistent with observations on actual use of commodity futures by cattle feeders.

Literature Review

Numerous studies have been conducted on the use of commodity futures and, more recently, options on commodity futures to manage price risk faced by cattle feeding enterprises. The general conclusion of these studies are that routine hedging with commodity futures and options can be used to reduce variations in prices, cash flow and profits. In addition to this reduction in risk is usually a reduction in overall or average profit levels.

The optimal hedge ratio literature suggests cattle feeders can minimize risk by hedging 60% to 98% of their cash position and that this action will reduce the variation in revenue by 12% to 40% (See Elam and Blank et al.). More detailed studies have shown that the risk minimizing strategies may not be attractive because they result in losses. These studies then go on to examine more elaborate hedge decision rules. There are often strategies which are more attractive than the pure cash or routine hedge strategies on the risk/return continuum (See Hayenga et al. and references therein).

Most studies to date have assumed fixed and nonstochastic production systems. Cattle feeders purchase a feeder of a constant weight (600 to 650 pounds) and constant ration components (grain and forage) at prevailing prices. These animals are then fed for a constant number of days and sold at a fixed weight, less shrink and pen death loss, at prevailing prices. If a constant production strategy is not the best representation of the actions followed by cattle feeders, the results of these studies may over-estimate the effectiveness of hedging and may recommend hedging actions in excess of the optimal. Further, prevailing market prices may not capture the variation in prices experienced by cattle feeders due to market price dispersion and output uncertainty. This research expands on previous work by generalizing the production strategy cattle feeders are assumed to follow and by measuring the price variation with pen level transaction data.

Production and Hedging Model

A two-period model is used to summarize the problem faced by the cattle feeder. The producer purchases the feeder animal in the first period and sells the fed animal in the second and is assessed feed costs. The producer has the ability to enter into a live cattle futures transaction the day the feeder animal is purchased and this transaction is offset the day the fed animal is marketed. The profit per head from the cash and futures position is calculated as follows

$$\begin{aligned}PROFIT = {} & [FEDP\cdot SALEWT\cdot(1-DEATHL) - [FEEDERP\cdot PLACEWT \\ & + FEEDP\cdot((SALEWT-PLACEWT)\cdot CR)]\cdot(1+IRATE\cdot DOF/365)] \\ & + \alpha\cdot(LP2-LP1)\cdot SALEWT\cdot(1-DEATHL) - COMMISSION\end{aligned} \tag{1}$$

where FEDP, FEEDERP and FEEDP denote the slaughter animal, feeder animal and feed prices, SALEWT and PLACEWT denote the slaughter animal and feeder animal weights, DEATHL denotes percent death loss, CR denotes the feed conversion rate (pounds of feed per pound of gain), DOF is the number of days the animal is on feed, IRATE is the market interest rate, LP2 and LP1 are the live cattle futures prices on the day animals are placed on feed and the day animals are marketed, COMMISSION is the futures commission per animal, and α is the percentage of the cash position which is hedged. The first two lines of the equation capture the cash market returns and the third line is the return to the futures position.

The volume of hedging conducted by a cattle feeder is treated as a percentage of fed animal production. A pen level data set is used, composed of approximately 3500 observations of cattle fed from 1986 through 1990. The data suggest that pens are often combined when animals are sold; one-third of the pens are combined from smaller lots. On average, there were 183 animals in a marketed pen. Feeder animals are bought in smaller lot sizes. Further, there are multiple pens sold by a feedlot on any one day. Therefore, the data suggest that the lumpiness of live cattle futures contracts (35 cattle per contract) does not influence hedging decisions by commercial feeders and is not incorporated into the model. The results also allow direct comparison to recommendations from the optimal hedge ratio literature.

The interrelatedness and the stochastic nature of the quantity components of the profit equation are modelled statistically. This model system (described in a later section) is used to simulate the interaction of production decisions and the variation in production decisions given variations in market prices. Through simulation, cash and futures returns series are constructed and evaluated under flexible and constant production assumptions.

An expected utility framework is used to evaluate the effectiveness of hedging. The producer is assumed to maximize an expected utility function in choosing the optimal percentage of the cash position to be hedged. The optimization model is

$$\underset{\alpha}{Max}\iint U[Profit(CR,FR,\alpha)]\,f(CR,FR)\,dCRdFR \tag{2}$$

where CR and FR denote the cash and futures position returns and f(CR,FP) denotes the joint distribution of the returns. A statistical model developed to capture the production flexibility and, based on the pen-level data, is used to simulate the joint cash and futures returns density. The utility function used is the negative exponential, U[Profit] = $-\exp(-\phi\cdot \text{Profit})$, where ϕ is the Arrow-Pratt coefficient of absolute risk aversion.[1] Given distributions on cash and futures

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[1] Although this utility function has been criticized because of the implicit constant absolute risk aversion assumption, it has been used extensively in the literature on decision making under risk. Further, empirical studies have found that the results from this function are qualitatively similar to that of alternative specifications (Adam).

returns, expected utility is maximized through numerical methods. The optimization is performed for several values of the Arrow-Pratt coefficient representing producers whose risk preferences can be described as between risk averse and risk neutral.

