Feedlot operators’ decision making regarding price and animal health risk

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Abstract

Cattle feedlot operators face multiple forms of risk, which can impact profitability. Our objective was to determine if feedlot operators view price risk and animal health risk as two separate and independent risks or if they view them jointly. The animal health attribute of interest was single source, while the output price risk mitigation tools were futures contracts, forward contracts, other, and accept cash price at time of sale. Primary data was collected using an online survey administered to feedlot operators. Participants were placed in forward looking, decision making scenarios utilizing a seven block split-sample design. Three blocks placed operators in feeder steer purchasing oriented scenarios and four blocks placed producers in output price hedging scenarios. In the feeder cattle procurement scenarios, a complementary relationship was found between single source premiums and output hedging information. However, no relationship was found in the output price hedging scenarios.

Keywords: Animal health, beef, cattle, hedging, risk

Chapter 1 - Feedlot operators' decision making regarding price and animal health risk

Cattle feedlot operators face multiple forms of risk, which can impact profitability. Such risks include price, production, animal health, disease outbreaks, weather, business, and financial risk. How do feedlot operators and their team of experts make decisions in this risky environment? Researchers have largely focused on the role of futures and options markets to mitigate price risk from feeder cattle, live cattle and corn prices (Tonsor and Schroeder 2011; Hart, Babcock and Hayes 2001; Mark, Schroeder and Jones 2000; Schroeder and Hayenga 1988). However, little work has examined relationships between different types of risk feedlot operators face and available risk mitigation strategies. In an example of the limited research on both price and animal health risk, Belasco et al., (2009) developed an ex-ante model of price and yield risks associated with cattle feeding. They determined that both animal health and price risk have statistically significant impacts on conditional mean and variability of profits. To better understand tradeoffs and relationships between risk management decisions, this analysis will focus on the relationship between price and animal health risks.

Our objective is to determine if feedlot producers view price risk and animal health risk as two separate and independent risks or if they view them jointly. To accomplish this we will place feedlot operators in forward looking, decision making scenarios. If producers approach risk jointly, understanding if mitigation strategies for price risk and animal health risk are substitutes or complements is important. As part of meeting this objective, we will also map out the prevalence of price risk and animal health risk mitigation strategies in the feedlot industry.

Potentially a risk management strategy that internalizes both price and animal health components could be more effective and beneficial. However, whether cattle feedlot operators view price and animal health risk independently or jointly is unknown. For example, operations have a fixed budget. Therefore, feedlot operators could decide to implement increased animal health risk mitigation strategies instead of hedging using futures market contracts (substitute relationship). Conversely, animal health and price risk mitigation strategies could be complements. Animal health practices could decrease uncertainty on the pounds of live animal produced and therefore operators could better match their production to futures contracts, increasing their use. This could possibly help explain past "surprises" by analysts when producers have hedged price risk less than "expected" (Goodwin and Schroeder 1994).

Goodwin and Schroeder (1994) and Belasco et al. (2009) state that price risk is one of the largest risks faced by producers. Feedlot operators face price risk for inputs, primarily feeder cattle and corn, and output prices, live cattle. Hedging alternatives including forward contracts and futures contracts exist allowing feedlot operators to manage price risk. However, feedlot operations do not hedge as much as many academic studies suggest they should (Moschini and Hennessy 2001; Goodwin and Schroeder 1994). There are likely multiple factors which contribute the lower than expected participation in hedging. One potential explanation that will be examined in this study is if operators are making tradeoffs in their management decisions. For price risk management we will focus on hedging of live cattle using futures contract, forward contracts, other programs, and accepting the cash price at time of sale.

In addition to price risk, feedlot operators face animal health risks that extends beyond feed conversion and average daily gain. For instance, animal disease events may be rare but are often damaging if not devastating to operations that experience drastic reductions in output or spikes in production costs (Schroeder et al. 2015). Many factors contribute to the potential disease risk of cattle coming into a feedlot including "source, age, distance transported, previous health management, amount of comingling, shrink, and weather conditions" (Rambo 2013). When feedlot operators are looking to place a lot of feeder cattle, they can buy the number of head required from a single seller (i.e. a single farm) or assemble the required number of head from multiple sources (i.e. an auction). When placed in feedlots, cattle are faced with adapting to new environments, establishing a social hierarchy and adjusting to a new diet (Rambo 2013). Due to these and other factors, lots composed of feeder cattle purchased from multiple sources are considered a higher risk for animal disease than feeder cattle purchased from a single source (Rambo 2013). Single source of origin will be the animal health risk mitigation practice of interest in this study.

Conceptual Model

Feedlot operator i will make decisions to maximize their expected utility, EU_i:

$$EU_i = E[U_i(w_0 + \tilde{\pi})] \quad (1)$$

where w_0 is initial wealth and $\tilde{\pi}$ is profit, a random variable (Moschini and Hennessy 2001). Profit for the total operation is the sum of profit per pen (j pens),

$$\tilde{\pi} = \sum_j \tilde{\pi}_j. \quad (2)$$

Profit per pen of cattle is a function of input and output prices and quantities. However, when a feedlot operator places the cattle there is uncertainty on both prices and quantities. This uncertainty makes profit a random variable. Following Moschini and Hennessy (2001), profit can be written as

$$\tilde{\pi} = PG(x; \tilde{e}) - rx - K \quad (3)$$

where P is output price, $G(x; \tilde{e})$ is a stochastic production function where realized output depends on the input vector x and a random variable $\tilde{e}$, r is a vector of input prices and K is fixed costs. This framework can be adapted to feedlot operators' decision making under price and animal health risk. We consider two scenarios, allowing one risk type to vary while holding the other fixed.

First, consider how animal health production practices impact profit, holding live cattle price constant. A relationship between quantity of feeder cattle placed, Q^{FC}, and quantity of live cattle produced, Q^{LC}, exists. Additionally, the relationship between pounds of feeder cattle placed and pounds of live cattle at finishing will be a function of animal health production practices, $z = \{additional\ animal\ health\ practice\ (AH),\ standard\ practices\ (ST)\}$. For example, an additional animal health practice might be purchasing cattle from a single, known source. While cattle are being fed they can potentially get sick and therefore their final finish weight is uncertain. Additionally, due to death loss, the total number of finished head is uncertain. Thus, the production function depends on the specific practices used,

$$Q_{AH}^{LC} = f(Q_{AH}^{FC}, x; \tilde{e}) \quad (4)$$

$$Q_{ST}^{LC} = g(Q_{ST}^{FC}, x; \tilde{e}). \quad (5)$$

Potentially, due to factors such as seasonality and other characteristics of the feedlots, $f(.)$ and $g(.)$ could be related. Therefore, profit functions can be written as

$$\widetilde{\pi_{AH}} = \widetilde{P^{LC}} * f(Q_{AH}^{FC}, x; \tilde{e}) - \widetilde{P_{AH}^{FC}} * Q_{AH}^{FC} - rx_{AH} - K \quad (6)$$

$$\widetilde{\pi_{ST}} = \widetilde{P^{LC}} * g(Q_{ST}^{FC}, x; \tilde{e}) - \widetilde{P_{ST}^{FC}} * Q_{ST}^{FC} - rx_{ST} - K \quad (7)$$

where P^{LC} is price per hundred weight (cwt) of live cattle (finished cattle, output), P_z^{FC} is feeder cattle price, Q_z^{LC} is the total cwts of cattle produced (output pounds), Q_z^{FC} is the total cwts of feeder cattle at the time the animals were purchased, and x_z is a vector of other input quantities. Other inputs costs, including feed costs, veterinary costs, and labor, will vary by pen and production practices used specifically for that pen. Therefore, additional animal health practices impact profit through differences in premiums paid for feeder cattle, production costs, and pounds of live cattle produced.

Now, consider how price risk management strategies impact profitability, assuming animal health practices remain constant. We assume operators are price takers. However, they can have some control over when they lock in input and output prices through hedging. A feedlot operator can hedge feeder cattle, live cattle, and corn prices using futures contacts, forward contracts or other tools. Hedging allows producers to decrease price risk (uncertainty about prices). Consider the formula,

$$net\ price = futures\ price + basis. \tag{8}$$

Hedging using futures contracts locks in the futures price component of equation (8) and only allows basis risk. Basis risk is usually less than cash price risk. Hedging using forward contracts often locks in both the futures price and the basis, eliminating all price risk. One downfall to hedging with futures or forward contracts is producers cannot benefit from price movements in their favor. However, hedging protects a producer from drastic adverse price movements. Thus price risk management strategies can impact input and output prices that directly impact profitability. Assuming that feedlot operators only hedge live cattle and feeder cattle prices or use cash markets, $h = \{hedged\ price\ (H),\ cash\ price(C)\}$, profit can be written as

$$\widetilde{\pi_H} = \widetilde{P_H^{LC}} * G(Q^{FC}, x; \tilde{e}) - \widetilde{P_H^{FC}} * Q_{FC} - rx - K \tag{9}$$

$$\widetilde{\pi_C} = \widetilde{P_C^{LC}} * G(Q^{FC}, x; \tilde{e}) - \widetilde{P_C^{FC}} * Q_{FC} - rx - K. \tag{10}$$

Therefore, profit can vary based on differences in prices paid for inputs and received for outputs by using cash markets only or hedging.

Futures contracts are standardized meaning they have a set delivery date, quality and quantity of the product. The live cattle contract is for 40,000 lbs of finished cattle. Assume that on average the operator expects finished steers to weigh 1,400 lbs each. To almost fully hedge a pen of 150 steers (210,000 lbs) the feedlot operator would sell five live cattle contracts (covering approximately 143 steers) for six months in the future. However, what happens when cattle in a pen get sick and only finish at 1,250lbs each? Now the five live cattle contracts cover 160 cattle each weighing 1,250 lbs. The pen is “over-hedged.” The operator is now a speculator on ten cattle that the feedlot does not have. A similar thought exercise could be completed for other hedging alternatives such as forward contracts.

One link between hedging and animal health production practices could be the expectation of the total pounds of finished cattle. If there is a large variance in pounds produced per pen, then a feedlot operator may be less likely to hedge because they cannot properly assess the number of futures contracts they should use or specifications they should agree to in a forward contract. If animal health production practices decrease the variability in finishing weight and death loss, then an operator can make more informed output price hedging decisions. Thus, operators avoid adding risk associated with becoming a speculator on the futures market or not being able to meet the forward contract agreements.

There can be a substitution, complementary, or no relationship between price risk and animal health risk mitigation strategies. Risk mitigation strategies are not free and feedlot operations have a limited budget. A feedlot operator could decide the feedlot would be more profitable if they invested in only animal health mitigation strategies instead of also managing price risk. This would be an example of substitution. Alternatively, operators could view price and animal health risk mitigation strategies as complements. Certain animal health risk mitigation strategies can decrease uncertainty about the pounds of animals produced. This decreased uncertainty will allow producers to make more informed hedging decisions.

Additionally, there could be no relationship between feedlot operator's decisions regarding price risk mitigation and animal health risk mitigation strategies. Determining this relationship is a core component of our analysis. We hypothesize there is some relationship between price risk and animal health risk mitigation strategies. However, to investigate this hypothesis we need to look at the individual feedlot operators' decision making process.

Research Methodology

Although revealed preference data is often desirable in economics, its collection is not always feasible. In order to understand feedlot operators' decision making regarding risk, primary, stated preference data was collected using online surveys administered to a sample of feedlot operators (see data collection below). Past studies of cattle producers that utilized surveys, including choice experiments, were successful in finding results consistent with market observations (Schulz and Tonsor 2010; Schumacher, Schroeder, and Tonsor 2012). In order to assess if price risk and animal health risk mitigation strategies are viewed as independent and separate or jointly, a split sample choice design was used and is the core information source for this study. To assess individual feedlot operators' decision making process, operators were placed in a realistic decision making mindset where they were making decisions and forming expectations around events that will happen in the future. They were asked to make a decision as if it were February 15, 2017 for feeder animals being placed in March 2017 with an expected August 2017 closeout. A seven-block design (Table 1.1) was utilized to test key hypotheses by comparing responses across scenarios to isolate differences of central interest similar to Tonsor, Schroeder, and Lusk (2013). The animal health, feeder cattle procurement practice of interest was known single source feeder steers versus feeder steers of unknown background. The fed cattle output price risk management strategies were futures hedge, forward contract, other, or accept cash price at sale. An additional difference across designs is how the expected hedge basis was presented. The hedge basis was unambiguous (e.g. -$1.00/cwt) or ambiguous (e.g. 35% chance of being less than -$1.00/cwt and a 65% chance of being greater than -$1.00/cwt) (Mauro and Maffioletti 2004).

Each participant was randomly assigned to one block of the seven blocks. Blocks fall into two broad categories: placement oriented or output pricing oriented. Blocks 1-3 consisted of two scenarios about placing a lot of feeder steers, one where no output pricing information is given (question 11; Q11) and one where potential output pricing information is shown (question 12; Q12). See Figure 1 for an example of block 2 where information about forward contracts being offered is shown in Q12. Blocks 4-7 include one scenario were the participant was asked how many of the 150 head purchased they would place in each of the four output pricing strategies. No information on the source of the feeder cattle was given in blocks 4 and 5, however, in blocks 6 and 7 participants were told the steers were sourced from a single source and given a random premium paid. See Figure 2 for an example of block 7. Blocks 3, 5, and 7 have ambiguous fed cattle basis for futures hedges. By comparing responses across treatments we can gain an understanding of if/how producers alter decisions when animal health and price risks are individually versus jointly examined. Blocks 1, 2, 4, 5, 6 and 7 will be the primary focus of this study.

Hypothetical bias is a concern when collecting data from surveys. Tonsor and Shupp (2011) found that including cheap talk scripts yield more reliable willingness to pay results in consumer surveys. Therefore, before answering the choice questions participants saw these instructions, "*The following two questions look similar but importantly are different. Please* *complete both questions carefully. Research studies have found people overstate their willingness to pay in hypothetical situations, such as a survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.*" for blocks 1 to 2 and, "*Research studies have found people overstate their willingness to participate in hypothetical situations, such as a survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.*" for blocks 4 to 7. Lusk and Schroeder (2004) found that although total willingness to pay was overstated in hypothetical choice experiments, marginal willingness to pay was not statistically different across hypothetical and actual payment scenarios. Thus, hypothetical bias concerns are mitigated since our core hypotheses tests depends on net differences across blocks.

Values of the key variables of interest in the choice design were randomly drawn for each participant from a range selected to match current market conditions. The source premium shown ranged from $1.00 to $10.00/cwt, the CME live cattle contract price from $95.00 to $110.00/cwt (consistent with the market as on January 9th, 2017), all basis numbers ranged from $-5.00 to $5.00/cwt (consistent with historical basis numbers from LMIC) and the random percent for the ambiguous basis scenario ranged from 1 to 99%.

Econometrically, systems of Tobit models are utilized because the dependent variables (either quantity of feeder head purchased, or quantity of head placed in each output price risk strategy) are continuous but censored between 0 and 150. Using these methods, coefficient estimates, and, of more central interest, marginal effects can be calculated and compared across designs to identify if relationships exist between animal health risk mitigation and output price risk mitigation.

Feeder cattle placement scenarios (blocks 1-2)

For blocks 1 and 2, the two latent variables of interest, the number of head purchased when output pricing information was not shown ($Q11head_i^*$) and the number of head purchased when potential output price information was shown ($Q12head_i^*$), can be modeled as:

$$Q11head_i^* = \boldsymbol{X}'_{Q11,i}\boldsymbol{\beta}_{Q11} + \varepsilon_{Q11,i} \tag{11}$$

$$Q12head_i^* = \boldsymbol{X}'_{Q12,i}\boldsymbol{\beta}_{Q11} + \varepsilon_{Q12,i} \tag{12}$$

where the relationships between the latent variables and the observed variables are:

$$Q11head_i = \begin{cases} Q11head_i^* & if\ 0 \leq Q11head_i^* \leq 150 \\ 0 & if\ Q11head_i^* < 0 \\ 150 & if\ Q11head_i^* > 150 \end{cases} \tag{13}$$

$$Q12head_i = \begin{cases} Q12head_i^* & if\ 0 \leq Q12head_i^* \leq 150 \\ 0 & if\ Q12head_i^* < 0 \\ 150 & if\ Q12head_i^* > 150. \end{cases} \tag{14}$$

In equations (11) and (12) $\boldsymbol{X}'_{Qj,i}$ (where $j = 11, 12$) is a vector of information given in the question (e.g., source premium, CME price, expected basis) and explanatory variables for each individual i (e.g. operation size, risk preferences, etc.), $\boldsymbol{\beta}_{Qj}$ are coefficient estimate vectors, and $\varepsilon_i \sim N(0, \sigma_{Qj}^2)$. Equations (11) and (12) are modeled jointly with maximum likelihood. The error terms $\varepsilon_{Q11,i}$ and $\varepsilon_{Q12,i}$ are specified following a bivariate normal distribution with a zero mean, standard deviations σ_{Q11}^2 and σ_{Q12}^2 and correlation ρ. By estimating these equations jointly we can test if unobservable factors are impacting the number of head purchased in each question. If ρ is zero then the equations could have been estimated independently (Cornick et al. 1994). The cmp command in Stata (Roodman 2011) was used to estimate all models.

Output price risk scenarios (blocks 4 to 7)

For blocks 4 to 7 the latent variables of interest are the number of head placed in each output price risk management strategy out of the 150 feeder steers purchased: futures hedge ($FutHedge_i^*$), forward contract ($ForwardCont_i^*$), other ($Other_i^*$), and spot market at time of sale ($Spot_i^*$). The number of head must sum to 150. A multivariate system can be modeled as:

$$FutHedge_i^* = \boldsymbol{X}_i'\boldsymbol{\beta}_{FutHedge} + \varepsilon_{FutHedge,i} \tag{15}$$

$$ForwardCont_i^* = \boldsymbol{X}_i'\boldsymbol{\beta}_{\text{ForwardCont}} + \varepsilon_{ForwardCont,i} \tag{16}$$

$$Other_i^* = \boldsymbol{X}_i'\boldsymbol{\beta}_{\text{Other}} + \varepsilon_{Other,i} \tag{17}$$

$$Spot_i^* = \boldsymbol{X}_i'\boldsymbol{\beta}_{\text{Spot}} + \varepsilon_{Spot,i} \tag{18}$$

where the relationships between the observed and latent variables are:

$$FutHedge_i = \begin{cases} FutHedge_i^* & if\ 0 \le FutHedge_i^* \le 150 \\ 0 & if\ FutHedge_i^* < 0 \\ 150 & if\ FutHedge_i^* > 150 \end{cases} \tag{19}$$

$$ForwardCont_i = \begin{cases} ForwardCont_i^* & if\ 0 \le ForwardCont_i^* \le 150 \\ 0 & if\ ForwardCont_i^* < 0 \\ 150 & if\ ForwardCont_i^* > 150 \end{cases} \tag{20}$$

$$Other_i = \begin{cases} Other_i^* & if\ 0 \le Other_i^* \le 150 \\ 0 & if\ Other_i^* < 0 \\ 150 & if\ Other_i^* > 150 \end{cases} \tag{21}$$

$$Spot_i = \begin{cases} Spot_i^* & if\ 0 \le Other_i^* \le 150 \\ 0 & if\ Other_i^* < 0 \\ 150 & if\ Other_i^* > 150. \end{cases} \tag{22}$$

In equations (15), (16), (17) and (18) $\boldsymbol{X}_i'$ is a vector of information given in the scenario (e.g., source premium, CME price, expected basis) and explanatory variables for each individual i (e.g. past output pricing behavior, etc.), $\boldsymbol{\beta}_m$ (where $m = FutHedge, \text{ForwardCont}, \text{Other}, \text{Spot}$) are coefficient estimate vectors, and $\varepsilon_{m,i} \sim N(0, \sigma_m^2)$. Since the four dependent variables sum to 150, only three (15, 16, and 18) equations are estimated jointly. When modeled jointly, the error terms $\varepsilon_{FutHedge,i}$, $\varepsilon_{\text{ForwardCont},i}$ and $\varepsilon_{\text{Spot},i}$ are specified following a multivariate normal distribution with a zero mean, standard deviations $\sigma^2_{FutHedge}$, $\sigma^2_{\text{ForwardCont}}$ and σ^2_{Spot}, and correlation.

Feedlot operations vary in their experience with alternative marketing methods as well as in relationships with entities who buy their finished cattle. These factors likely not only effect observed selections in our survey, but are endogenous to our decisions of central interest. Accordingly, the system of equations above can be extended as:

$$FutHedge_i^* = \boldsymbol{X}_i'\boldsymbol{\beta}_{FutHedge} + \gamma_{1,FutHedge}PastHedge_i + \gamma_{2,FutHedge}PastForward_i + \varepsilon_{FutHedge,i} \tag{23}$$

$$ForwardCont_i^* = \boldsymbol{X}_i'\boldsymbol{\beta}_{\text{ForwardCont}} + \gamma_{1,\text{ForwardCont}}PastHedge_i + \gamma_{2,\text{ForwardCont}}PastForward_i + \varepsilon_{ForwardCont,i} \tag{24}$$

$$Spot_i^* = \boldsymbol{X}_i'\boldsymbol{\beta}_{\text{Spot}} + \gamma_{1,\text{Spot}}PastHedge_i + \gamma_{2,\text{spot}}PastForward_i + \varepsilon_{Spot,i} \tag{25}$$

$$PastHedge_i = \boldsymbol{Z}_i'\boldsymbol{\delta}_{\text{PastHedge}} + \varepsilon_{PastHedge,i} \tag{26}$$

$$PastForward_i = \boldsymbol{Z}_i'\boldsymbol{\delta}_{\text{Spot}} + \varepsilon_{PastHedge,i} \tag{27}$$

where $PastHedge_i$ and $PastForward_i$ are variables indicating past futures hedging and forward contract participation, $\boldsymbol{Z}_i'$ is a vector explanatory variables, and γ and δ are parameters to be estimated.

Data Collection

Primary data was collected from feedlot operators using online surveys sent out via an anonymous email link. See Appendix A for full survey instrument. The survey was programmed using Qualtrics. Feedlots in Colorado, Iowa, Nebraska, Kansas, and Texas were targeted. These states comprise the five market average price reported by the USDA and are home to 80% of cattle on feed at feedlots with 1000+ head capacity (USDA 2017). Survey links were emailed to members/subscribers by the Colorado Livestock Association, Iowa Cattlemen's Association, Kansas Livestock Association, Nebraska Cattleman, Texas Cattle Feeders Association, and Feedlot Magazine. The survey launched on January 19, 2017 and ended on February 14, 2017.[1] In addition to the core choice experiment, data on operator and operation demographics, current risk mitigation strategies and views on risk we collected.

There were 588 responses. However, only 281 were usable responses for this analysis. Participants whose operation did not include a feedlot and/or who did not make price risk or animal health risk management decisions were dismissed from the survey after questions 1 and 2. Additionally those participants who qualified to continue, but did not answer any questions past question 13 were consider not usable.

Results and discussion

Summary statistics for all the useable responses and by block are shown in Table 1.2. The average respondent age was 49 years old, with a minimum age of 23 years and maximum of 85 years. Nearly half of the participants had completed at least a Bachelor's degree. Feedlot operators from Iowa comprised 50% of the sample, Nebraska 18%, Texas 10%, Kansas 6% and Colorado 5%. Nineteen percent of respondents were from a medium sized operation (defined as having sold between 8,000 and 31,999 fed cattle in the last 12 months) and 16% from large operations (defined as having sold more than 32,000 fed cattle in the last 12 months). Just over

[1] Colorado Livestock Association sent link on February 8. Feedlot Magazine sent survey link on January 19 and 26. Iowa Cattlemen's Association sent survey link on January 19 and 26. Kansas Livestock Association sent link on January 19 and 30. Nebraska Cattleman sent survey link on January 23 and 30. Texas Cattle Feeders Association sent survey link on January 24 and 30.

20% of participants were considered custom feeders owning less than 40% of their cattle. To better understand participant's price expectation they were asked if they believed the August CME live cattle contract price would settle higher, lower or the same as today. Nearly 29% of participants thought the August CME contract price would increase. Participants were asked a series of questions to gauge their risk aversion following the Global Rick-Attitude Construct (Pennings and Garcia 2001). These variables collapsed down to one factor. Therefore, only one question was needed. Participants were considered risk averse if they somewhat agreed, agreed or strongly agreed with the statement, "I usually like "playing it safe" (for instance, "locking in a price") instead of taking risks for market prices for fed cattle." Since single source feeder cattle purchases and fed cattle price hedging are of key interest, participants were asked about their past behaviors. Nearly 65% of participants had purchased single source calves before. On average, participants hedged 19% and 18% of their finished cattle using futures and forward contracts, respectively. However, these hedging percentages ranged from 0 to 100%.

Purchasing feeder cattle (CV1 and CV2)

Bivariate model results from block 1 (CV1) are in Table 1.3. There were 40 respondents in CV1. Recall, the difference between Q11 and Q12 is participants were presented additional information on potential output pricing information (the live cattle CME price and the expected local basis) in Q12. The statistically significant ρ indicates there is a relationship between the Q11 and Q12 residuals in each model and thus Q11 and Q12 should be estimated jointly. Model A is the base model with variables only for the information shown. The source premium coefficients in Q11 and Q12 are negative and statistically significant as expected indicating that the willingness to purchase feeder cattle decreases as the source premium increases. Additionally the source premium coefficient in Q12 is smaller in absolute terms than in Q11, indicating that sensitivity to the source premium is smaller whenever output price information is given.

Other alternative models with additional explanatory variables (i.e. operation size dummies, custom feeder dummy, if the August CME price would increase, risk aversion, and if they had purchased single source cattle before) and interaction terms (CME * source premium, basis * source premium) were explored. Based on likelihood ratio tests, the preferred model for CV1 is model B, which includes additional interaction terms in Q12. The source premium and CME price interaction term is statically significant indicating a relationship between incoming cattle purchasing and the potential output price information mentioned. The interaction terms make the coefficients difficult to interpret, therefore, feeder cattle demand curves (using mean values for included explanatory variables) from model B are plotted for Q11 and Q12 in Figure 3. When output pricing information was show the demand for feeder cattle is more inelastic (steeper).

Models C and D combine the CME price and basis into an expected price (expected price=expected basis + CME price). Model C is the base model and model D is the preferred model when using expected price. Overall, the results from models C and D are similar to models A and B.

When using Tobit models, the marginal effects within the censored bounds are of interest. Average marginal effects for models A to D are shown in Table 1.4. Focusing on model B, the source premium marginal effect in both Q11 and Q12 are negative. A $1.00/cwt increase in the source premium decreased the number of feeder steers purchased (from a maximum of 150) by 13.52 head and 6.41 head in Q11 and Q12, respectively. These marginal effects are statistically different from zero and from each other ($\chi^2(1) = 9.33, p - value =$

0.002). Thus, whenever the CME price and expected basis were shown participants were less sensitive to single source premium. The CME price and expected basis marginal effects are both positive with the expected basis marginal effect being statistically different than zero. When the expected basis increased by $1.00/cwt head purchased increased by approximately five.

Plots of the marginal effects with 95% confidence bands for model B are shown in Figure 4 to Figure 9. Q11 and Q12 source premium marginal effects at different values are shown in Figure 4 and Figure 5. The marginal effect of a $1.00/cwt increase in the source premium decreases as the source premium increases, but is statistically different from zero. Additionally, the Q11 source premium marginal effect is greater in absolute terms than the Q12 source premium marginal effects.

Marginal effect plots are also needed because of continuous interaction terms. At lower values of CME ($96.00/cwt to around $99.00/cwt) the source premium marginal effect is not different than zero. However, as the CME price increases, the source premium marginal effect increases in absolute terms. This could suggest that at lower CME prices, feedlots are not purchasing single source cattle due to tighter profit margins or potentially not even placing cattle at all. However at higher CME prices, and thus more appealing profit margins, more cattle are being placed overall and a $1.00/cwt increase in the source premium has a larger effect on head placed. The same general story is also evident in source premium’s marginal effect at different levels of expected basis (Figure 7). CME price’s marginal effect at different levels of source premium is shown in Figure 8. At lower source premiums, a $1.00/cwt increase in the CME price increases the number of head purchased. However, at premiums greater than $4.00/cwt, a $1.00/cwt increase in the CME price does not increase the feeder steers purchased. The expected basis marginal effect at different values of source premium is greater than the CME price marginal effect, but still exhibits a decreasing pattern (Figure 9). Potentially, this difference exists because the CME price is generally more variable than basis. In other words, a $1.00/cwt change in the CME price is more likely to occur than a $1.00/cwt increase in the expected basis. Overall, the marginal effect plots indicate a relationship between source premium and shown fed cattle futures hedging information.

Model results for block 2 (CV 2) are shown in Table 1.5. There were 41 respondents in CV2. Forward contract information (CME live cattle price and offered basis) is shown in Q12. Model E is the base model with CME price and forward contract information as two separate variables and model G is the base model when using expected price. Based on likelihood ratio tests, models F and H are preferred to models E and G, and interaction terms are not needed. The statistically significant ρ indicates there is a relationship between the errors of Q11 and Q12 in each model and thus Q11 and Q12 should be estimated jointly. Focusing on model F, the source premium coefficient is negative and significant in Q11, but is negative and not significant in Q12. These two coefficients are statistically different ($\chi^2(1) = 5.11, p - value = .02$). The forward contract basis coefficient is positive and significant. The effect of the explanatory variables is somewhat different across Q11 and Q12. In Q11, medium and large feedlots purchased fewer single source steers relative to smaller feedlots. Additionally, custom feeders purchased more single source steers. In Q12, those who thought the August CME live cattle contract price was going to increase purchased more single source feeder steers.