Two cash and futures returns densities are generated through stochastic simulation. The first assumes flexible production and the second assumes a fixed production system. In order to assess the consequences of assuming constant production, optimal hedge ratios and other returns characteristics are compared under these two simulations. Certainty equivalents are used to convert expected utility measures to risk-adjusted money terms for comparison of market outcomes. The certainty equivalent (CE) for negative exponential utility is calculated as $CE = -\ln(-EU[\bullet])/\phi$, where $EU[\bullet]$ is expected utility and ϕ is the Arrow-Pratt measure of absolute risk aversion.

The hedging model focuses on a simple futures transaction decision. The cattle feeder hedges some portion, possibly zero, of the cattle in the feedlot when the cattle are placed on feed and the futures position is lifted when the finished cattle are marketed. The simple model focuses on the tradeoff between managing risk through production decisions and routine hedging.

Data Description

Data were obtained on approximately 3500 pens of cattle fed in Oklahoma, Western Texas, Northeast New Mexico, and Southwest Kansas feedlots from May 1986 through December 1990. The data were made available from a consulting company, Professional Cattle Consultants, Inc., which collects this pen level data and provides aggregate and market summaries to clients. Between forty-four and seventy-five feedlots participate in this service, with a total capacity of approximately 25% of the USDA seven states cattle on feed numbers. The data set contains detailed information on each pen of cattle including: placement date, total dollars paid at placement, number of head placed, placement weight, the date the pen was shipped to slaughter, total dollars from the sale, number of head sold, sale weight, total pounds gained, number of days on feed, pounds of feed consumed, and total feed cost.

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 profit, revenue, feeder animal costs and feed costs. The balance is interest on feeder animal and feed costs. Data are limited to pens of steers and statistics indicate that the price, quantity, revenue and cost characteristics of these pens are within industry norms.

Structure of the Price and Production System and the Simulation

Pen-level information on prices and quantities, and market-level information on live cattle futures prices and interest rates are used to construct a system of physical and price interactions. The system models the dependencies between production decisions and market prices — conditional means, error variances and covariances. System specification is outlined in figure 1 and is discussed below along with the statistical findings. Details of the system and the estimates are presented in Koontz, Trapp, and Cleveland. An earlier version of this work which uses a short sample period is reported in Trapp and Cleveland.

Four prices are treated as exogenous but correlated: feed prices, distant live cattle futures contract price at placement, the change in futures contract price between placement and marketing, and interest rates. These exogenous prices can be thought of as conditioning information. Given information on these prices, production system choices are described. These prices are largely determined by market forces, prior to or outside of the influence of production decisions. Feed prices are assumed to be exogenous since they are largely determined by supply and demand conditions in grain markets. However, the price level is systematically related to the season of the year. Price levels of live cattle futures contracts to be delivered four to six months in the future are a function of expected market conditions and are modelled as a function of seasonal factors. The change in futures price between the placement and marketing date is modelled as a function of the price level at the time of placement. Relatively high (low) placement period prices result in gains (losses) on the futures transaction. The interest rate used is the prime rate plus 1.5%. PCC staff indicate that this is the cost of capital used by banks loaning money to cattle feeding clients. The interest rate also varies with the season of the year. Cattle feeders are assumed to observe random draws of these correlated prices, and production decisions are conditioned on these prices.

The remainder of the system captures tradeoffs made by cattle feeders in production decisions and is structured as a recursive system. Quadratic and interaction terms are used to capture nonlinear relationships within the system. Feeder animal placement weights are modelled as a function of feed prices and seasonal factors. Cattle feeders place animals of different weights during different seasons according to availability. There is also large variation in placement weights given the level of feed prices. During times of high feed prices cattle feeders place heavier 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. This model is similar to a hedonic price model and reflects a derived demand specification. The price of an individual pen of cattle is a function of a price at a central market and it varies around this price given the weight of the cattle, price of feed, and season of the year. The central market price used is the distant live cattle futures price, which is the market-determined value of these animals when they reach finish several months in the future. Further, heavier weight feeder cattle have lower prices, and when feed costs are higher feeder animals are priced lower. The residual from this equation is used in other models as an instrument which measures the quality of the pen of feeder animals. Positive residuals indicate pens of higher quality than average.