The coefficient estimates from model F were used to plot feeder cattle demand curves for Q11 and Q12. As in CV1, the demand curve in Q11 when no output pricing information is given is more elastic, while the Q12 demand curve is more inelastic when output information is given.

The average marginal effects accounting for censoring in models E, F, G and H are shown in Table 1.6. The source premium marginal effect is negative in all equations and models. The source premium marginal is statistically different across Q11 and Q12 in models F ($\chi^2 = 4.80, p - value = 0.03$) and H, but not models E and H. In the preferred model, model F, the source premium average marginal effect is nearly 13 head in Q11, but six head in Q12 when forward contract information is given. In Q12, the average marginal effect on the forward contract basis is nearly seven and statistically different from zero. The CME average marginal effect is not significant. If the participant believed the August CME live cattle contract price was going to increase, they purchased almost 35 more head than those who thought the price would decrease or stay the same.

The average marginal effect plots for model F are shown in Figure 11 to Figure 14. The source premium average marginal effects plots for Q11 and Q12 are different. The 95% confidence bands do not cross zero in Q11 where the marginal effect has a decreasing effect as source premium increases (Figure 11). In Q12, the 95% confidence bands are wide at lower values of source premium (Figure 12). However, the same decreasing marginal effect as in Q11 is generally exhibited. The CME marginal effects are not different than zero at all CME values investigated (Figure 13). On the other hand, the forward contract average marginal effect is different than zero for all basis numbers investigated (Figure 14). At weaker basis levels, the average marginal effect of increasing basis by $1.00/cwt is smaller than at stronger basis levels. However, the marginal effect increases at a decreasing rate.

Discussion of core hypotheses

The coefficient estimates, demand curve plots and average marginal effects in CV1 and CV2 can collectively be used to discuss the relationship between incoming cattle risk and output price risk. Overall, there is evidence that a complementary relationship exists. Finding that the demand curves for Q11, when no output pricing information is given, are more elastic than when output price risk management information is given supports this conclusion. Additionally, the marginal effects point to a complementary relationship. Consider the impact of an increase in the CME price and source premium on profitability. An increase (decrease) in the CME price or a decrease (increase) in the source premium would increase (decrease) profit per head. Given that the marginal effect of source premium increases in absolute terms when the CME price increases suggests a complementary relationship between incoming cattle risk and output price risk for futures hedging and forward contracting.

In consumer choice studies, willingness to pay estimates vary based on the number and mix of attributes shown (Pozo, Tonsor, and Schroder 2012; Gao and Schroder 2009). Therefore, we recognize that simply having more information presented in Q12 (potential output price hedging) than Q11 could influence the source premium coefficients and marginal effects. However, the relationship between source premium and output pricing information is rational. If output prices are considered strong, then more feedlots will be interested in placing feeder steers and then paying a premium for single source steers is a consideration. Conversely, if output prices are weak, then fewer feedlots will place cattle and potentially ignore single source cattle premiums. The significance of the interaction terms in Q12 and the marginal effect interaction plots support this conclusion.

Output pricing (CV4 to CV7)

No sourcing information given (CV4 and CV5)

CV4 and CV5 asked feedlot operations which output pricing strategies they would implement for a lot of 150 purchased on February 15th for March placement. No information was given on the feeder cattle source. The difference between CV4 and CV5 is the way basis information was presented for futures hedging. In CV4 a non-ambiguous basis was given, while an ambiguous basis was given in CV5.

Pooled model results with a treatment variable and interaction terms are shown in Table 1.7 (model I). There were 78 usable responses when the two blocks are combined. The CV4 treatment dummy and interactions are jointly insignificant ($\chi^2(12) = 13.01, p - value = 0.37$). Therefore the ambiguous basis did not impact the head placed under each output pricing strategy. Looking at the ρ estimates, the equations need to be estimated jointly, including the past behavior ($\rho_{3,4}, \rho_{2,5}, \rho_{3,5}, \rho_{4,5}$). This confirms expectations of past hedging behavior endogeneity. In the past hedging and forward contracting equations, custom feeders placed fewer head under futures hedges, and risk averse producers placed more head under forward contracts.

For the main three equations, the average marginal effects for each treatment are of main interest (Table 1.8). None of the average marginal effects across CV4 and CV5 are statistically different from each other. This can also been seen with the overlapping 95% confidence intervals. Additionally many of the average marginal effects are insignificant. A $1.00/cwt increase in the forward contract basis increased the number of head placed under a forward contract by 2.5 head in CV4. For spot marketing, an increase in the CME price by $1.00/cwt decreased the number of head sold by about two. Past forward contract percentage had a significant positive impact on the number of head placed in forward contracts and a significant negative impact on the number of head sold in the spot market. For each 1% increase in the number of cattle placed under a forward contract in the past, almost one more head was placed under a forward contract in CV4 and CV5, and over one head less in the spot market.

Since feedlot operations are professionals, they are likely very familiar with current market conditions. Therefore, participants could have used their outside knowledge when answering the survey questions. No information was given in the survey about the base feeder cattle price. Thus, the CME feeder cattle futures price for the day the participant took the survey was added as an explanatory variable. Model J results including feeder cattle future price are in Table 1.9. Overall, model J results are similar to model I results and the feeder cattle coefficients are insignificant in all three equations. However, the feeder cattle futures price marginal effect is significant and positive for futures hedging and spot market (Table 1.10). The other average marginal effects are robust to the model I average marginal effects, however the CME marginal effect is significant and positive for forward contract usage and negative for spot market. The persistence is past output pricing behavior is still present.

Single source information given (CV6 and CV7)

CV6 and CV7 informed participants that the feeder steers came from a single source and gave the premium paid for the steers. As with CV4 and CV5, the difference between CV6 and CV7 is the ambiguous expected hedge basis in CV7. The pooled model results for CV6 and CV7 (model K) are found in Table 1.11. There were 78 participants combined in these two blocks. Unlike CV4 and CV5, the CV6 treatment dummy and interactions are jointly significant ($\chi^2(15), p - value = 0.003$). The significant ρ coefficients confirms the five equations need to be estimated jointly.

Average marginal effects for CV6 and CV7 are shown in Table 1.14. Except for the forward contract basis and past futures hedging percent marginal effects in the spot market equations, the marginal effects in CV6 and CV7 are not statistically different from one another. A $1.00/cwt increase in the source premium increased the number of head placed in a forward contract and decreased the number of head sold in the spot market. A $1.00/cwt increase in the forward contract basis decreased the number of head sold in the spot market by three head. Past output pricing behavior had the largest effect. A 1% increase in past futures hedging percent increased the number of head placed under a futures hedge by over one head, and decreased spot market head by over one. Additionally, a 1% increase in past forward contracting percent increased head placed under a forward contract by about one head and decreased head under spot market pricing by one head.

Feeder cattle futures price on the day the participant took the survey was also brought in as an additional explanatory variable in model L (Table 1.13). The coefficient estimates are fairly robust across models K and L, however of the new variables only the feeder futures and CV6 interaction in the futures hedge equation is statistically significant. Marginal effects for model L are in Table 1.14 and are robust to average marginal effects from model K. Of the additional feeder cattle futures marginal effects, the marginal effect in CV7 for the futures hedge equation is statistically significant and negative. Thus a $1.00/cwt increase in the feeder cattle futures price decreased the number of head placed under a futures contract by over two head.

Discussion of core hypotheses

To test the core hypothesis that a relationship between incoming cattle risk and output price risk exists, the 95% confidence intervals from the marginal effects are compared.[2] Specifically, when comparing CV4 marginal effects to CV6, and CV5 to CV7, only one difference in confidence intervals were found. In both the models with and without feeder futures, the marginal effect for forward contract basis in the spot market in CV5 and CV7 were different. Therefore, there is little evidence of a relationship between incoming cattle risk and output price risk management. This contradicts the input oriented results from CV1 and CV2.

There could be multiple explanations for little evidence of a relationship between incoming cattle risk and output pricing strategies. First of all, the hypothetical nature of the survey and small sample cannot be ignored. Our finding would suggest that incoming cattle characteristics are ignored (at least the source of cattle in our experiment) when making output price hedging decisions. Potentially, feedlot operators ignore incoming cattle characteristics because the decision is already made, likely reflecting pre-existing business relationships, and cannot be changed. Thus, it is a sunk decision and not considered moving forward. Alternatively, the incoming cattle characteristics could not be considered because of the persistence of past behavior and existing relationships with fed cattle buyers. In the United States there are approximately 734,000 operations with beef cows (LMIC 2017), nearly 30,000 feedlots (just over 2,000 with 1,000+ head capacity) (USDA 2017) and 650 plants, 179 of which slaughter more than 1,000 head (USDA 2017b). Therefore, there are more options to buy feeder

[2] Schenker and Gentleman (2001) found that comparison of 95% confidence intervals is more conservative than standard methods of significance testing when the null hypothesis is true and falsely rejects the null hypothesis more frequently when the null hypothesis is false.

cattle from than to sell these cattle once finished. This would support our finding of a relationship between incoming cattle and output pricing risk in the feeder cattle purchasing equations but not in the output pricing questions.

Conclusion and implications

To the best of our knowledge, this is the first study that seeks to understand feedlot operators' decision making regarding both animal health and output price risk. The objective was to determine if feedlot operators view these two risks jointly or independently. The animal health practice of interest was single source steers while the output price risk hedging strategies were futures contacts, forward contracts, other, and accept cash price at time to sale. An online survey with seven choice blocks was used to put feedlot operators in a forward-looking mindset to better understand their decision making. Blocks 1 to 3 asked operators purchasing feeder steer oriented questions. Blocks 4 to 7 were output pricing oriented scenarios.

Using blocks 1 and 2 evidence of a complementary relationship between willingness to pay a source premium and output pricing information was found. Willingness to purchase single source cattle was more inelastic when output pricing information, for both futures hedging and forward contracts, was shown. Additionally, interaction terms between source premium and output pricing information were significant in block 1. The average marginal effect plots indicate a higher sensitivity to increases in source premium at more favorable output prices. Additionally, the CME and basis marginal effects were more sensitive at lower values of source premium. Given that the marginal effect of source premium increases in absolute terms when the CME price increases suggests a complementary relationship between incoming cattle risk and output price risk for futures hedging and forward contracting.

No relationship was found between information on feeder cattle source and output pricing risk mitigation strategies in blocks 4 to 7. Most of the average marginal effects were the same across treatments that included and did not include single source information. Potentially, this finding suggests that feedlot operators view the feeder cattle purchase as a "sunk decision" when deciding how to manage output price risk. Additionally, there was strong evidence of persistent behavior in output pricing. This could be the result of existing relationships with cattle buyers and the relatively limited number of outlets to sell finished cattle. Potentially this persistence also stems for unfamiliarity with other output pricing strategies. This may highlight a need for more education on output price risk mitigation strategies or less complex risk mitigation tools. The absence of a relationship between single source information and output pricing strategies could also be a function of the hedging strategies considered. In the hedging options, no distinction was made regarding cattle quality. Conceivably, single source cattle might grade better at harvest and receive quality premiums, however, this was not accounted for in our hedging scenarios.

Moving forward, there are multiple potential extensions of this study. Other animal health practices such as weaning and preconditioning certifications could be investigated instead of single source premium. Additionally, the concept of tradeoffs between input and output types of risk mitigation can be extended to any livestock species and even non-livestock crops.

Table 1.1. Split sample design

Block	**1**		**2**		**3**		**4**	**5**	**6**	**7**
	Q11	**Q12**	**Q11**	**Q12**	**Q11**	**Q12**				
Placement oriented	X	X	X	X	X	X				
Output pricing oriented							X	X	X	X
Single source premium	X	X	X	X	X	X			X	X
Output pricing options shown										
CME price		X		X		X	X	X	X	X
Expected local basis		X					X		X	
Ambiguous local basis						X	X	X	X	X
Forward contract basis				X				X		X

Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot.

Suppose it is February 15th. You are looking to buy feeder steers for March placement with an expectation of August finish/sale. A sale lot of 150 feeder steers, which will weigh approximately 800 lbs each at placement, are available for purchase from a single known ranch for a premium of $ 7.96 /cwt over cattle purchased at an auction from unknown sources.

Of the 150 head of feeder steers available from the single source ranch, how many would you purchase?

Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot.

Suppose it is February 15th. You are looking to buy feeder steers for March placement with an expectation of August finish/sale. A sale lot of 150 feeder steers, which will weigh approximately 800 lbs each at placement, are available for purchase from a single known ranch for a premium of $ 3.96 /cwt over cattle purchased at an auction from unknown sources.

The August CME live cattle futures contract is trading at $ 95.31 /cwt. A forward contract (with typical specifications for your area) is currently being offered with a basis of $ -4.04 /cwt tied to the August futures contract.

Of the 150 head of feeder steers available from the single source ranch, how many would you purchase?

Figure 1 Block 2 example

Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot.

Suppose it is February 15th. You just purchased a lot of 150 feeder steers weighing approximately 800 lbs each for March placement with an expectation of August finish/sale. The steers were sourced from a single known ranch for a premium of $ 7.96/cwt over cattle purchased at an auction from unknown sources.

The August CME live cattle futures contract is trading at $ 95.31 /cwt (CME contract is for 40,000lb of live cattle).

How many head would you place under each of the following output pricing strategies?

A forward contract (with typical specifications for your area) with a basis of $ -4.04 /cwt tied to the August futures contract.	0	head
A futures hedge where the expected local August basis has a 54% chance of being less (weaker) than $ 2.13, and a 46% chance of being greater (stronger) than $ 2.13.	0	head
Other output pricing strategy (e.g., options, Livestock Risk Protection, formula pricing, etc.)	0	head
I would accept the local cash price at time of sale in August	0	head
Total	0	head

Figure 2 Block 7 example

Table 1.2 Summary statistics

	Full sample	V1	V2	V3	V4	V5	V6	V7
Number of observations	281	40	41	42	36	42	41	38
Age (years)	49.16	51.60	49.17	46.31	49.58	49.59	50.83	46.75
Bachelor's degree	49.47%	40.00%	60.98%	45.24%	44.44%	42.86%	56.10%	57.89%
TX	10.32%	12.50%	14.63%	7.14%	8.33%	11.90%	12.20%	5.26%
NE	18.86%	22.50%	17.07%	19.05%	22.22%	14.29%	21.95%	15.79%
IA	49.47%	47.50%	51.22%	40.48%	44.44%	61.90%	46.34%	55.26%
CO	5.34%	5.00%	7.32%	4.76%	5.56%	2.38%	4.88%	7.89%
KS	6.41%	2.50%	4.88%	11.90%	11.11%	0.00%	9.76%	5.26%
Cattle sold- medium	18.51%	10.00%	29.27%	16.67%	19.44%	14.29%	14.63%	26.32%
Cattle sold- large	15.66%	15.00%	14.63%	21.43%	16.67%	14.29%	14.63%	13.16%
Custom feeders	21.35%	12.50%	19.51%	26.19%	22.22%	23.81%	17.07%	26.32%
August contract increase	28.83%	35.00%	34.15%	23.81%	25.00%	23.81%	34.15%	26.32%
Purchased single source before	56.58%	52.50%	56.10%	57.14%	61.11%	69.05%	51.22%	50.00%
Risk averse	64.77%	70.00%	63.41%	66.67%	63.89%	66.67%	63.41%	60.53%
Past futures hedge percent	18.50%	19.00%	20.98%	17.41%	15.83%	17.62%	20.20%	18.68%
Past forward contract percent	17.78%	14.23%	21.76%	24.86%	17.50%	14.88%	14.08%	15.92%

Table 1.3 CV1 model coefficient estimates

Model	A		B		C		D	
	Q11	Q12	Q11	Q12	Q11	Q12	Q11	Q12
Source premium	-33.00***	-25.58***	-36.22***	224.52	-32.57***	-27.00***	-34.52***	232.45
	(7.89)	(6.08)	(7.42)	(123.28)	(8.30)	(6.27)	(7.69)	(127.87)
CME price		-0.47		16.05*				
		(3.10)		(8.00)				
Expected hedge basis		13.97**		31.18**				
		(4.56)		(9.59)				
Source premium * CME price				-2.38*				
				(1.19)				
Source premium * Expected hedge basis				-2.60				
				(1.55)				
Expected price- hedge						4.91*		21.75*
						(2.43)		(8.88)
Source premium * Expected price-hedge								-2.48*
								(1.22)
Intercept	206.30***	179.18	223.10***	-1545.77	203.94***	-378.57	214.08***	-2134.64*
	(35.81)	(317.71)	(32.81)	(834.54)	(37.65)	(255.71)	(34.29)	(940.84)
Sigma	122.87***	108.32***	125.76***	96.80***	121.85***	120.89***	123.19***	111.88***
	(18.43)	(16.96)	(19.21)	(15.90)	(18.13)	(18.78)	(18.27)	(18.86)
Rho	0.75***		0.78***		0.72***		0.74***	
	(0.08)		(0.08)		(0.12)		(0.11)	
N	40		40		40		40	
SBC/BIC	513.33		515.78		515.04		515.36	
Pseudo-loglikelihood	-240.07		-237.60		-242.76		-241.08	

Table notes: Robust standard errors in (). * p<0.05, ** p<0.01, *** p<0.001

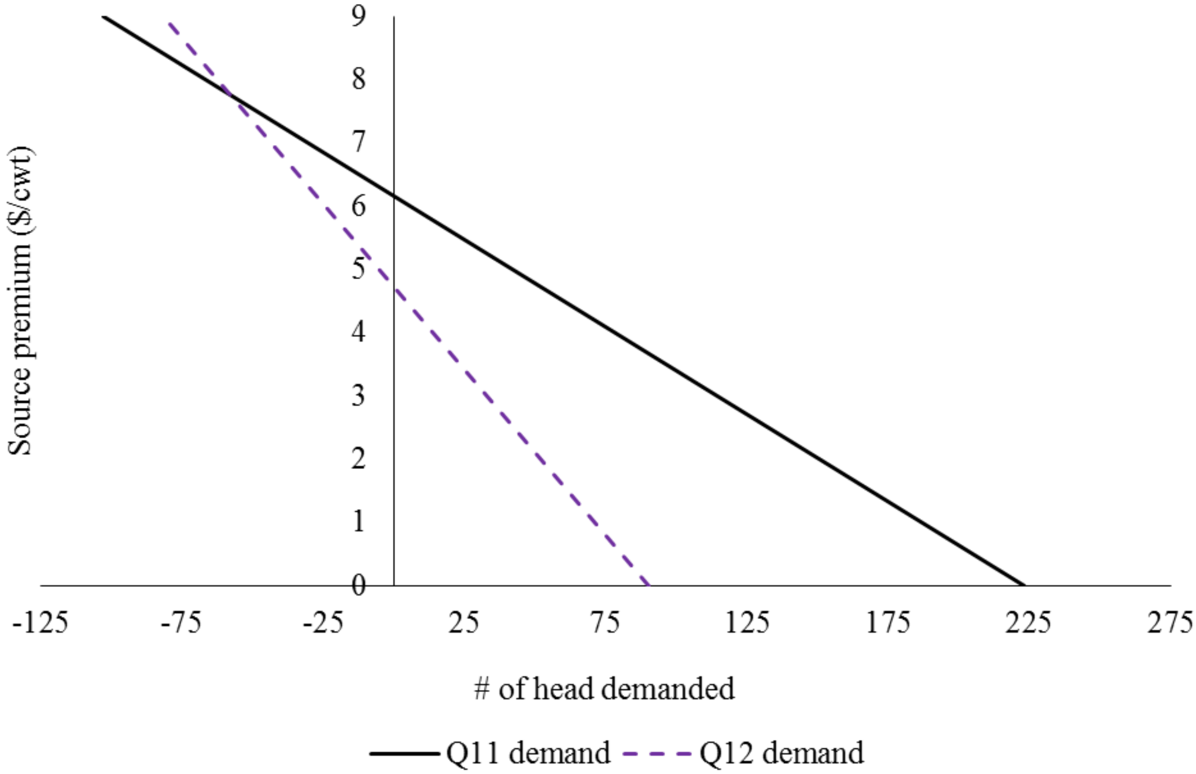

Figure 3 Demand curves for model B

Table 1.4 CV1 marginal effects

Model	A		B		C		D	
	Q11	Q12	Q11	Q12	Q11	Q12	Q11	Q12
Source premium	-12.75***	-7.77***	-13.52***	-6.41***	-12.68***	-7.83***	-13.19***	-6.71***
	(2.19)	(1.49)	(1.88)	(1.44)	(2.34)	(1.52)	(2.05)	(1.58)
	[-17.04, -8.46]	[-10.68, -4.85]	[-17.21, -9.83]	[-9.24, -3.59]	[-17.26, -8.10]	[-10.81, -4.84]	[-17.20, -9.18]	[-9.80, -3.62]
Statistically different	Yes		Yes		Yes		Yes	
CME price		-0.14		0.88				
		(0.94)		(0.94)				
		[-1.99, 1.70]		[-0.95, 2.72]				
Expected hedge basis		4.24***		5.11***				
		(1.35)		(1.11)				
		[1.59, 6.89]		[2.94, 7.28]				
Expected price- hedge						1.42**		2.51***
						(0.69)		(0.72)
						[0.06, 2.78]		[1.11, 3.91]

Table notes: Standard errors are reported in (). 95% confidence intervals reported in []. * p<0.05, ** p<0.01, *** p<0.001. Yes in statistically different line means that the source premium marginal effect in Q11 is statistically different than the source premium marginal effect in Q12 at the .10 level.

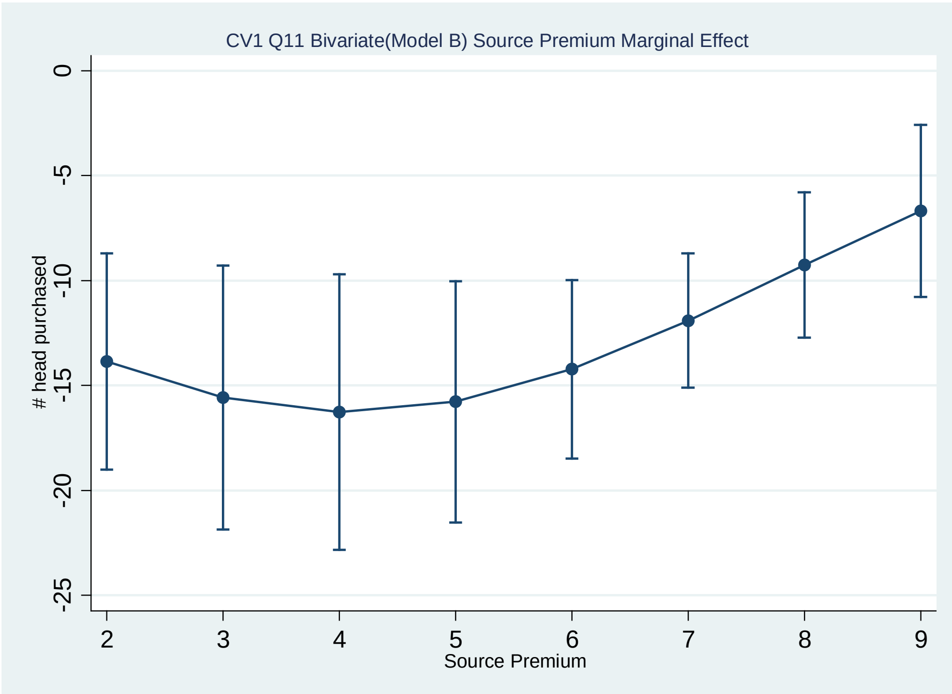

Figure 4 CV1 Q11 (Model B) source premium marginal effect

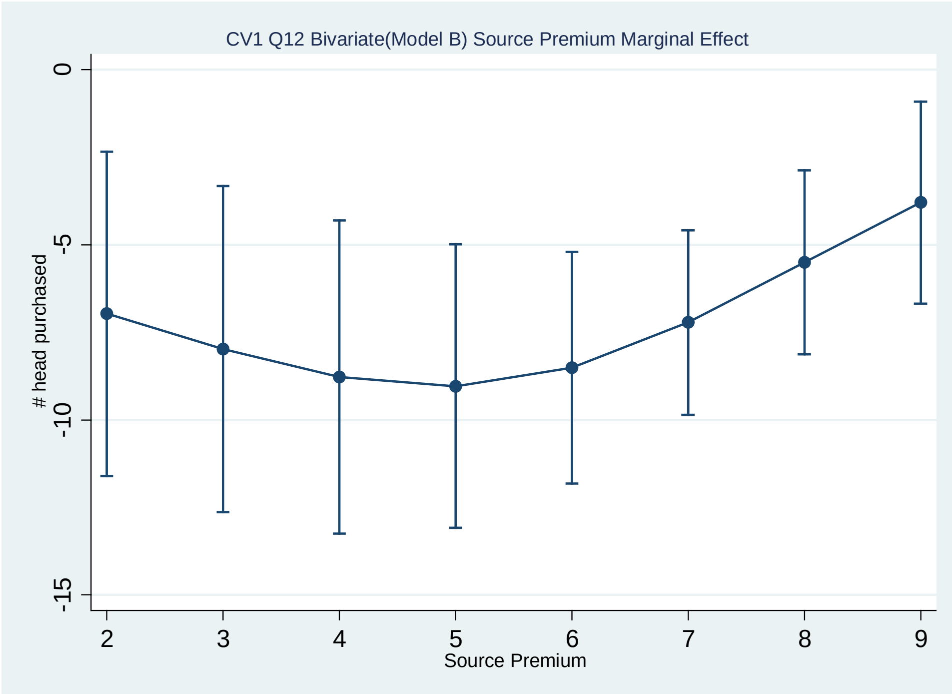

Figure 5 CV1 Q12 (Model B) source premium marginal effect

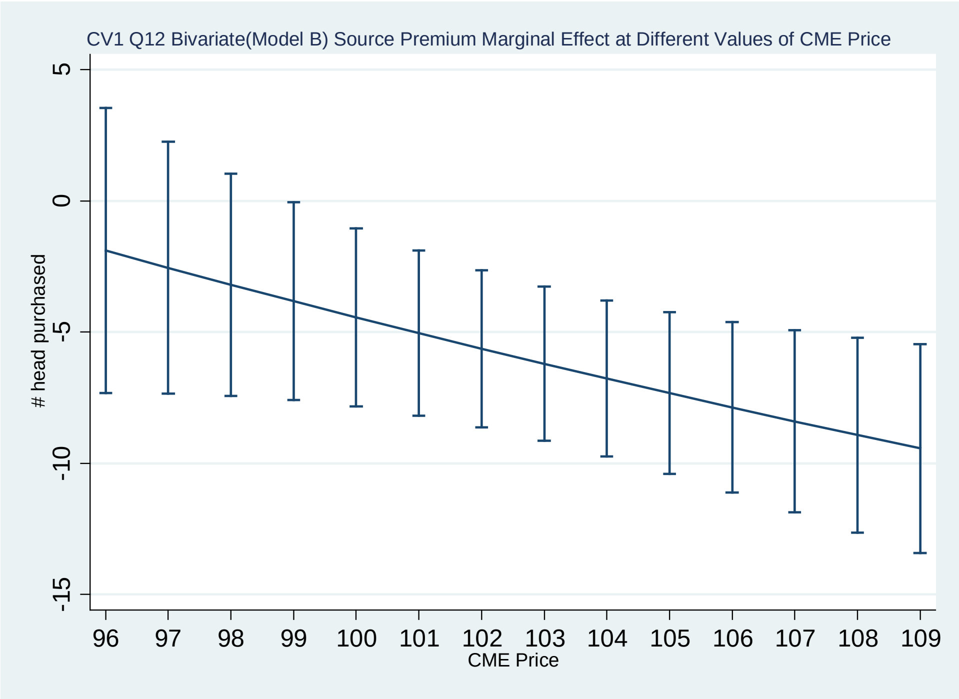

Figure 6 CV1 Q12 (Model B) source premium marginal effect at different values of CME price

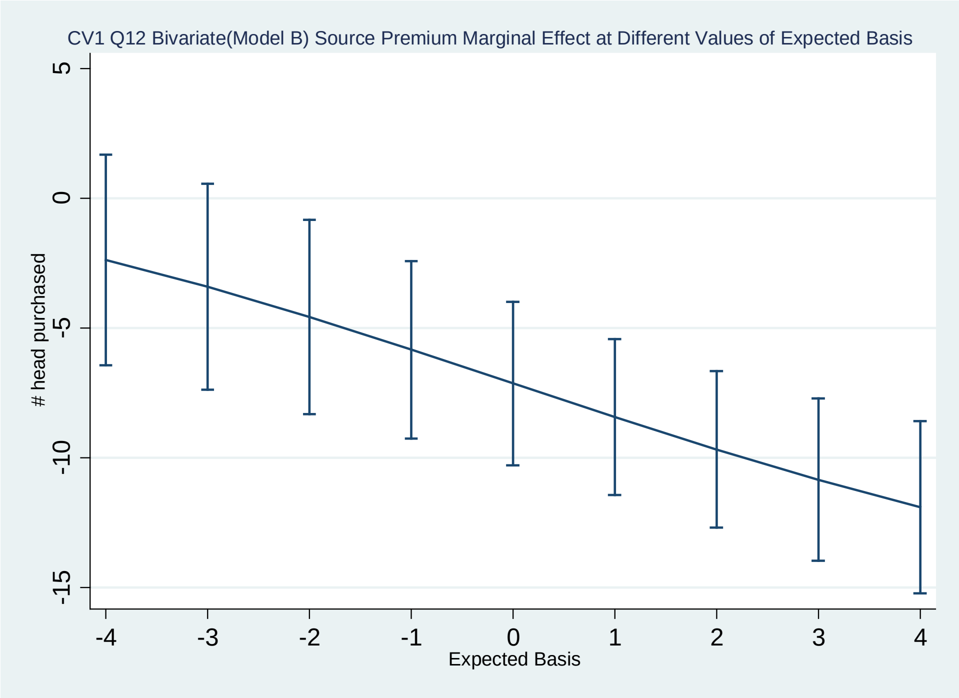

Figure 7 CV1 Q12 (Model B) source premium marginal effect at different values of expected basis