The average slaughter weight at which a pen of cattle is marketed is a function of the average placement weight, feeder animal quality, feed price, and seasonal factors. Increases in placement weights and feeder animal quality result in higher slaughter weights. Increases in feed prices result in lower slaughter weights. In addition, there are variations in slaughter weights due to weather, feed ration components, and other seasonal factors.

Slaughter prices are a function of the nearby cattle futures contract price, slaughter weight, feeder animal quality, and seasonal factors. By including the nearby live cattle futures contract price the equation captures basis variation. Slaughter weight also influences slaughter price. Increases in slaughter weight result in premiums for animals; however, at very heavy weights discounts occur. Higher quality feeder animals result in slaughter cattle price premiums. In addition, there are variations in slaughter prices due to seasonal factors.

The average conversion rate (pounds of feed per pound of gain) for a pen of cattle is a function of average slaughter weight, placement weight, animal quality, and seasonal factors. The heavier the animal at slaughter the lower the conversion rate due to lower marginal feeding gains during the final days of feeding. The heavier the animal at placement the higher the conversion rate due to marginal feeding gains during the beginning of the feeding period. Higher quality animals perform better in the feedlot and therefore have higher conversion rates. The weather, and thus the season of the year, affect feeding performance of cattle and thus the 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. Animals which were placed on feed at heavier weights spend less time in the feedlot. Also, animals which are sold at heavier weights spend more time in the feedlot. Relatively well-performing animals, animals with low conversion rates, spend less time in the feedlot, and higher quality animals spend less time in the feedlot. Seasonal factors may also influence the number of days a pen of cattle is on feed primarily 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. Heavier animals appear to have more difficulty adjusting to the stress of shipment than do smaller animals. Likewise, higher quality animals appear to be in better health and these pens experience lower death loss. Seasonal factors reflecting changing weather and temperature influence death loss.[2]

The system is estimated via Seemingly Unrelated Regression. Coefficients and the error covariance matrix are used to simulate the price and production system interactions. Predicted values of slaughter weight and pen death loss equations are used in the futures transaction component of the profit equation to capture the effects of output uncertainty on the hedge ratio recommendations. Generally, the error terms of the system are distributed normal. Tests of skewness and kurtosis of the error terms were examined (White and MacDonald). Error terms for the feeder animal placement weights and prices, slaughter animal sale weight and price, the futures price change between placement and marketing, and interest rate equations were distributed normal. Tests for normality in the error terms for the feed price, distant futures price, conversion rate, and days on feed equations were rejected at marginal to standard significance levels. However,

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[2] The death loss equation is modelled in a two-step process to account for the dependent variable which is truncated at zero. 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 Mill's 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 used. This is the two-step Tobit estimator suggested by Heckman. The inverse of Mill's ratio alleviates the parameter bias from using the truncated dependent variable. The unbiased parameters are used in the simulation.

because of the difficulty in generating correlated non-normally distributed random variables, normality is imposed on all error terms. Further, truncation of draws from the normal pseudo-random number generator at three standard deviations or at minimum or maximum values of the actual error terms aided in making the random draws look like the actual data. The procedure used to generate correlated random variables is that developed in Naylor et al. The equation is

$$e = A \cdot n \tag{3}$$

where n is a vector of independent pseudo-random normal draws, A is the Cholesky decomposition (square root) of Σ the error covariance matrix, i.e., the upper triangular matrix where $A'A = \Sigma$, and e is the resulting vector of correlated random normal variables.

A second simulation is used to restrict the system to reflect constant production as has been assumed in most previous hedging studies. Prices vary and are correlated, but the production components of the system are held constant at mean levels of the first simulation. Further, the error variances and covariances of the constant dependent variables are zero in the generation of correlated random errors from equation (3).

Means and standard deviations of the production and price system variables for both simulations are reported in table 1. In most cases the means and the variances are not significantly different from the statistics of the actual data. Also the correlations among the simulated variables are similar to those between the actual data. The obvious differences between the actual and simulated data are in the size of the placement and sale weight and the number of days on feed. Placement and sale weights are smaller and days on feed is larger than the actual data. This may in part be due to the non-normality of the feed price errors; further fine tuning of the simulation is needed. The mean and standard deviation of the simulated profit per head are also different from the actual data statistics at standard significance levels. This suggests caution should be used in comparing the results from the two simulations to the results from the actual data. However, comparisons across the two simulations, flexible production and constant production, should be valid.