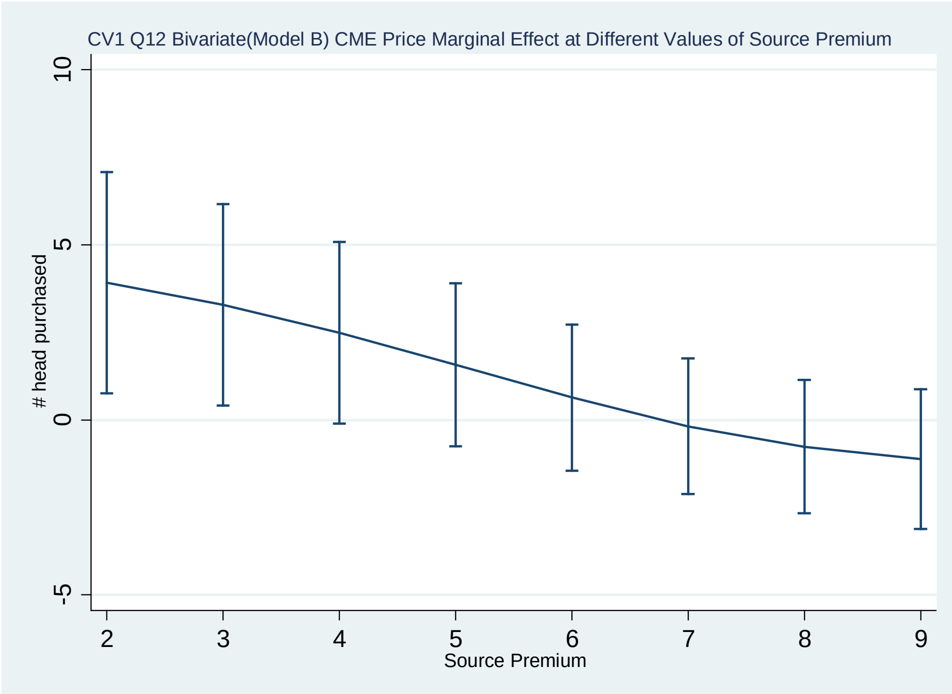

Figure 8 CV1 Q12 (Model B) CME price marginal effect at different values of source premium

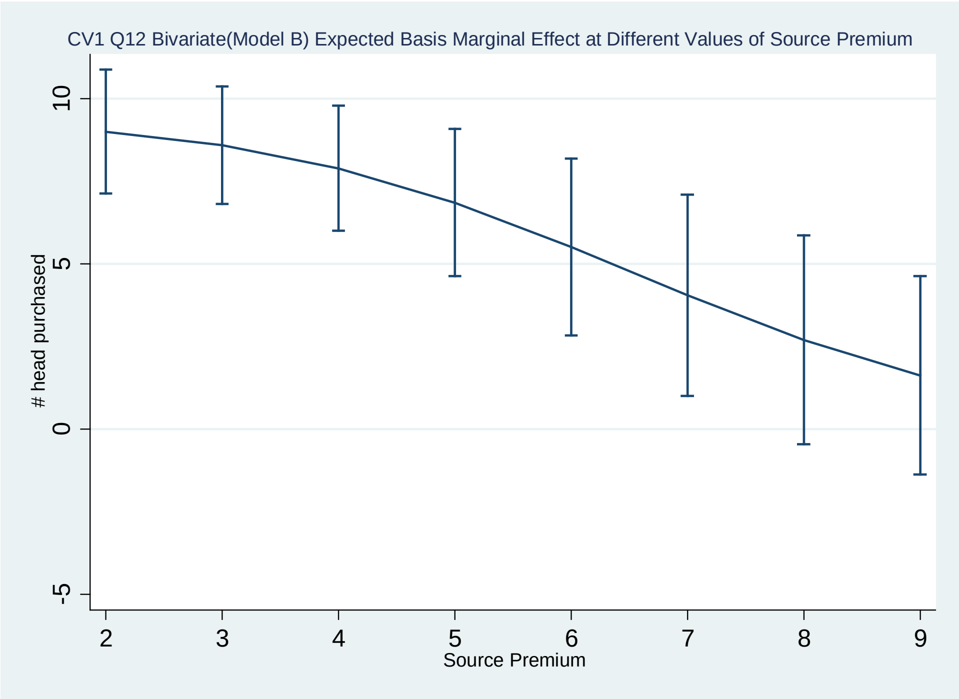

Figure 9 CV1 Q12 (Model B) expected basis price marginal effect at different values of source premium

Table 1.5 CV2 model coefficient estimates

Model	E		F		G		H	
	Q11	Q12	Q11	Q12	Q11	Q12	Q11	Q12
Source premium	-25.10***	-14.12	-35.06***	-14.86	-24.42***	-15.27	-34.93***	-14.65
	(6.84)	(9.69)	(6.34)	(7.64)	(7.34)	(9.22)	(7.21)	(7.89)
CME price		-3.09		-5.38				
		(4.86)		(4.55)				
Forward contract basis		12.63*		16.01**				
		(5.61)		(4.93)				
Expected price-forward contract						3.85		4.64
						(3.30)		(3.45)
Cattle sold- medium			-126.36***	41.01			-133.87***	26.97
			(35.93)	(45.73)			(40.68)	(41.27)
Cattle sold- large			-134.91*	-32.16			-133.34*	-14.54
			(53.33)	(48.04)			(55.15)	(52.29)
Custom feeders			161.27***	32.91			164.79***	46.52
			(34.57)	(43.49)			(37.00)	(41.47)
August contract increase			-18.22	84.00*			-21.10	62.44
			(31.75)	(37.19)			(31.28)	(35.91)
Risk averse			10.18	21.31			16.52	9.81
			(29.63)	(35.46)			(29.67)	(37.36)
Purchased single source before			-14.33	33.93			-15.90	35.77
			(33.86)	(39.05)			(32.41)	(40.46)
Intercept	151.78***	406.24	237.10***	567.27	149.70***	-310.87	237.29***	-460.68
	(31.54)	(500.28)	(42.73)	(471.38)	(33.76)	(341.77)	(43.03)	(365.10)
Sigma	111.82***	108.84***	93.41***	103.47***	109.72***	110.95***	89.65***	103.42***
	(16.91)	(15.03)	(17.17)	(16.03)	(15.94)	(14.61)	(16.34)	(14.43)
Rho	0.52***		0.76***		0.41**		0.61***	
	(0.17)		(0.12)		(0.17)		(0.18)	
N	41		41		41		41	
SBC/BIC	605.34		620.45		605.50		625.26	
Pseudo-log likelihood	-285.96		-271.23		-287.89		-275.50	

Table notes: Robust standard errors in (). * p<0.05, ** p<0.01, *** p<0.001

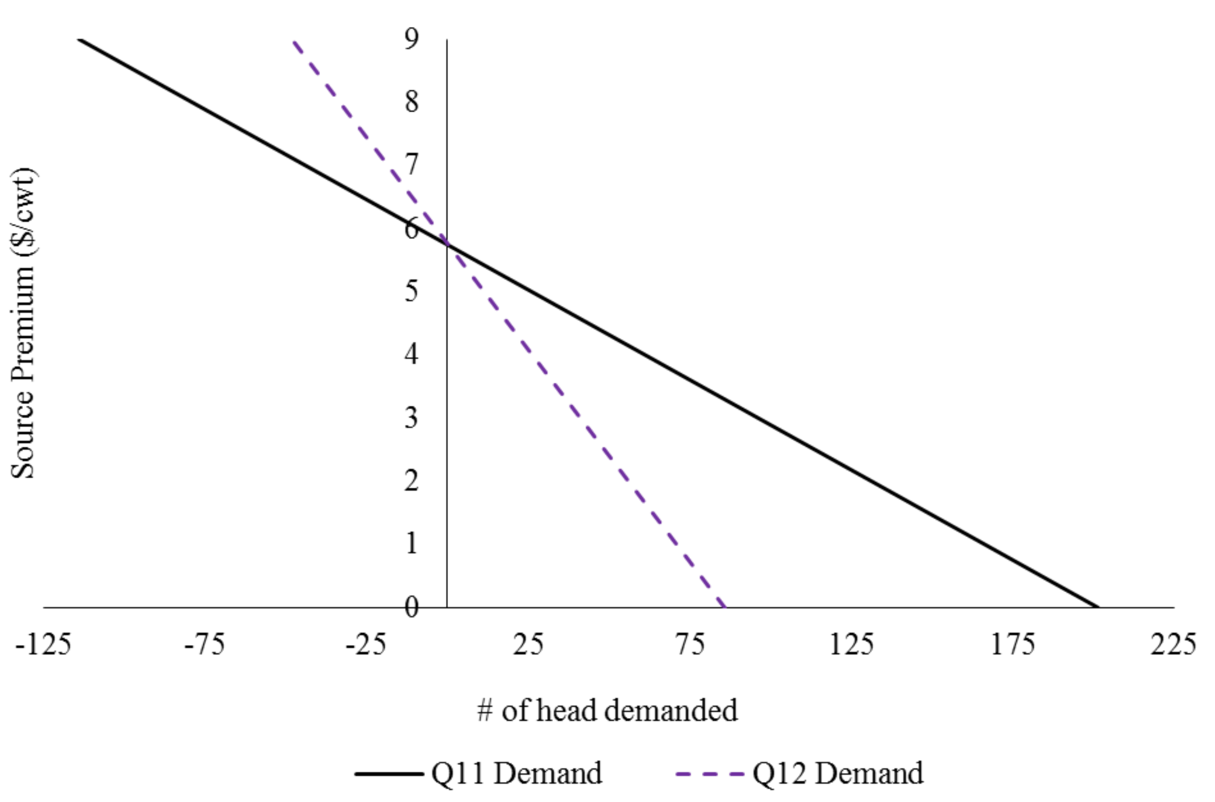

Figure 10 Demand curves from model F

Table 1.6 CV2 marginal effects

Model	E		F		G		H	
	Q11	Q12	Q11	Q12	Q11	Q12	Q11	Q12
Source premium	-9.65***	-6.12	-12.80***	-6.04**	-9.59***	-6.79*	-13.03***	-6.45*
	(1.73)	(3.85)	(1.33)	(2.90)	(1.93)	(3.72)	(1.49)	(3.31)
	[-13.03, -6.27]	[-13.67, 1.43]	[-15.41, -10.19]	[-11.73, -0.34]	[-13.36, -5.81]	[-14.08, 0.50]	[-15.94, -10.11]	[-12.94, 0.04]
Statistically different	No		Yes		No		Yes	
CME price		-1.34		-2.19				
		(2.09)		(1.78)				
		[-5.43, 2.75]		[-5.68, 1.30]				
Forward contract basis		5.47**		6.50***				
		(2.15)		(1.73)				
		[1.26, 9.68]		[3.11, 9.90]				
Expected price-forward contract						1.71		2.04
						(1.42)		(1.47)
						[-1.08, 4.51]		[-0.84, 4.93]
Cattle sold- medium			-39.19***	16.93			-41.46***	12.09
			(10.08)	(19.19)			(10.24)	(18.83)
			[-58.95, -19.42]	[-20.67, 54.54]			[-61.52, -21.39]	[-24.81, 48.98]
Cattle sold- large			-40.94***	-12.63			-41.38***	-6.30
			(11.88)	(18.10)			(12.11)	(22.21)
			[-64.22, -17.65]	[-48.11, 22.85]			[-65.11, -17.64]	[-49.83, 37.24]
Custom feeders			59.93***	13.86			61.94***	21.54
			(12.69)	(18.90)			(12.36)	(19.57)
			[35.06, 84.80]	[-23.17, 50.90]			[37.72, 86.17]	[-16.83, 59.90]
August contract increase			-6.54	34.81**			-7.71	28.55*
			(11.41)	(14.65)			(11.42)	(16.31)
			[-28.90, 15.82]	[6.09, 63.52]			[-30.08, 14.67]	[-3.41, 60.52]
Risk averse			3.69	8.65			6.09	4.32
			(10.80)	(14.43)			(10.93)	(16.54)
			[-17.46, 24.85]	[-19.62, 36.93]			[-15.33, 27.51]	[-28.09, 36.73]
Purchased single source before			-5.25	13.74			-5.95	15.55
			(12.45)	(15.65)			(12.20)	(17.32)
			[-29.65, 19.15]	[-16.93, 44.42]			[-29.87, 17.97]	[-18.40, 49.49]

Table notes: Standard errors are reported in (). 95% confidence intervals reported in []. * p<0.05, ** p<0.01, *** p<0.001.