Empirical Results

The mean and standard deviation of profit per head are reported in table 2 for various levels of hedging. Profit per head figures are reported for the actual data, the first simulation where all prices and production components of the system vary and where model predictions are used as producer output expectations in the futures transaction portion of the profit equation, and the second simulation where only price components of the system vary. Results are revealing and the general interpretation is uniform across the three groups. Hedging does help manage risk; the standard deviations on profit per head are reduced from the pure cash marketing levels when routine hedging is employed. However, the reductions in risk are small compared to the simultaneous reductions in mean profit level. Moving from a pure cash strategy to a 10% routine hedging strategy reduces the standard deviations on returns by less than \$1.00/head while reducing profits by approximately \$4.00/head. Further, hedging above 40% to 60% of production results in expected losses, while reducing the standard deviation on returns by $2.50 to $3.00/head (three to four percent) from pure cash marketing levels. The high degree of basis risk, due to general price dispersion and variation in pen quality, appears to be the most important factor influencing the standard deviation of a returns series.

Comparison of the returns standard deviations between the first and second simulation reveal that variations in production system quantities are the second largest part of the risk associated with cattle feeding. The standard deviations on returns from the constant production simulation (simulation 2) are 60% to 70% of the standard deviations on returns from the flexible production simulation (simulation 1). Variation in production adds to variation in feeding profits. The returns from the flexible production simulation are also approximately $3.00/head lower than those of the constant production simulation. This reduction in returns suggests variation in production appears to be more due to the stochastic nature of production and less due to decisions to manage risk or capture marketing opportunities.

The optimal hedge proportion and certainty equivalents are reported in table 3 for producers with various degrees of risk aversion. The results indicate that the optimal hedge ratio for most producers was zero, hedging none of their production. There are two apparent reasons for this result. First, prices in both the cash and futures markets were trending up during the time period considered, so the average futures return was negative. The second reason is that hedging reduced standard deviations of returns only slightly. Furthermore, hedging tended to skew returns negatively, whereas risk averse producers likely prefer positive skewness (Cox and Rubinstein, p.308). Thus, the losses in expected returns outweighed any reduction in risk for all but the most risk averse producer. Table 3 shows that a positive hedge ratio is preferred by producers with Arrow-Pratt risk aversion coefficient of $\phi = 2.5$ or higher. Certainty equivalents are also presented in table 3. In the cases where the model recommends hedging, the certainty equivalents are negative. This suggests that such producers require compensation, a risk premium, for bearing the risk associated with cattle feeding that is larger than the expected returns. In short, that level of risk aversion is not likely to be observed among cattle feeders.

Conclusions

An analysis of pen-level cattle feeding data suggests that routine output hedging with live cattle futures is not an effective means of managing feedlot risk. The variation in returns to cattle feeders are extensive. Basis risk appears to be prohibitively large in transaction data. This is due to variation in animal weight, quality, and price dispersion in transactions. It is in general not possible to manage these risks through trading futures contracts. However, further research is needed to evaluate the risk/return tradeoffs of more selective hedging strategies. This research is limited by the simple decision strategy and the upward trend in prices over the sample period. Further, production decisions made by feedlots appear to be constrained by available animals and feedstuffs. Few production decisions are made to specifically capture marketing opportunities. Forty percent of the variation in profits is due to variation in animal weight and quality. More research is needed to identify sources, degrees, and management of feedlot profit risk.

Figure 1. Structure of the Price and Production System.

Price System

Feed Price = f(Seasonals) $+ \epsilon_1$

Distant Live Cattle Futures Price = f(Feed Price, Seasonals) $+ \epsilon_2$

Live Cattle Futures Gain/Loss = f(Distant Live Cattle Futures Price, Seasonals) $+ \epsilon_3$

Interest Rate = f(Seasonals) $+ \epsilon_4$

Production System

Placement Weight = f(Feed Price, Seasonals) $+ \epsilon_5$

Feeder Price = f(Distant Live Cattle Futures Price, Feed Price, Placement Weight, Seasonals) $+ \epsilon_6$

Slaughter Weight = f(Placement Weight, Feeder Animal Quality(ϵ_6)*, Feed Price, Seasonals)* $+ \epsilon_7$

Slaughter Price = f(Nearby Live Cattle Futures Price, Slaughter Weight, Feeder Animal Quality(ϵ_6)*, Seasonals)* $+ \epsilon_8$

Conversion Rate = f(Slaughter Weight, Placement Weight, Feeder Animal Quality(ϵ_6)*, Seasonals)* $+ \epsilon_9$

Days on Feed = f(Slaughter Weight, Placement Weight, Conversion Rate, Feeder Animal Quality(ϵ_6)*, Seasonals)* $+ \epsilon_{10}$

Death Loss = f(Feed Price, Placement Weight, Feeder Animal Quality(ϵ_6)*, Seasonals)* $+ \epsilon_{11}$

Table 1. Means and Standard Deviations for Prices, Quantities, Returns and Costs from the Pen Level Cattle Data and Market Price Information.