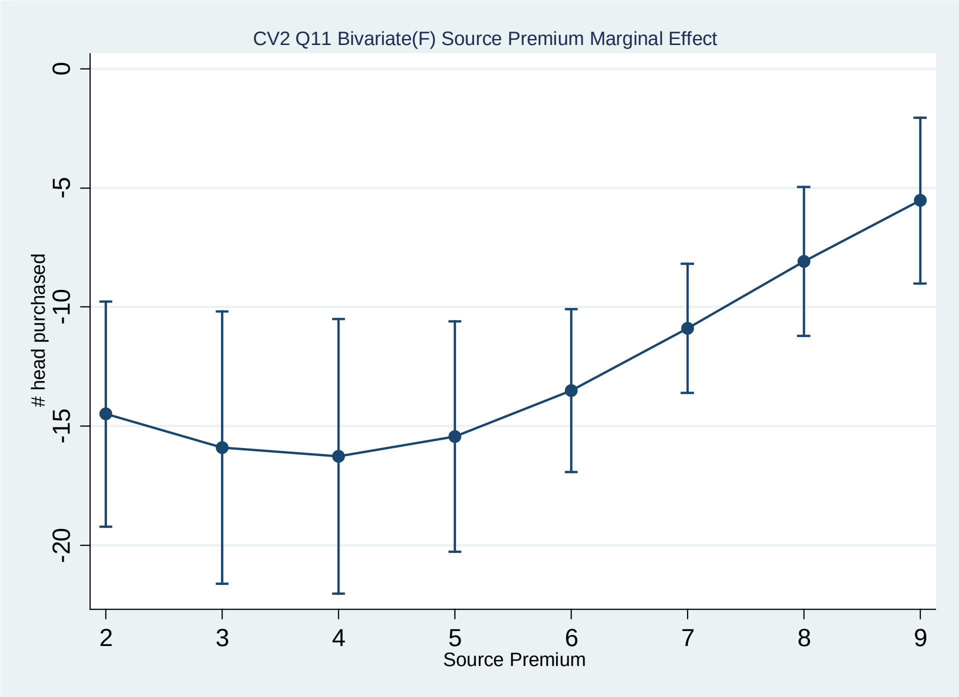

Figure 11 CV2 Q11 (Model F) source premium marginal effect

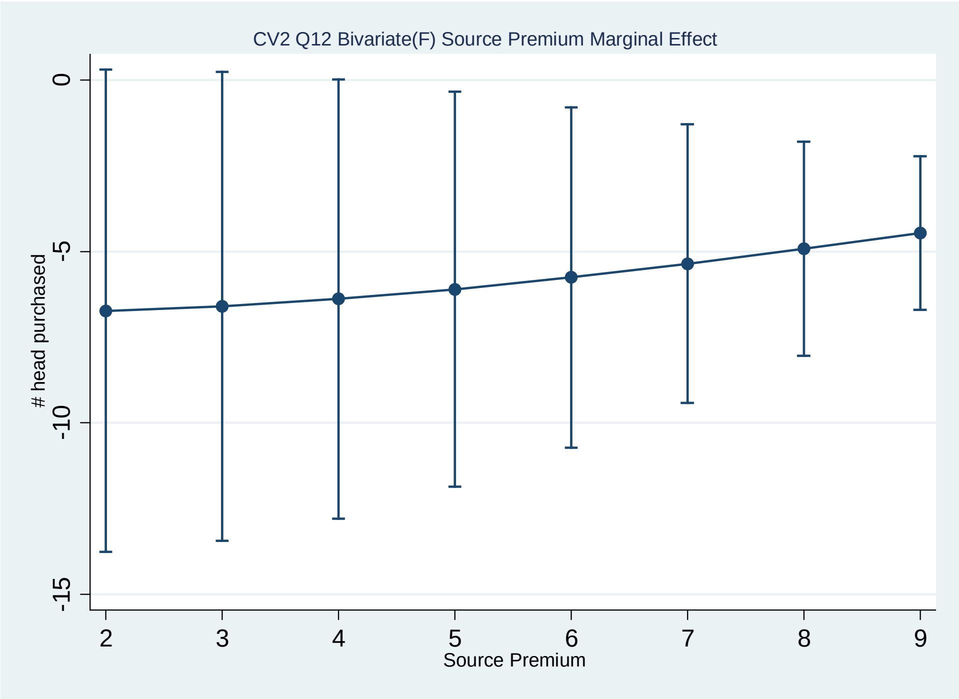

Figure 12 CV2 Q12 (Model F) source premium marginal effect

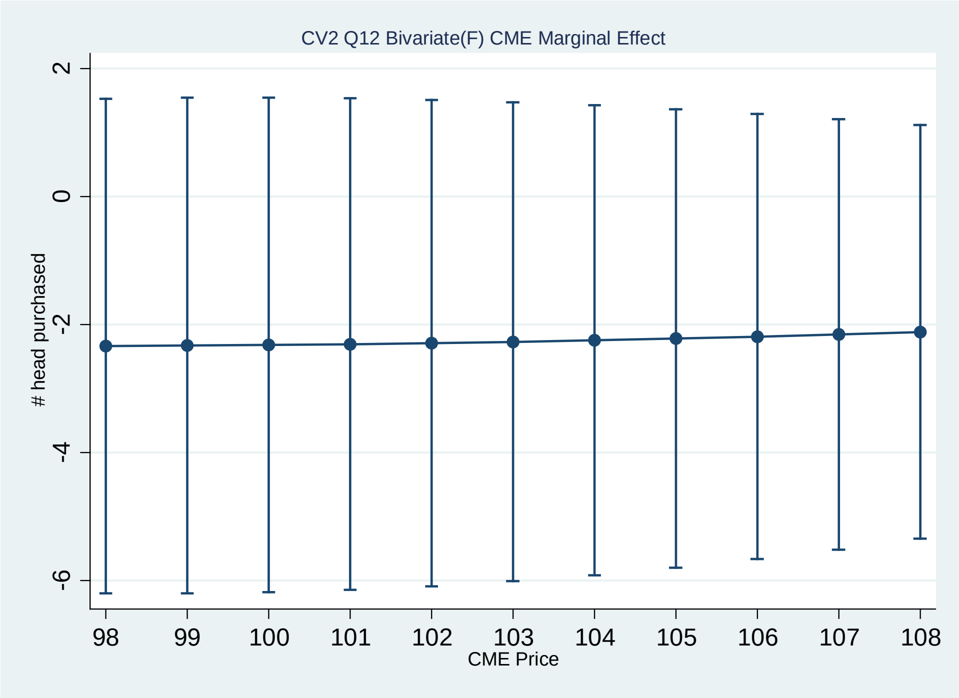

Figure 13 CV2 Q12 (Model F) CME price marginal effect

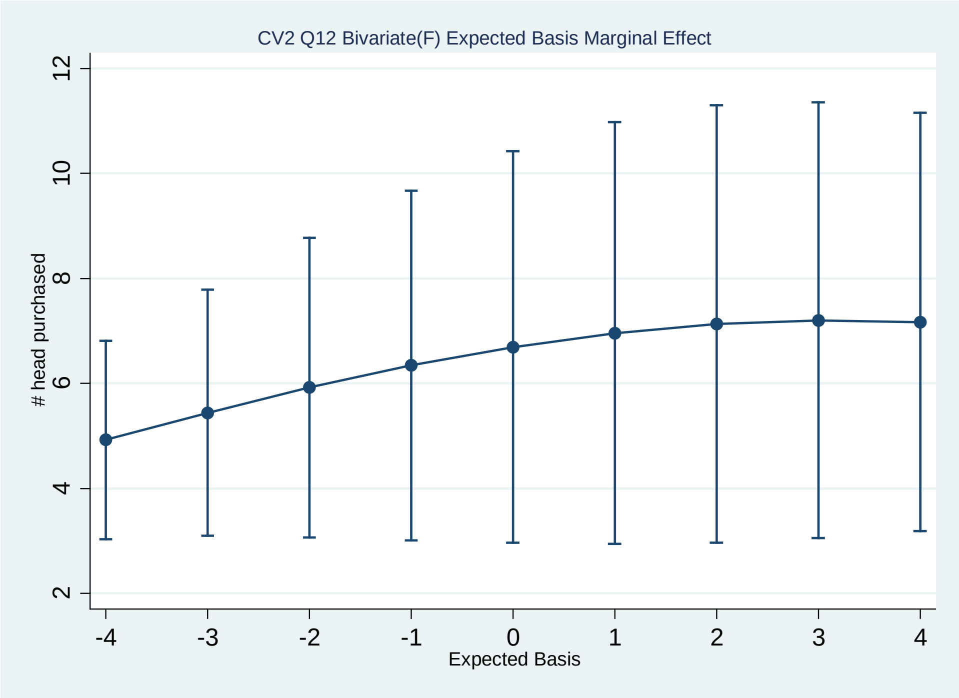

Figure 14 CV2 Q121 (Model F) expected basis marginal effect

Table 1.7 Model I coefficient estimates

	Futures Hedge	Forward Contract	Spot	Past hedging percent	Past forward contract percent
CME price	2.96	-1.22	-1.51		
	(4.02)	(5.51)	(2.91)		
CME price * CV4	-3.02	11.07	-4.40		
	(6.01)	(8.12)	(4.15)		
Expected hedge basis	2.54	-6.84	1.22		
	(5.88)	(7.96)	(4.01)		
Expected hedge basis * CV4	-0.12	16.72	2.55		
	(8.47)	(11.39)	(5.18)		
Forward contract basis	-3.62	-0.75	8.57*		
	(5.21)	(6.79)	(4.28)		
Forward contract basis * CV4	6.51	11.92	-4.17		
	(7.82)	(8.86)	(5.79)		
Past futures hedging percent	1.26	0.37	-2.05		
	(1.66)	(3.08)	(1.69)		
Past forward contract percent	0.57	3.79	-3.60***		
	(1.38)	(2.27)	(0.99)		
CV4	297.10	461.41	461.41		
	(612.38)	(424.90)	(424.90)		
Cattle sold- large				4.07	10.17
				(12.97)	(10.35)
Risk averse				11.07	17.66**
				(5.74)	(5.40)
Custom feeder				-16.89***	12.70
				(4.55)	(8.91)
Intercept	-329.20	-3.02	267.47	11.69**	1.08
	(406.53)	(556.82)	(291.52)	(3.64)	(3.25)
Sigma	94.27***	143.45***	109.13***	24.93***	28.5***
	(10.95)	(38.96)	(23.11)	(2.78)	(3.02)
		Rho i2	**Rho i3**	**Rho i4**	**Rho i5**
Rho 1j		-0.56**	-0.04	0.14	-0.06
		(0.25)	(0.35)	(0.54)	(0.51)
Rho 2j			-0.67***	0.00	-0.66*
			(0.18)	(0.66)	(0.37)
Rho 3j				0.06	0.77***
				(0.46)	(0.20)
Rho 4j					-0.31***
					(0.07)
Rho 5j					
N	78				
SBC/BIC	2950.75				
Pseudo-loglikelihood	-1359.92				

Table notes: Robust standard errors are reported in (). * p<0.05, ** p<0.01, *** p<0.001.

Table 1.8 Model I marginal effects

	Futures Hedge		Forward Contract		Spot	
	CV4	CV5	CV4	CV5	CV4	CV5
CME price	-0.02	1.24	2.23	-0.25	-2.22**	-0.56
	(1.72)	(1.70)	(1.39)	(1.12)	(1.02)	(1.09)
	[-3.40, 3.36]	[-2.08, 4.57]	[-0.49, 4.95]	[-2.44, 1.94]	[-4.22, -0.21]	[-2.70, 1.58]
Expected hedge basis	0.97	1.07	2.24	-1.40	1.41	0.46
	(2.54)	(2.47)	(1.70)	(1.75)	(1.36)	(1.49)
	[-4.00, 5.94]	[-3.78, 5.92]	[-1.11, 5.58]	[-4.83, 2.02]	[-1.24, 4.07]	[-2.46, 3.37]
Forward contract basis	1.16	-1.52	2.53*	-0.16	1.65	3.19**
	(2.27)	(2.23)	(1.47)	(1.40)	(1.52)	(1.62)
	[-3.30, 5.61]	[-5.89, 2.85]	[-0.36, 5.41]	[-2.91, 2.60]	[-1.34, 4.63]	[0.02, 6.36]
Past futures hedging percent	0.50	0.53	0.08	0.08	-0.77	-0.76
	(0.62)	(0.64)	(0.71)	(0.65)	(0.52)	(0.57)
	[-0.71, 1.72]	[-0.72, 1.78]	[-1.30, 1.47]	[-1.20, 1.35]	[-1.79, 0.26]	[-1.88, 0.35]
Past forward contract percent	0.23	0.24	0.86**	0.78***	-1.35***	-1.34***
	(0.57)	(0.60)	(0.35)	(0.26)	(0.44)	(0.37)
	[-0.89, 1.35]	[-0.94, 1.42]	[0.16, 1.55]	[0.27, 1.28]	[-2.21, -0.49]	[-2.06, -0.62]

Table notes: Standard errors are reported in (). 95% confidence intervals reported in []. * p<0.05, ** p<0.01, *** p<0.001.

Table 1.9 Model J coefficient estimates

	Futures Hedge	Forward Contract	Spot	Past hedging percent	Past forward contract percent
Feeder futures	9.45	-4.54	8.81		
	(5.20)	(7.51)	(4.69)		
Feeder futures * CV4	-0.21	-2.37	-11.44		
	(7.84)	(9.56)	(5.92)		
CME price	3.14	-1.64	-0.81		
	(3.95)	(5.32)	(3.01)		
CME price * CV4	-3.97	11.82	-4.37		
	(5.74)	(8.03)	(4.24)		
Expected hedge basis	3.54	-7.69	3.25		
	(5.73)	(7.76)	(4.06)		
Expected hedge basis * CV4	-0.55	17.04	0.12		
	(8.09)	(11.60)	(5.14)		
Forward contract basis	-4.71	-0.87	8.74*		
	(4.97)	(6.71)	(4.24)		
Forward contract basis * CV4	10.20	10.36	-5.41		
	(7.72)	(9.14)	(6.02)		
Past futures hedging percent	1.43	0.59	-1.77		
	(1.92)	(3.18)	(1.77)		
Past forward contract percent	0.26	3.91	-3.91***		
	(1.58)	(2.36)	(1.06)		
CV4	418.29	-895.27	1918.61*		
	(1174.51)	(1468.34)	(843.65)		
Cattle sold- large				3.04	10.44
				(13.42)	(9.98)
Risk averse				11.42	17.54**
				(5.86)	(5.35)
Custom feeder				-16.73***	12.78
				(4.96)	(8.78)
Intercept	-1548.66	614.07	-928.34	11.59**	1.10
	(838.00)	(1081.62)	(704.84)	(3.69)	(3.23)
Sigma	90.03***	144.33***	112.41***	24.93***	28.49***
	(9.48)	(40.15)	(26.79)	(2.78)	(3.02)
		Rho i2	**Rho i3**	**Rho i4**	**Rho i5**
Rho 1j		-0.62**	0.01	0.06	0.06
		(0.27)	(0.46)	(0.67)	(0.63)
Rho 2j			-0.68***	-0.03	-0.66*
			(0.22)	-0.66*	(0.38)
Rho 3j				-0.04	0.83***
				(0.46)	(0.16)
Rho 4j					-0.31***
					(0.07)
Rho 5j					
N	78				
SBC/BIC	2967.00				
Pseudo-loglikelihood	-1354.98				

Table notes: Robust standard errors are reported in (). * p<0.05, ** p<0.01, *** p<0.001.

Table 1.10 Model J marginal effects

	Futures Hedge		Forward Contract		Spot	
	CV4	CV5	CV4	CV5	CV4	CV5
Feeder futures	3.71	3.95*	-1.55	-0.93	-0.99	3.27*
	(2.37)	(2.14)	(1.33)	(1.56)	(1.48)	(1.76)
	[-0.93, 8.34]	[-0.25, 8.15]	[-4.16, 1.06]	[-3.98, 2.13]	[-3.88, 1.91]	[-0.17, 6.71]
CME price	-0.33	1.31	2.28*	-0.34	-1.94*	-0.30
	(1.62)	(1.67)	(1.35)	(1.08)	(1.01)	(1.12)
	[-3.52, 2.85]	[-1.96, 4.58]	[-0.37, 4.92]	[-2.44, 1.77]	[-3.92, 0.04]	[-2.49, 1.89]
Expected hedge basis	1.20	1.48	2.09	-1.57	1.26	1.21
	(2.34)	(2.41)	(1.73)	(1.75)	(1.30)	(1.48)
	[-3.38, 5.78]	[-3.24, 6.20]	[-1.31, 5.49]	[-5.00, 1.86]	[-1.29, 3.81]	[-1.70, 4.11]
Forward contract basis	2.20	-1.97	2.13	-0.18	1.25	3.24**
	(2.31)	(2.16)	(1.51)	(1.38)	(1.67)	(1.59)
	[-2.33, 6.74]	[-6.20, 2.27]	[-0.84, 5.09]	[-2.88, 2.52]	[-2.02, 4.51]	[0.13, 6.35]
Past futures hedging percent	0.58	0.60	0.13	0.12	-0.66	-0.66
	(0.68)	(0.69)	(0.72)	(0.68)	(0.57)	(0.61)
	[-0.76, 1.91]	[-0.75, 1.95]	[-1.29, 1.55]	[-1.22, 1.46]	[-1.79, 0.46]	[-1.85, 0.54]
Past forward contract percent	0.10	0.11	0.88**	0.80***	-1.46***	-1.45***
	(0.65)	(0.68)	(0.37)	(0.26)	(0.46)	(0.39)
	[-1.17, 1.37]	[-1.22, 1.43]	[0.28, 1.32]	[0.15, 1.60]	[-2.37, -0.56]	[-2.22, -0.68]

Table notes: Standard errors are reported in (). 95% confidence intervals reported in []. * p<0.05, ** p<0.01, *** p<0.001.

Table 1.11 Model K coefficient estimates

	Futures Hedge	Forward Contract	Spot	Past hedging percent	Past forward contract percent
Source premium	2.73	5.51	-8.17*		
	(8.03)	(8.60)	(3.94)		
Source premium *CV6	7.77	-21.98	4.14		
	(10.12)	(16.44)	(5.62)		
CME price	-2.28	10.91**	3.24		
	(3.69)	(3.92)	(2.20)		
CME price * CV6	3.64	-13.67*	-4.67		
	(4.75)	(6.01)	(2.87)		
Expected hedge basis	11.23	-0.00	2.52		
	(6.17)	(6.52)	(3.44)		
Expected hedge basis * CV6	-2.07	-31.51*	0.08		
	(8.93)	(12.85)	(5.00)		
Forward contract basis	11.09	7.40	-10.10**		
	(7.87)	(7.27)	(3.53)		
Forward contract basis * CV6	-22.50*	3.70	11.61*		
	(10.07)	(11.81)	(5.56)		
Past futures hedging percent	4.88	-0.68	-4.08**		
	(2.51)	(3.70)	(1.50)		
Past forward contract percent	-0.85	4.36	-3.26		
	(3.45)	(6.53)	(2.54)		
CV6	-417.46	1444.65*	494.53		
	(500.92)	(632.04)	(296.38)		
Cattle sold- large				16.02	14.26
				(8.43)	(15.56)
Risk averse				16.87**	4.83
				(6.43)	(9.18)
Custom feeder				-6.99	9.08
				(5.55)	(8.65)
Intercept	150.33	-1286.97**	-132.84	5.83*	13.47**
	(376.41)	(451.47)	(233.02)	(2.60)	(4.61)
Sigma	138.17	132.77	111.48***	23.46***	31.71***
	(85.51)	(171.49)	(37.85)	(2.79)	(2.98)
		Rho i2	**Rho i3**	**Rho i4**	**Rho i5**
Rho 1j		-0.36	-0.38	-0.76***	0.41
		(1.02)	(0.70)	(0.22)	(0.69)
Rho 2j			-0.59	0.25	-0.73
			(0.45)	-0.73	(0.84)
Rho 3j				0.41	0.55
				(0.66)	(0.67)
Rho 4j					-0.36***
					(0.06)
Rho 5j					
N	78				
SBC/BIC	2939.14				
Pseudo-loglikelihood	-1341.05				

Table notes: Robust standard errors are reported in (). * p<0.05, ** p<0.01, *** p<0.001.

Table 1.12 Model K marginal effects

	Futures Hedge		Forward Contract		Spot	
	CV6	CV7	CV6	CV7	CV6	CV7
Source Premium	2.55*	0.69	-2.41	0.92	-1.35	-2.69**
	(1.38)	(2.00)	(1.78)	(1.83)	(1.51)	(1.31)
	[-0.15, 5.25]	[-3.23, 4.61]	[-5.90, 1.08]	[-2.68, 4.51]	[-4.30, 1.60]	[-5.25, -0.13]
CME price	0.33	-0.58	-0.40	1.82	-0.48	1.07
	(0.80)	(0.99)	(0.71)	(2.63)	(0.73)	(0.74)
	[-1.23, 1.90]	[-2.52, 1.37]	[-1.79, 0.98]	[-3.33, 6.97]	[-1.90, 0.95]	[-0.39, 2.52]
Expected hedge basis	2.22	2.84	-4.61	-0.00	0.87	0.83
	(1.58)	(1.75)	(3.57)	(1.09)	(1.24)	(1.15)
	[-0.88, 5.33]	[-0.59, 6.27]	[-11.60, 2.39]	[-2.13, 2.13]	[-1.56, 3.30]	[-1.43, 3.09]
Forward contract basis	-2.77	2.80	1.62	1.23	0.50	-3.33***
	(1.81)	(2.34)	(1.41)	(2.23)	(1.61)	(1.19)
	[-6.31, 0.77]	[-1.77, 7.38]	[-1.15, 4.39]	[-3.14, 5.60]	[-2.64, 3.65]	[-5.65, -1.00]
Past futures hedging percent	1.18***	1.23***	-0.10	-0.11	-1.36**	-1.34**
	(0.34)	(0.30)	(0.47)	(0.49)	(0.68)	(0.55)
	[0.52, 1.85]	[0.65, 1.82]	[-1.03, 0.83]	[-1.07, 0.84]	[-2.70, -0.03]	[-2.42, -0.27]
Past forward contract percent	-0.21	-0.21	0.64	0.73***	-1.09*	-1.07
	(0.79)	(0.82)	(0.44)	(0.11)	(0.61)	(0.72)
	[-1.75, 1.34]	[-1.81, 1.38]	[-0.22, 1.50]	[0.51, 0.94]	[-2.29, 0.11]	[-2.48, 0.33]

Table notes: Standard errors are reported in (). 95% confidence intervals reported in []. * p<0.05, ** p<0.01, *** p<0.001.

Table 1.13 Model L coefficient estimates

	Futures Hedge	Forward Contract	Spot	Past hedging percent	Past forward contract percent
Feeder futures	-10.47	-5.80	7.54		
	(6.48)	(8.63)	(4.79)		
Feeder futures * CV6	17.04*	1.40	-5.99		
	(7.90)	(10.59)	(5.88)		
Source premium	-1.13	4.16	-8.22*		
	(7.95)	(7.85)	(3.64)		
Source premium *CV6	11.67	-19.08	3.81		
	(9.94)	(15.15)	(5.41)		
CME price	-2.82	11.33**	3.34		
	(3.57)	(4.02)	(2.25)		
CME price * CV6	3.89	-13.76*	-4.83		
	(4.62)	(5.91)	(2.96)		
Expected hedge basis	9.89	-0.49	4.05		
	(5.81)	(6.63)	(3.42)		
Expected hedge basis * CV6	-1.39	-30.06*	-1.65		
	(8.87)	(13.55)	(4.94)		
Forward contract basis	12.95	6.88	-10.60**		
	(8.32)	(7.21)	(3.64)		
Forward contract basis * CV6	-24.48*	2.84	12.35*		
	(10.26)	(11.47)	(5.64)		
Past futures hedging percent	5.22	-0.60	-4.24**		
	(3.50)	(3.10)	(1.56)		
Past forward contract percent	-1.96	3.94	-3.10		
	(5.16)	(5.17)	(2.69)		
CV6	-2632.32*	1261.65	1277.65		
	(1060.11)	(1411.89)	(779.64)		
Cattle sold- large				17.45*	14.69
				(7.24)	(13.36)
Risk averse				15.84**	4.98
				(5.99)	(8.26)
Custom feeder				-7.96	8.70
				(6.11)	(8.75)
Intercept	1577.01	-576.37	-1105.62	6.35*	13.41**
	(953.99)	(1239.84)	(663.22)	(2.61)	(4.56)
Sigma	163.43	121.14	109.45***	23.51***	31.7***
	(157.93)	(125.71)	(34.34)	(2.87)	(2.95)
		Rho i2	**Rho i3**	**Rho i4**	**Rho i5**
Rho 1j		-0.44	-0.28	-0.79***	0.60
		(1.09)	(0.77)	(0.14)	(0.62)
Rho 2j			-0.55	0.21	-0.68
			(0.55)	-0.68	(0.84)
Rho 3j				0.47	0.49
				(0.70)	(0.77)
Rho 4j					-0.36***
					(0.06)
Rho 5j					
N	78				
SBC/BIC	2957.95				
Pseudo-loglikelihood	-1337.38				

Table notes: Robust standard errors are reported in (). * p<0.05, ** p<0.01, *** p<0.001.

Table 1.14 Model L marginal effects

	Futures Hedge		Forward Contract		Spot	
	CV6	CV7	CV6	CV7	CV6	CV7
Feeder futures	1.47	-2.32*	-0.66	-1.05	0.53	2.48
	(1.19)	(1.34)	(0.85)	(2.54)	(1.10)	(1.56)
	[-0.86, 3.80]	[-4.95, 0.31]	[-2.32, 1.00]	[-6.02, 3.92]	[-1.63, 2.68]	[-0.58, 5.53]
Soure premium	2.36*	-0.25	-2.24	0.75	-1.49	-2.70**
	(1.30)	(1.78)	(1.66)	(1.56)	(1.53)	(1.24)
	[-0.19, 4.90]	[-3.74, 3.24]	[-5.50, 1.01]	[-2.31, 3.82]	[-4.49, 1.51]	[-5.13, -0.27]
CME price	0.24	-0.63	-0.37	2.05	-0.50	1.10
	(0.72)	(0.83)	(0.71)	(2.55)	(0.76)	(0.76)
	[-1.18, 1.65]	[-2.25, 1.00]	[-1.76, 1.02]	[-2.95, 7.05]	[-2.00, 1.00]	[-0.39, 2.59]
Expected hedge basis	1.90	2.19	-4.59	-0.09	0.81	1.33
	(1.35)	(1.47)	(2.99)	(1.19)	(1.24)	(1.15)
	[-0.75, 4.55]	[-0.68, 5.06]	[-10.45, 1.27]	[-2.43, 2.25]	[-1.62, 3.25]	[-0.92, 3.58]
Forward contract basis	-2.58	2.87	1.46	1.25	0.59	-3.48***
	(1.66)	(2.14)	(1.30)	(2.08)	(1.61)	(1.24)
	[-5.83, 0.67]	[-1.34, 7.07]	[-1.09, 4.01]	[-2.84, 5.33]	[-2.57, 3.75]	[-5.92, -1.04]
Past futures hedging percent	1.17**	1.16***	-0.09	-0.11	-1.43*	-1.39**
	(0.48)	(0.40)	(0.42)	(0.46)	(0.74)	(0.62)
	[0.24, 2.10]	[0.38, 1.93]	[-1.01, 0.80]	[-0.91, 0.73]	[-2.89, 0.02]	[-2.60, -0.19]
Past forward contract percent	-0.44	-0.43	0.59	0.71***	-1.05	-1.02
	(1.05)	(1.01)	(0.38)	(0.12)	(0.67)	(0.74)
	[-2.49, 1.61]	[-2.41, 1.54]	[-0.16, 1.34]	[0.48, 0.94]	[-2.36, 0.26]	[-2.46, 0.43]

Table notes: Standard errors are reported in (). 95% confidence intervals reported in []. * p<0.05, ** p<0.01, *** p<0.001.

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Appendix A - Survey Instrument

Following is a survey designed to obtain important information from U.S. feedlot operators. The survey is focused on assessing various aspects of risk management including incoming cattle purchases and outgoing cattle sales. We want to emphasize that your participation in this survey is entirely voluntary and highly encouraged. All your responses will be kept in strict confidence. Typical demographic questions are included to ensure our sample is representative of the U.S. feedlot industry and will remain strictly confidential. If you wish to provide comments please use the space at the end of the survey. We very much appreciate your assistance with this important project and look forward to receiving your completed survey. If you have any questions or comments regarding this survey, please feel free to contact Melissa McKendree (mgsm@ksu.edu) or Dr. Glynn Tonsor by email (gtonsor@ksu.edu) or by phone (785-532-1518).

Q1A Please describe your cattle operation by indicating the percentage of your operation devoted to each segment of the beef cattle industry (should sum to 100%)

______ Seed Stock (1)

______ Cow-calf (2)

______ Backgrounding/Stocker (3)

______ Feedlot (4)

______ Other (please describe): (5)

Q1B Do you play a role in price risk management and/or animal health risk management decisions?

- o Yes, both price risk and animal health risk decisions (3)
- o Yes, price risk management decisions (1)
- o Yes, animal health risk management decisions (2)
- o No (4)

The following questions will refer to "your operation." Please answer the questions when considering the finishing feedlot(s) in your operation. If your operation includes multiple feedlots, please answer for them collectively.

Q2 Please answer the following questions:

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)
How often does your operation use futures markets to hedge corn for feeding? (1)					
How often does your operation use futures markets to hedge feeder cattle? (2)					
How often does your operation use futures markets to hedge fed cattle? (3)					

Q3 What is the average placement weight of calves your feeding operation places in March?

- o Under 600 lbs (1)
- o 600 to 699 lbs (2)
- o 700 to 799 lbs (3)
- o 800 to 899 lbs (4)
- o 900 lbs or more (5)

Q4 On average, what percentage of feeder cattle does your operation source from (should sum to 100%):

______ Traditional auction (1)

______ Satellite/video auction (2)

______ Purchased direct from seller (ranch) (3)

______ Home raised from own cow-herd (4)

______ Custom fed, so I did not buy or own animals (5)

______ Other(please describe): (6)

Q5 Compared to calves sourced from auctions with unknown backgrounds, how do you believe calves from a single source ranch perform (i.e. average daily gain, feed conversion, morbidity) in the feedlot?

- o Much worse (1)
- o Somewhat worse (2)
- o About the same (3)
- o Somewhat better (4)
- o Much better (5)

Q6 In the past 12 months, what do you believe is the average premium paid nationally in the market for feeder calves sourced from a single known ranch versus multiple unknown sources?

- o Discount (1)
- o No premium (2)
- o Premium less than $1/cwt (3)
- o $1 to $1.99/cwt premium (4)
- o $2 to $2.99/cwt premium (5)
- o $3 to $3.99/cwt premium (6)
- o $4 to $4.99/cwt premium (7)
- o $5 to $5.99/cwt premium (8)
- o $6 to $6.99/cwt premium (9)
- o $7 to $7.99/cwt premium (10)
- o $8 to $8.99/cwt premium (11)
- o $9 to $9.99/cwt premium (12)
- o Premium greater than $10/cwt (13)

Q7 In the past 12 months, what percentage of finished cattle did your operation market as (should sum to 100%):

______ Live weight, negotiated price (includes auctions) (1)

______ Live weight, formula price (2)

______ Live weight, forward contract (3)

______ Dressed weight, negotiated price (4)

______ Dressed weight, formula price (5)

______ Dressed weight, forward contract (6)

______ Grid (dressed, grade and yield) (7)

______ Other (please describe): (8)

Q8 In the past 12 months, what percentage of the following pricing methods did your operation use for marketing finished cattle (should sum to 100%):

______ Spot cash market (1)

______ Forward contract or marketing agreement (2)

______ Futures hedge (3)

______ Options hedge (4)

______ Livestock Risk Protection (LRP) Insurance (5)

______ Livestock Gross Margin (LGM) Insurance (6)

______ Other (please describe): (7)

Q9 How do you think the August 2017 live cattle futures contract will settle (at expiration in August)?