	Actual	Simulation 1	Simulation 2
	Mean Std. Dev.	Mean Std. Dev.	Mean Std. Dev.
Feed Price ($/cwt.)	6.103 (0.791)	6.081 (1.128)	6.146 (0.771)
Placement Weight (lbs.)	654.1 (80.3)	610.8 (47.97)	610.8
Feeder Cattle Price ($/cwt.)	80.83 (9.87)	80.41 (10.48)	80.85 (7.93)
Sale Weight (lbs.)	1125.1 (74.0)	1104.8 (38.37)	1104.8
Fed Cattle Price ($/cwt.)	72.59 (5.01)	71.48 (4.75)	72.32 (4.16)
Conversion Rate (lb. feed)	8.00 (1.12)	7.88 (1.09)	7.88
Days on Feed	165.6 (23.2)	178.9 (19.3)	178.9
Death Loss (%)	0.013 (0.016)	0.010 (0.02)	0.010
Distant Futures Price ($/cwt.)	68.68 (5.96)	66.96 (6.48)	67.88 (5.02)
Nearby Futures Price ($/cwt.)	71.97 (5.06)	71.17 (5.18)	71.62 (4.18)
Futures Gain/Loss ($/cwt.)	-3.29 (2.93)	-4.21 (2.64)	-3.74 (2.40)
Interest Rate (%)	0.111 (0.012)	0.112 (0.008)	0.112 (0.007)
Net Return ($/Hd.)	13.96 (65.59)	23.05 (85.66)	25.85 (54.79)
Fed Animal Revenue ($/Hd.)	807.00 (83.48)	790.23 (65.21)	799.02 (45.97)
Feeder Animal Cost ($/Hd.)	527.60 (83.57)	489.74 (63.93)	493.84 (48.44)
Feed Cost ($/Hd.)	227.09 (37.76)	237.15 (61.96)	239.15 (29.99)

Table 2. Means and Standard Deviations of the Profits Per Head Under Various Proportions of Live Cattle Hedging.

	Actual	Simulation 1	Simulation 2
	Mean Std. Dev.	Mean Std. Dev.	Mean Std. Dev.
Cash Marketing	13.96 (65.59)	23.05 (85.66)	25.85 (54.79)
10% Hedging	10.28 (64.72)	18.42 (84.93)	21.72 (54.18)
20% Hedging	6.59 (64.01)	13.79 (84.29)	17.59 (53.69)
30% Hedging	2.91 (63.44)	9.16 (83.74)	13.47 (53.33)
40% Hedging	−0.77 (63.04)	4.53 (83.29)	9.34 (53.10)
50% Hedging	−4.46 (62.80)	−0.10 (82.93)	5.21 (53.00)
60% Hedging	−8.14 (62.72)	−4.72 (82.68)	1.08 (53.03)
70% Hedging	−11.82 (62.81)	−9.35 (82.52)	−3.05 (53.19)
80% Hedging	−15.51 (63.06)	−13.98 (82.47)	−7.17 (53.49)
90% Hedging	−19.19 (63.47)	−18.61 (82.51)	−11.30 (53.91)
100% Hedging	−22.87 (64.06)	−23.24 (82.65)	−15.43 (54.46)

Table 3. Optimal Hedge Proportions from the Expected Utility Maximization Model and Certainty Equivalents.

Arrow-Pratt Coefficient	Actual		Simulation 1		Simulation 2	
	Ratio	C.E.	Ratio	C.E.	Ratio	C.E.
0.00001	0.0	13.98	0.0	23.04	0.0	25.87
0.25	0.0	13.98	0.0	23.04	0.0	25.87
0.50	0.0	13.98	0.0	23.04	0.0	25.87
0.75	0.0	13.98	0.0	23.04	0.0	25.87
1.00	0.0	13.98	0.0	23.04	0.0	25.87
1.25	0.0	13.98	0.0	23.04	0.0	25.87
1.50	0.0	13.98	0.0	23.04	0.0	25.87
1.75	0.0	13.98	0.0	22.99	0.0	25.87
2.00	0.0	11.54	0.0	21.34	0.0	25.65
2.25	0.0	5.22	0.0	23.04	0.0	13.00
2.50	0.45	-16.80	0.55	-16.76	0.70	-16.66

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