- o Settle price will be higher than today's trading price (1)
- o Settle price will be lower than today's trading price (2)
- o Settle price will be the same as today's trading price (3)

Display This Question:

If What are your price expectations for fed cattle between now and August 2017? Prices will increase Is Selected

Q9-A By how much do you expect the August 2017 live cattle price to increase by settle (at expiration in August)?

- increase by less than $2/cwt (1)
- increase by $2 to $4/cwt (2)
- increase by $4 to $6/cwt (3)
- increase by $6 to $8/cwt (4)
- increase by $8 to $10/cwt (5)
- increase by more than $10/cwt (6)

Display This Question:

If What are your price expectations for fed cattle between now and August 2017? Prices will decrease Is Selected

Q9-B By how much do you expect the August 2017 live cattle price to decrease by settle (at expiration in August)?

- decrease by less than $2/cwt (1)
- decrease by $2 to $4/cwt (2)
- decrease by $4 to $6/cwt (3)
- decrease by $6 to $8/cwt (4)
- decrease by $8 to $10/cwt (5)
- decrease by more than $10/cwt (6)

Q10 What is the historical nearby August fed cattle basis ($/cwt) in your area? (Please slide the purple circle to the appropriate basis) Note: Basis = local cash price - futures price

_______ August basis ($/cwt) (1)

CV1

The following two questions look similar but importantly are different. Please complete both questions carefully. Research studies have found people to overstate their willingness to pay in hypothetical situations, such as this survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.

Q11.1 Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot. Suppose it is February 15th. You are looking to buy feeder steers for March placement with an expectation of August finish/sale. A sale lot of 150 feeder steers, which will weigh approximately 800 lbs each at placement, are available for purchase from a single known ranch for a premium of $ 0 /cwt over cattle purchased at an auction from unknown sources. Of the 150 head of feeder steers available from the single source ranch, how many would you purchase?

Q12.1 Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot. Suppose it is February 15th. You are looking to buy feeder steers for March placement with an expectation of August finish/sale. A sale lot of 150 feeder steers, which will weigh approximately 800 lbs each at placement, are available for purchase from a single known ranch for a premium of $ 0 /cwt over cattle purchased at an auction from unknown sources. The August CME live cattle futures contract is trading at $ 0/cwt (CME contract is for 40,000lb of live cattle). The expected local August basis is $ 0 /cwt. Of the 150 head of feeder steers available from the single source ranch, how many would you purchase?

Display This Question:

If Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at... Text Response Is Greater Than 0

Q12B.1 Of the ${q://QID22/ChoiceTextEntryValue} feeder steers purchased, how many would you place under a futures hedge using the CME live cattle contract given the above information? Recall: The August CME live cattle futures contract is trading at $ 0/cwt (CME contract is for 40,000lb of live cattle). The expected local August basis is $ 0 /cwt.

CV2

The following two questions look similar but importantly are different. Please complete both questions carefully. Research studies have found people to overstate their willingness to pay in hypothetical situations, such as this survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.

Q11.2 Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot. Suppose it is February 15th. You are looking to buy feeder steers for March placement with an expectation of August finish/sale. A sale lot of 150 feeder steers, which will weigh approximately 800 lbs each at placement, are available for purchase from a single known ranch for a premium of $ 0 /cwt over cattle purchased at an auction from unknown sources. Of the 150 head of feeder steers available from the single source ranch, how many would you purchase?

Q12.2 Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot. Suppose it is February 15th. You are looking to buy feeder steers for March placement with an expectation of August finish/sale. A sale lot of 150 feeder steers, which will weigh approximately 800 lbs each at placement, are available for purchase from a single known ranch for a premium of $ 0 /cwt over cattle purchased at an auction from unknown sources. The August CME live cattle futures contract is trading at $ 0 /cwt. A forward contract (with typical specifications for your area) is currently being offered with a basis of $ 0 /cwt tied to the August futures contract. Of the 150 head of feeder steers available from the single source ranch, how many would you purchase?

Display This Question:

If Single source feeder calves, originating from a single ranch of origin, are generally considered... Text Response Is Greater Than 0

Q12B.2 Of the ${q://QID24/ChoiceTextEntryValue} feeder steers purchased, how many would you place under a forward contract (with typical specification for your area) given the above information? Recall: The August CME live cattle futures contract is trading at $ 0 /cwt. A forward contract (with typical specifications for your area) is currently being offered with a basis of $ 0 /cwt tied to the August futures contract.

CV3

The following two questions look similar but importantly are different. Please complete both questions carefully. Research studies have found people to overstate their willingness to pay in hypothetical situations, such as this survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.

Q11.3 Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot. Suppose it is February 15th. You are looking to buy feeder steers for March placement with an expectation of August finish/sale. A sale lot of 150 feeder steers, which will weigh approximately 800 lbs each at placement, are available for purchase from a single known ranch for a premium of $ 0 /cwt over cattle purchased at an auction from unknown sources. Of the 150 head of feeder steers available from the single source ranch, how many would you purchase?

Q12.3 Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot. Suppose it is February 15th. You are looking to buy feeder steers for March placement with an expectation of August finish/sale. A sale lot of 150 feeder steers, which will weigh approximately 800lb each at placement, are available for purchase from a single known ranch for a premium of $ 0 /cwt over cattle purchased at an auction from unknown sources. The August CME live cattle futures contract is trading at $ 0 /cwt (CME contract is for 40,000lb of live cattle). The expected local August basis has a ${e://Field/Percent1} % chance of being less (weaker) than $ 0, and a 100% chance of being greater (stronger) than $ 0. Of the 150 head of feeder steers available from the single source ranch, how many would you purchase?

Display This Question:

If Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at... Text Response Is Greater Than 0

12B.3 Of the ${q://QID47/ChoiceTextEntryValue} feeder steers purchased, how many would you place under a futures hedge using the CME live cattle contract given the above information? Recall: The August CME live cattle futures contract is trading at $ 0 /cwt (CME contract is for 40,000lb of live cattle). The expected local August basis has a ${e://Field/Percent1} % chance of being less (weaker) than $ 0, and a 100% chance of being greater (stronger) than $ 0.

CV4

Research studies have found people to overstate their willingness to participate in hypothetical situations, such as this survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.

Q11.4 Suppose it is February 15th. You just purchased a lot of 150 feeder steers weighing approximately 800 lbs each for March placement with an expectation of August finish/sale. The August CME live cattle futures contract is trading at $ 0 /cwt (CME contract is for 40,000lb of live cattle). How many head would you place under each of the following output pricing strategies?

______ A futures hedge with an expected local August basis of $ 0/cwt. (1)

______ A forward contract (with typical specifications for your area) with a basis of $ 0 /cwt tied to the August futures contract. (2)

______ Other output pricing strategy (e.g., options, Livestock Risk Protection, formula pricing, etc.) (3)

______ I would accept the local cash price at time of sale in August (4)

CV5

Research studies have found people to overstate their willingness to participate in hypothetical situations, such as this survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.

Q11.5 Suppose it is February 15th. You just purchased a lot of 150 feeder steers weighing approximately 800 lbs each for March placement with an expectation of August finish/sale. The August CME live cattle futures contract is trading at $ 0 /cwt (CME contract is for 40,000lb of live cattle). How many head would you place under each of the following output pricing strategies?

______ A futures hedge where the expected local August basis has a ${e://Field/Percent1}% chance of being less (weaker) than $ 0, and a 100% chance of being greater (stronger) than $ 0. (1)

______ A forward contract (with typical specifications for your area) with a basis of $ 0 /cwt tied to the August futures contract. (2)

______ Other output pricing strategy (e.g., options, Livestock Risk Protection, formula pricing, etc.) (3)

______ I would accept the local cash price at time of sale in August (4)

CV6

Research studies have found people to overstate their willingness to participate in hypothetical situations, such as this survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.

Q11.6 Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot.   Suppose it is February 15th. You just purchased a lot of 150 feeder steers weighing approximately 800 lbs each for March placement with an expectation of August finish/sale. The steers were sourced from a single known ranch for a premium of $ 0/cwt over cattle purchased at an auction from unknown sources. The August CME live cattle futures contract is trading at $ 0/cwt (CME contract is for 40,000lb of live cattle). How many head would you place under each of the following output pricing strategies?

______ A futures hedge with an expected local August basis of $ 0 /cwt. (1)

______ A forward contract (with typical specifications for your area) with a basis of $ 0 /cwt tied to the August futures contract. (2)

______ Other output pricing strategy (e.g., options, Livestock Risk Protection, formula pricing, etc.) (3)

______ I would accept the local cash price at time of sale in August (4)

CV7

Research studies have found people to overstate their willingness to participate in hypothetical situations, such as this survey. It is important that you make your selection as if you were actually facing these choices in operation of your feed yard.

Q11.7 Single source feeder calves, originating from a single ranch of origin, are generally considered less risky than calves with unknown histories due to their better performance and lower morbidity at the feedlot.   Suppose it is February 15th. You just purchased a lot of 150 feeder steers weighing approximately 800 lbs each for March placement with an expectation of August finish/sale. The steers were sourced from a single known ranch for a premium of $ 0/cwt over cattle purchased at an auction from unknown sources. The August CME live cattle futures contract is trading at $ 0 /cwt (CME contract is for 40,000lb of live cattle).   How many head would you place under each of the following output pricing strategies?

______ A futures hedge where the expected local August basis has a ${e://Field/Percent1}% chance of being less (weaker) than $ 0, and a 100% chance of being greater (stronger) than $ 0. (1)

______ A forward contract (with typical specifications for your area) with a basis of $ 0 /cwt tied to the August futures contract. (2)

______ Other output pricing strategy (e.g., options, Livestock Risk Protection, formula pricing, etc.) (3)

______ I would accept the local cash price at time of sale in August (4)

Q13 Please rate your level of agreement or disagreement with the following statements.

	Strongly Disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
I usually like "playing it safe" (for instance, "locking in a price") instead of taking risks for market prices for fed cattle. (1)							
When selling/marketing fed cattle, I prefer financial certainty to financial uncertainty. (2)							
When selling/marketing fed cattle, I am willing to take higher risks in order to realize higher average returns. (3)							
I like taking financial risks with my feeding operation. (4)							
I accept more risk in my feedlot than other feedlot operators. (5)							
With respect to the conduct of business, I dislike risk. (6)							

Q14 What was the average cost of gain for feeder cattle placed over the past 12 months on your operation?

- o Less than $60/cwt (1)
- o $60 to $64.99/cwt (2)
- o $65 to $69.99/cwt (3)
- o $70 to $74.99/cwt (4)
- o $75 to $79.99/cwt (5)
- o $80 to $84.99/cwt (6)
- o $85/cwt to $89.99/cwt (7)
- o Over $90.00/cwt (8)

Q15 How important are the following traits for the feeder cattle you buy?

	Extremely important (13)	Very important (14)	Moderately important (15)	Slightly important (16)	Not at all important (17)
Weaned at least 30 days (1)					
Weaned at least 45 days (2)					
Vaccination history (3)					
Third-party health verified (4)					
Animal care/handling practices (5)					
Castrated (6)					
Dehorned (7)					
Implanted (8)					
Specific sire/genetic information (9)					
Breed background information (10)					
Reputation of seller (11)					
Weight (12)					
Frame (13)					
Condition (14)					
Number of head in a lot (15)					
Uniformity of head in a lot (16)					
Sex of animal (17)					
Age and source verified (18)					
Naturally raised (19)					
Organically raised (20)					
Non-hormone treated (21)					

Q16 In what state does your operation primarily feed cattle?

- Alabama (1)
- Alaska (2)
- Arizona (3)
- Arkansas (4)
- California (5)
- Colorado (6)
- Connecticut (7)
- Delaware (8)
- Florida (9)
- Georgia (10)
- Hawaii (11)
- Idaho (12)
- Illinois (13)
- Indiana (14)
- Iowa (15)
- Kansas (16)
- Kentucky (17)
- Louisiana (18)
- Maine (19)
- Maryland (20)
- Massachusetts (21)
- Michigan (22)
- Minnesota (23)
- Mississippi (24)
- Missouri (25)
- Montana (26)
- Nebraska (27)
- Nevada (28)
- New Hampshire (29)
- New Jersey (30)
- New Mexico (31)
- New York (32)
- North Carolina (33)
- North Dakota (34)
- Ohio (35)
- Oklahoma (36)
- Oregon (37)
- Pennsylvania (38)
- Rhode Island (39)
- South Carolina (40)
- South Dakota (41)
- Tennessee (42)
- Texas (43)
- Utah (44)
- Vermont (45)
- Virginia (46)
- Washington (47)
- West Virginia (48)
- Wisconsin (49)
- Wyoming (50)

Q17 For the feeding operation I am the:

- Owner and manager (1)
- Owner (2)
- Manager (3)
- Other (please specify): (4) ____________________

Q18 I am ________ years old.

Q19 The best description of my educational background is:

- o Did not obtain high school diploma (1)
- o High school graduate (2)
- o Some college (3)
- o Technical training (Certification or Associates Degree) (4)
- o Bachelor's (B.S. or B.A.) College Degree (5)
- o Graduate or Professional Degree (M.S., Ph.D., D.V.M., Law School) (6)
- o Other (please describe): (7) ____________________

Q20 What percentage of the cattle fed on your operation in the last 12 months were (should sum to 100%):

______ Commercial beef cattle (1)

______ Dairy cattle (2)

______ Beef and dairy cross cattle (3)

______ Other (please describe): (4)

Q21 How many fed cattle were sold on your operation in the last 12 months?

- o Less than 1,000 head (1)
- o 1,000 to 1,999 head (9)
- o 2,000 to 3,999 head (2)
- o 4,000 to 7,999 head (3)
- o 8,000 to 15,999 head (4)
- o 16,000 to 23,999 head (5)
- o 24,000 to 31,999 head (6)
- o 32,000 to 49,999 head (7)
- o More than 50,000 head (8)

Q22 Of the animals placed on feed in the last 12 months, what percentage of calves placed did your operation own (as opposed to someone outside the operation retaining ownership)?

- 0% (1)
- 1 to 20% (2)
- 21 to 40% (3)
- 41 to 60% (4)
- 61 to 80% (5)
- 81 to 100% (6)

Q23 What is the one-time capacity of your feedlot?

- Less than 1,000 head (1)
- 1,000 to 1,999 head (9)
- 2,000 to 3,999 head (2)
- 4,000 to 7,999 head (3)
- 8,000 to 15,999 head (4)
- 16,000 to 23,999 head (5)
- 24,000 to 31,999 head (6)
- 32,000 to 49,999 head (7)
- More than 50,000 head (8)

Q24 How easy were the survey questions to understand?

- Extremely easy (20)
- Somewhat easy (21)
- Neither easy nor difficult (22)
- Somewhat difficult (23)
- Extremely difficult (24)

Q25 Thank you for your participation! Please leave any additional comments here: