PRODUCER PERCEPTION OF FED CATTLE PRICE RISK

by

JOHN MICHAEL RILEY

B.S., Mississippi State University, 2002
M.S., Mississippi State University, 2004

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics
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Abstract

Risk is an inevitable part of agricultural production and all producers face various forms of risk. Output price has been shown to be the major contributor to the risk in cattle feeding, yet few choose to manage this risk. This study used subjective price expectations and price distributions of survey participants to determine how producer's expectations compare with that of the market. In addition, demographic information gathered from survey participants allowed for further examination as to how these factors effect price outlook and variability. Data used for this study were gathered through survey responses from Kansas State University Extension meeting and workshop participants and other meetings targeted to livestock producers.

First, data were aggregated and analyzed at a group level. Only two of the twelve price forecast were significantly lower than the futures settlement price. On the other hand, all but one of the aggregated group volatility expectations was different. Typically nearby contract price risk expectation was underestimated and distant contract price risk expectation was overestimated.

Individual respondent's discreet stated price and price distribution information was fitted to a continuous distribution and an implied mean and standard deviation were determined. These were compared to market price and price risk data. Respondent's expectation of price was significantly lower than the market for distant months for five of the six groups. Individual volatilities resulting from each fitted distribution were significantly lower from the volatility measure resulting from Black's model.

Demographic data were estimated to show the impact of this information on overall error of price forecast and price risk expectations. Those living outside the Northeast and Northern

Plains tended to have larger error in their expectation of price volatility. Larger backgrounding operations reported lower price variance error and selling more fed cattle each year increased price risk expectation error. Lastly, prior use of risk management tools for the most part did not have an impact on error in either price expectation or price volatility expectation.

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Dedication

This dissertation is dedicated to my family. More importantly it is dedicated to my wife for her love and support and to my mom and dad for their encouragement.

CHAPTER 1 - Introduction

This chapter offers insight on cattle feeding and its associated risks. The first section overviews risk prevalent in agriculture and more specifically in cattle production. The second section highlights risk management tools common in the beef industry. The concluding section lists the specific problem and objectives of this study.

1.1 General Problem

Production agriculture is unique as compared to other production industries due to the inherent level of risk involved. Risk is an inevitable part of agricultural production and all producers face various forms of risk. Producers of both crops and livestock experience yield variability stemming from weather, genetics, pests and disease. They also battle the risk of volatile prices due to supply and demand factors, whether it is local in nature or a global phenomenon.

Beef production is most commonly impacted by genetics and disease. For example, genetics can vary greatly across a group of animals within the same herd and this can impact the ending weight and consistency of the group. Animals that are struck with illness typically experience higher mortality, lower weight gain, and worse feed conversion compared to those that are healthy. Genetic risk can be partially offset by sire and dam selection through visual and genetic appraisal (for example, by using Expected Progeny Differences). Disease risk can be managed through vaccination and proper herd management.

Price risk in the beef industry stems from fluctuations in consumer demand or producer supply and to combat price risk there are various tools that can be utilized. These include futures and options contracts, forward contracts and insurance products.

1.2 Risk Management Products Associated With Feeding Cattle

Although livestock insurance products have only been around for a short time, many of the tools available to minimize price risk have been in existence for a number of years. The most recognizable is the organized trading of futures contracts which date back to the 1860s (Purcell and Koontz, 1999), however futures for fed cattle did not begin until 1964. Even though these tools have been available for some time, few agricultural producers use them to manage risk (Shapiro and Brorsen 1988; Asplund, Forester and Stout 1989; Makus et al. 1990) and even fewer livestock producers, as compared to crop producers, use these products (Goodwin and Schroeder 1994; Schroeder at al. 1998; Hall et al. 2003). Some of the common reasons cited for limited utilization of price risk management tools are the lack of knowledge of the products, the high cost associated with using these products and producer perceptions that many risk management tools do not effectively reduce overall risk or stabilize income.

Other risk management tools available to producers are forward contracts and livestock insurance products. Much like futures contracts, forward contracts distinguish the final weight and quality characteristics the cattle must meet and the price the producer will receive for these characteristics. Unlike futures, though, each of these requirements are agreed upon individually by the buyer and seller. Insurance products are relatively new (first available in 2000) and are available through the United States Department of Agriculture's (USDA) Risk Management

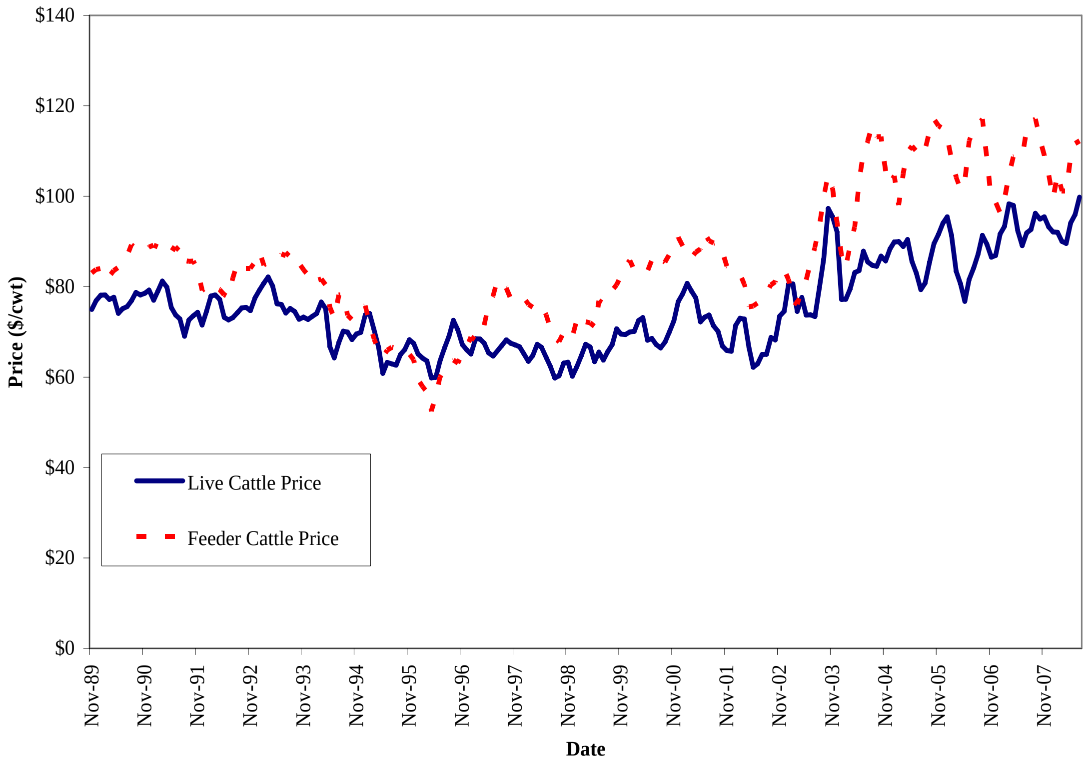
Agency (RMA). Two different insurance options exist, one that insures the price of the cattle and one that protects a producer’s profit margin.

1.3 Specific Problems and Objectives

Feeder cattle are calves weighing approximately 700 to 800 pounds. These cattle enter a confined feeding operation and are fed a high energy ration intended to maximize weight production of each animal or group of animals. They are fed for approximately four months to a weight of about 1,100 to 1,200 pounds. Once the cattle achieve this weight range they are called fed cattle. Feeder and fed cattle prices have the greatest impact on fed cattle profits (Mark, Schroeder and Jones 2000) and volatility of these prices invoke increased risk for feeders (Schroeder et al., 1993). Figure 1.1 charts the price of the live and feeder cattle futures contracts (daily settlement prices are aggregated to monthly values) from late 1989 to mid 2008. This figure shows a number of price swings across the time period, especially from April 2005 to present.

Numerous studies have quantified the risks prevalent in cattle feeding, yet many producers do not attempt to offset price risk using the many tools available. A number of hypotheses about what factors contribute to producer use of price risk management tools have been tested including producer knowledge, experience, age, risk aversion level, operation leverage, diversification, and others. This study focuses on an untested hypothesis that producer expectations of the price risk they face is biased downward making them overoptimistic about market price stability. This research is the first to quantify producers’ expectations of fed cattle prices and associated price risk.

Figure 1.1 Monthly Feeder and Live Cattle Futures Contract Price, November 1989 to July 2008



Source: Chicago Mercantile Exchange

Gaining insight into producers' price and price variability expectations is crucial in understanding their management decisions. Two dimensions of producer expectations are evaluated. The first being producer's perception of the future price of two live cattle futures contracts, a nearby and a more distant forecast. The second information elicited is the expectations of price variability. The expected price is used to gauge producers' ability to forecast prices and the latter is used to gauge producers' outlook on price variability. This latter measure is compared to the variability present in the market via a common measure of market risk, implied volatility derived from the Black commodity option pricing model.

Knowledge of producer's risk expectations is beneficial for management consultation. For example, if producers convey expectations that are consistent with the market's expectation, then minimal use of tools for price risk protection is likely associated with something other than price risk expectations as producers foresee this risk and simply choose not to hedge against it. On the other hand, if producer perceptions of price risk are lower than the market anticipates, this would suggest that producers underestimate price risk inherent in the market. In this case, more education regarding the magnitude of the market risk present is needed to help producers be more aware of their price risk exposure.

This study uses the subjective price expectations of survey participants to determine how producer's expectations compare with that of the market. Utilizing the elicited probabilities, this research parameterizes the stated distribution and tests if group and individual distributions are different from the distribution established by the futures and options market. Results from this analysis are useful for assessing reasons for the apparent lack of use of risk management tools. Results from this study also provide insight to educators when designing information producers use for management decisions. Furthermore, with better information on producer perceptions of market risk expectations either the current design of risk management tools can be adjusted so that they better target the desired user, or new products can be implemented that better serve producers.

In addition to the above objectives, demographic information gathered from survey participants allows for examination of how these factors are related to price outlook and variability. This information is used to quantify effects on each producer's price expectation and distribution. With this information educators can tailor educational programs and information that focuses on the participants in each program that use the information. For example, extension programs can be designed for specific groups that more aptly address the needs of the group's demographics.

1.4 Summary

This chapter has overviewed the risk in agriculture and the beef industry. It has presented the issue that price risk primarily stems from the prices of the cattle put on feed and the prices received when the cattle are finished with the feeding process and ready to be sold for beef. Despite these findings beef producers do not take much action to lower their price risk. From the objectives outlined this research will estimate producers' perception of price and how demographic factors affect inaccuracies of these perceptions.

The following chapter will give more depth into the risk associated with cattle feeding and the level of producer management of price risk. It will discuss research that has been conducted in probability elicitation and producer perception of risk. Chapter three will define the data collection process. Chapter four will outline the methodology used in this research as well and compare this with previous methods used in the literature. Chapter five gives the results and chapter six draws conclusions from the results and discusses the implications from this research.

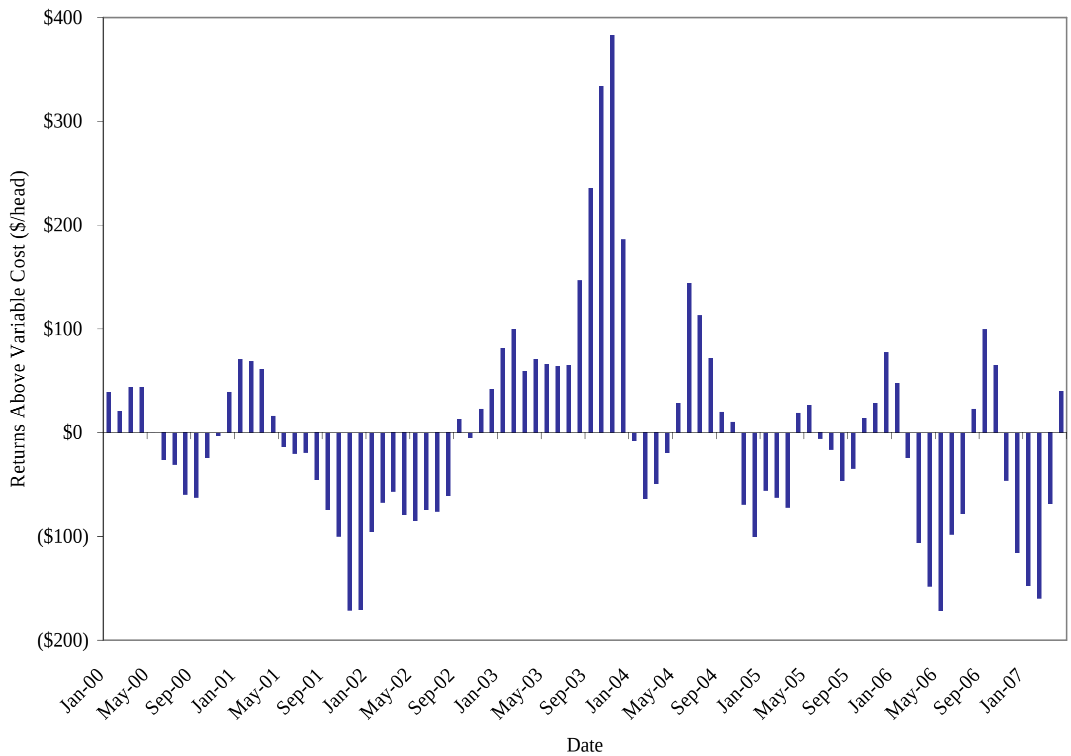
CHAPTER 2 - Previous Literature

This chapter references previous studies composed of: (1) the source of risk in the beef industry, (2) the lack of use of price risk reduction products and (3) procedures used in eliciting distribution information directly from producers via surveys. This literature will offer motivation for this study. Furthermore, it will provide an understanding of probability elicitation which is used for data collection outlined in chapter three and it serves as a foundation for the methods that will be described in chapter four.

2.1 Cattle Price Risk

Previous research has shown that there is much risk in the fed cattle industry. According to Jones (2007), the average monthly returns to fed steers in Kansas feedlots ranged from a loss of $171.00 to a profit of $383.00 per head between 2000 and 2007. Figure 2.1 shows the results reported by Jones (2007). From the summer of 2001 through the fall of 2002, returns were negative. This was changed through most of 2003 as profits, some of the highest over the time period shown, were noticeable by Kansas feedlots. In early 2004, immediately following the case of Bovine Spongiform Encephalopathy in the US, negative returns were visible again. The average profit during this time was -$1.00 with a standard deviation of over $100. Lawrence (2007) reported returns to feeding Iowa steers ranged from a loss of $161 to a profit of $378 per head, similar to those found by Jones.

Figure 2.1 Returns to Fed Steers in Kansas Feedlots, January 2000 to April 2007



Source: Jones, R., Kansas State University

Feeder cattle prices (one of many input prices for a feedlot) and fed cattle prices (output price) had the greatest impact on fed cattle profits according to Mark, Schroeder and Jones (2000). Lawrence, Wang and Loy (1999) estimated that 70 percent of the profit variability in fed cattle stems from feeder and fed cattle price. Similarly, Schroeder et al. (1993) reported that 70 to 80 percent of the variation in fed cattle profits was due to fed cattle price variability. Langemeier, Schroeder, and Mintert (1992) noted that approximately 50 percent of the variability in fed cattle profits stemmed from variability in fed cattle prices. They also concluded that roughly 25 percent of cattle feeding profit variability come from feeder cattle prices. The importance of fed cattle price on cattle feeding profit and the inherent variance present in fed cattle price, motivate our focus on quantifying producer expectations and perceived risk of future fed cattle price.

2.2 Use of Price Risk Management Products

Futures contracts for live cattle and feeder cattle were introduced in 1969 and 1971, respectively, and options on these contracts were first offered in 1984. Futures contracts are publicly traded derivatives whose specifications are defined by the commodity exchange on which they are traded. Forward contracts are another tool available to livestock producers. Forward contracts are privately traded and all specifications of the contract are agreed upon by the parties involved. Still, few agricultural producers use futures, options and/or forward contracts to minimize their price risk exposure. Table 2.1 summarizes several studies that report information on intensity of producer use of futures markets.

Asplund, Forster and Stout (1989) found, by way of survey, that 42 percent of Ohio crop farmers forward contract and only 7 percent used futures markets to hedge their price risk. Schroeder et al. (1998) conducted surveys at two different conferences, an Extension Agricultural Land Value conference in August of 1996 where the primary audience was crop producers and a Cattle Profit conference in August of 1997 where the participants were largely cattle producers. Results from the Agricultural Land Value conference showed that 64 percent of producers use forward contracting, 45 percent use futures and 56 percent use options. The Cattle Profit conference showed much different results however as 18 percent of cattle producers use forward contracting, 21 percent use futures and 18 percent use options.

Mishra and Perry (1999) state that roughly 40 percent of farmers had used a marketing strategy that included futures or forward contracts. Hall et al. (2003) surveyed Nebraska and Texas producers and found that 5 percent had used forward contracts and 7 percent had used futures and options. Shapiro and Brorsen (1988) found that 63 percent of crop producers in Indiana hedge some portion of their crop. Of the total crop acreage hedged they found that 11.4 percent was hedged using futures contracts and 20.5 percent was forward contracted despite stating that three-fourths of the 41 farmers surveyed were risk averse. The authors note that producers tended to disagree with the belief that using futures in turn reduced income variability and therefore they chose not utilize them.

Table 2.1 Summary of Multiple Studies Reporting Risk Management Usage by Producers

Study	Year	Location	Forward	Futures	Options	Forward and Futures	No. of Respondents	Type of Respondents
			(percent that use each method)					
Shapiro and Brorsen	1988	IN	 21	63 11			41	Crop
Asplund, Forester and Stout	1989	OH	42	7			353	Crop
Makus et al.	1990	US	57	32			595	Crop and Livestock
Goodwin and Schroeder	1994	KS	45 12	11 8	19 10		537	Crop and Livestock
Musser, Patrick and Eckman	1996	IN	74	53	35		62	Crop
Schroeder et al.	1998	KS	64 18	45 21	56 18		55 36	Crop Livestock
Mishra and Perry	1999	US				40	7,225	Crop and Livestock
Sartwelle et al.	2000	KS, IA, TX	25	16			351	Crop and Livestock
Hall et al.	2003	NE, TX	5	7			1,313	Livestock

Makus et al. (1990) surveyed 595 producers across 22 states and found that 32.3 percent had used futures contracts to hedge from 1986 to 1987 and 57.1 percent had used forward contracting. They found that age, whether the producer was engaged full-time, part-time or a land owner and whether the producer utilized government programs did not significantly affect futures use. The factors that did impact the use of futures were education, farm size, previous use of forward contracting and membership in marketing clubs.

Goodwin and Schroeder (1994) reported that only 10.4 percent of all Kansas agricultural producers surveyed used futures markets and only 8.4 percent of cattle producers hedged with futures contracts. Options on futures were utilized more frequently by cattle producers as 10.1 percent reported they used options. They found that 42.8 percent of producers used forward contracts; however of those surveyed only 11.9 percent of livestock producers forward contracted their cattle. They found farm size, education, crop and input intensity (the level of inputs such as fertilizer chemical used per acre) and debt-to-asset ratio increased the adoption of forward and futures use; however, experience decreased the level of price risk management use.

Musser, Patrick and Eckman (1996) found that 53.4 percent of Indiana crop producers hedge using futures contracts and 34.5 percent used options. The level of participation in forward pricing was the highest in this study with 74.1 percent of producers using this method of risk management. They found that larger farmers and corn producers were more likely to use forward and futures contracting as compared to previous studies.

Sartwelle et al. (2000) surveyed producers in Iowa, Kansas and Texas and found that 16 percent used futures or options and 25 percent used forward contracting. Experience was a significant factor in futures use but the number of crop acres, farm size and level of specialization did not have an effect. The amount of acres planted and the level of diversification did have a significant impact on the level of use of forward contracting; however, experience did not impact this use.

Recently, the Agriculture Risk Protection Act of 2000 gave livestock producers the ability to protect either risk or gross margin with insurance policies available through the Risk Management Agency (RMA). First offered in 2003, livestock risk protection (LRP) and livestock gross margin (LGM) protection insurance policies are available to all producers. LRP policies protect the insured against unfavorable price movements while LGM insures against adverse changes in producer's gross margin, which is composed of the price received for finished cattle as well as input prices like feed. These policies allow producers to insure up to 4,000 head per year and the level of coverage can range between 70 percent and 95 percent. Insurance, like futures and forward contracts, also receive little attention from producers.

Data from the United States Department of Agriculture (USDA) shows that few producers utilize these tools. Only 0.5 percent of all cattle and calves were protected under the two policies in 2007. Of the total crop and livestock liability covered by RMA policies in 2007, only 0.2 percent stems from the livestock sector. Finally, of the total policies sold by RMA for all insurance programs, LRP and LGM constitute only 0.3 percent. Although these values are low, it should be noted that all states do not offer these products. Secondly, they have only been available for a short period of time therefore adoption could be hampered from lack of knowledge of there policies. Still, it is apparent from the studies of producer's usage of all types of risk management tools that most livestock producers do not attempt to offset their price risk as a whole.

2.3 Probability Elicitation

Nelson (1980) investigated procedures for eliciting probabilities. He defined four methods of probing survey respondents for information on probabilities: 1) direct estimation, 2) assigning weights, 3) cumulative distribution approach and 4) triangular distribution approach. The direct estimation method requires the respondent to state the probabilities they feel would be associated with the occurrence of particular events. He claimed the direct estimation method might be exhausting since respondents must check to ensure all probabilities equal one. On the other hand, Hardaker, Huirne and Anderson (1997) stated that this task would be simplified by keeping the number of elicited probabilities low and the advantage of direct estimation is that it returns a comprehensive and precise estimate of expected probabilities. This type of probability elicitation was used by Egelkraut et al. (2006) in a study that elicited yield expectations of crop producers.

A similar approach is that of assigning weights. For this method a number of discreet choices are given and weights from one to one hundred are assigned to the choices. The sum of the weights are calculated and probabilities are derived by dividing the individual weight by the sum. Hardaker, Huirne and Anderson (1997) defined a process similar to the weighting method described by Nelson (1980) which involves the respondent assigning counters to choices. This method was employed by Eales et al. (1990) and Pease et al. (1993) which asked producers to provide expectations of crop prices and yield, respectively.

The third method described by Nelson is the cumulative distribution approach. Under this elicitation procedure respondents give their expected mean, an upper and lower bound and the upper and lower quartiles. From this a cumulative distribution can be developed.

The final probability elicitation procedure given is the triangular method. This method is fairly straightforward and easy for respondents to grasp since they simply give the expected value they believe will occur as well as the lowest and highest values expected to be observed. Although the positive aspect of this method is that it is fairly simple to understand, Nelson states that accuracy is lost when it is used. This type of methodology was used by Kenyon (2001) who asked for crop price expectations, however rather than having respondents give the high and low expected price he ask for the price that would have a one in ten chance of occurring on both the high and low side.

2.4 Price and Yield Expectations

No research exists that elicits price expectation directly from individual livestock producers, but a number of studies have examined crop producer's expectations of both yield and price. Eales et al. (1990) conducted a survey of Illinois grain producers and merchandisers eliciting their expectations of corn and soybean price distributions. The weighting method was utilized in their study and price ranges were split into 18 intervals. The survey was conducted seven times from June to December 1987 at various meetings across the state and the authors asked respondents for their expectations of both cash price and basis for two different contracts for corn and soybeans. The researchers stated that by asking for the cash price and basis rather than the futures price, survey participants were less likely to use the current futures price as an anchor for giving the probability of the final expected futures contract price at expiration.

Eales et al. (1990) aggregated the data for each group of survey participants and then compared the subjective results with the implied volatilities derived from the Black (1976) model. The Black model uses the current option premium as a gauge for the market implied volatility. They found that eight corn and twelve soybean price volatility expectations out of fourteen were significantly below the implied volatilities found via the Black model (at the 5 percent level). The level of error, the difference of producer expected risk from Black's implied volatility, was typically larger for soybean expectations as compared to corn. The two groups that were not different from the market for soybean risk perceptions were for nearby horizons as was the case for all nearby corn expectations excluding one group of grain merchandisers.

Pease et al. (1993) elicited subjective probabilities of crop yield and compared these to historical de-trended yields for individual farms over the time period of 1977 to 1986 using data from the Kentucky Farm Business Analysis Association. The authors calculated the percentage difference of the probability stated by each farm from the mean yield for that farm (individual farm data was available). They found that the simple mean of the ten years of data did not correspond well to the yield predicted by the farms. When the historical data were trimmed (removing a 20 percent of the lowest and highest values in the data), expected yields better matched expected yields given by the producers. On the other hand, when forecasts are made using the data, a simple linear trend using all ten years was roughly equal to farmer's expected yield.

Kenyon (2001) surveyed Virginia corn and soybean producers during January and February from 1991 thru 1998 during an annual meeting specifically targeted to corn and soybean producers. He asked participants to give cash price expectations of the two crops at their location. He also had producers give the "price with a one in ten chance of prices falling below at harvest" and a "price with a one in ten chance of prices rising above at harvest". Although the producers were not identified, given the nature of the meeting many respondents were the same each year. The price expectations were compared to the final harvest price at their respective location. Producers' expectation error (producer expectation minus the actual harvest price) varied from year to year, but when averaged across the eight-year period producers' expectations were within $0.03 for corn and $0.10 for soybeans. Distributions were formed from the price information gathered by Kenyon (2001) by formulating a histogram of the prices taking into account the high and low prices elicited. He found that producers typically were optimistic when forecasting prices.

Eagelkraut et al. (2006) estimated crop producer's expectations of corn yield and compared these values to aggregate county data supplied by the National Agricultural Statistics Service (NASS). Their survey elicited probability distributions of crop yield via the direct estimation approach outlined by Nelson. They provided 10 yield intervals for respondents to assign probabilities. They also asked producers to state their average corn yield as well as information that compared their farm's yield with a typical farm in the same county. They fit individual stated probabilities that were discreet to a continuous Weibull distribution and found implied corn yield distributions for each survey respondent. They found that implied distributions and de-trended county yield distributions were relatively equal. They also report that the average implied standard deviation and average county standard deviation were not significantly different from each other.

2.5 Risk Perceptions

Although no literature exists that elicits expectations on prices from livestock producers some researchers have reported results from surveys about producer perception of risk in the livestock sector. Schroeder et al. (1998) measured the differences between market perceptions of producers and extension economists. This study had producers rank the information they use when formulating price expectations. Producers were also asked various questions pertaining to their market risk, hedging and marketing strategies and perceptions of futures and options as price risk reducers. The results of this survey were compared to the responses of extension marketing economist (economist) that provide much of the information used by producers when making management decisions. When asked if the primary goal for farmers is to reduce risk, the majority of extension economists agreed with this concept whereas sentiment was split with the producers. Producers and economists alike tended to agree that producers would not reduce their average price by using forward contracting. Overall perception that hedging reduces risk and lowers returns was split across both groups. The majority of producers and economists agreed that not using futures or options implied that farmers are poor marketers; however economists tended to agree that using futures and options implied that farmers were good marketers.

Beef producers from Nebraska and Texas were the target of a study conducted by Hall et al. (2003). The study surveyed producers about their perceptions of the sources of risk they face as well the ability of risk management protocols to reduce risk. According to survey respondents price variability had the second greatest impact on income, with drought being the highest risk factor. When asked to rank the ability of various risk management activities to reduce risk, forward and futures contracts received the lowest rankings, eighth and ninth (of nine), respectively (some risk management options available to the producers were strictly focused on production risk). Other economic options included were lower cost which ranked second, maintain financial independence was third and diversification was sixth.

2.6 Chapter Summary

This chapter presented research that found price variance to be a major source of risk in the beef industry. Despite this result, it was shown that few producers engage in a form of available price risk management protocol. This chapter has also outlined the research currently available in regard to probability elicitation. No literature exists that examines beef producer expectations of future prices so this study uses the current body of literature available in regard to crop probability elicitation to build a format for surveying beef producers and the following chapter outlines these procedures.

CHAPTER 3 - Data

Data used for this study were gathered through survey responses from various meetings and workshops. Participants at these meetings were targeted due to their ties to the beef industry. An example of the survey used can be found in Appendix A. Table 3.1 lists the type of meeting or workshop where each survey was administered as well as the number of survey participants, the date the survey was conducted and the period that participants were asked to forecast. Given that the data are elicited at group specific meetings and workshops, the survey data are not a random sample. However, given that the focus of this research is centered on the cattle feeding industry and the expectations of those involved in this industry, the specific target audience was of most direct relevance and interest.

Table 3.1 Summary of Survey Locations, Dates, and Responses

	Surveys Given	Number of Usable Surveys	Date of Elicitation	Live Cattle Contract	Forecast Length (days)
KSU Risk and Profit Conference	69	26	Aug. 16, 2007	Oct. 2007	36
		24		Feb. 2008	116
KSU Stockers Conference	62	56	Sep. 27, 2007	Dec. 2007	50
		52		Apr. 2008	123
KSU Agricultural Lenders Conference	33	27	Oct. 10, 2007	Dec. 2007	41
		27		Apr. 2008	123
National Cattlemen's Beef Association Annual Meeting	93	76	Feb. 7, 2008	Apr. 2008	41
		70		Aug. 2008	123
High Plains Bio-Fuels Co Product Conference	52	42	Feb. 20, 2008	Apr. 2008	32
		40		Aug. 2008	114
Iowa Cattle Risk Management Workshop	14	9	Mar. 3&4, 2008	Apr. 2008	23.5
		10		Aug. 2008	105.5

The survey asked participants to give a most likely expected price (mean price) for two live cattle futures contract months, a nearby and a more distant (approximately 5-6 month deferred) contract, traded on the Chicago Mercantile Exchange. The first two groups were asked to provide the price and price distribution for their expectation of the live cattle futures price five business days prior to the contract's expiration. The remaining group of respondents were asked give their forecast for the final trading day of the option contract for each live cattle futures contract. All respondents were asked to provide a probability that the actual price on the stated date will be within two dollars of the price they expect. After this, probabilities that the actual contract price on the stated date would fall into five price ranges of four dollars higher and lower than their expected price were requested from the survey respondents. For example, if a participant expects a price $100 per hundredweight they would then give their expected probability that the actual price would be between $98 and $102. Then they would give their perceived chance that the price would be $94 to $98 and $102 to $106. The final price range was $18 or higher (lower). This method of expected price elicitation allows for flexibility by respondents in that they are able to center their stated distribution around their own expected price rather than a predetermined set of prices defined by the survey.

The meetings where surveys were conducted were typically one or two day events where producers attended a central location for educational training. Some of the meetings had speakers that gave price forecasts; however, if this was the case, the survey was given prior to such information dissemination. The KSU Risk and Profit Conference was a two day conference centered on agricultural risk and policy presentations by members of the Kansas State University faculty. The KSU Stocker Conference was a one day program hosted by the Kansas State University Animal Science and Industry Department that focused on backgrounding and feeding cattle. The KSU Agricultural Lender's Conference, was a one day event focused on members of the agricultural lending industry. The National Cattlemen's Beef Association Annual Conference is a yearly event for members of the association and the beef industry. A myriad of educational and informational programs and presentations targeted to members of the industry take place over the three day event. The High Plains Bio-Fuels CoProduct Conference was a one day event that focused on ethanol production in the US and the impacts it has in the cattle feeding industry. The Iowa Cattle Risk Management Workshops were two separate programs targeted to Iowa cattle producers to educate them on risk management issues and strategies. Two separate surveys were conducted for this group and the responses were combined.

Eales et al (1990) states that if producers are asked to give the expected futures contract price, they will use the current futures price as an 'anchor' rather than give their own expected price at the requested future date. Producers obtain price information and forecasts from various sources and this information is used to make management decisions in real time. Management decisions are often made using the current futures prices as an expectation and assessing these will likely be more in line with actual producer expectations. This study seeks to quantify producers' expectations of future market prices and the information that producers use is encompassed in that expectation. Furthermore, under the assumption of market efficiency, the current listed futures price takes into account all market information and thus is the most probable future price of the underlying commodity.

Surveys at all meetings, excluding the Risk and Profit conference, were personally given to each individual and were then collected in the same manner so it was possible that not all meeting participants were reached. Therefore, the second column in table 3.1 reports the number of surveys handed out rather than the total number of participants that attended each conference. The total number of surveys distributed was 323 and of these 236 and 223 could be used for analysis for the nearby and distant contract forecast, respectively. Unusable surveys were those that were not completed or where price and probability information could not be extracted in any way. Some survey respondents did not have price distribution probabilities that summed to one. These surveys were utilized by simply adding all reported probabilities and weighting each individual probability based on the summed value. For example, if the sum of all probabilities was 110 percent and the probability assigned to the $2-$6 higher expected price range was 20 percent, the adjusted probability for this range was 18.18 percent (or 20 divided by 110).

In addition to price and price distribution expectations, demographic information for each respondent was gathered for all groups, excluding the KSU Risk and Profit group. This survey was conducted in cooperation with another survey at the KSU Risk and Profit conference and the amount of information that could be included was limited. The demographic information was used in estimating how these factors influence the outlook of future prices and price variability. Respondents were first asked to state their age, gender and education level. Age is used as a proxy for level of experience and respondents' average age was 44.18 years. Gender was recorded as a one if the participant was male and zero if female and males accounted for 88.1 percent of the respondents. Participants were given four options to describe their level of education: (1) Some High School, (2) High School Graduate, (3) Some College and (4) College Graduate or Higher. The mean level of education was 3.53 meaning that the average respondent fell between some college education and a college graduate. Next, survey participants were asked to describe their primary occupation. A number of occupations related to the beef and other agricultural industries were given as options as well as a choice of "Other". The majority of the respondents were backgrounders, cow/calf producers, or feedlot operators (18.1, 16.7, and 15.2 percent respectively). Collectively, these account 50% of the sample. Respondents then listed the state in which they are located. This state level information was aggregated into three US regions, Midwest (12 percent), Southern Plains (68 percent), and Other (20 percent). If the individual was involved in livestock or crop production they were asked to give the overall size of their operation as number of head maintained each for cow/calf operation and the number of head sold each year for feeder and fed cattle operations. The total number of acres farmed each year was asked in regard to crop production. If no value was given for these categories then a zero was recorded. Lastly, respondents were asked how often they used futures. Those that had never used futures accounted for the majority of respondents, 54.8 percent, whereas 31.4 and 13.8 percent sometimes used and often used futures, respectively. Table 3.2 reports the results of respondents' demographic information.

Table 3.2 Summary Statistics of Demographic Data of Survey Respondents

Parameter	Mean	Standard Deviation	Minimum	Maximum
Age	44.18	15.44	18	85
Gender	88.10%			
Education	3.53	0.68	1	4
Occupation				
Cow/Calf	16.67%			
Backgrounder	18.10%			
Feedlot	15.24%			
Agribusiness	30.95%			
Academia	10.48%			
Other	8.57%			
Regional Location				
Midwest	11.90%			
Southern Plains	67.62%			
Other	20.48%			
Operation Size				
Cows	188.45	1,735.18	0	25,000
Feeders	400.89	3,490.05	0	50,000
Fats	10,252.51	45,757.26	0	500,000
Crops	294.24	946.15	0	8,000
Previous Futures/Forward Use				
Never	54.76%			
Some	31.43%			
Often	13.81%			
No. of Respondents (Nearby)	210			
No. of Respondents (Distant)	199			

[1] 1=Some High School, 2=High School Graduate, 3=Some College and 4=College Graduate or higher

CHAPTER 4 - Conceptual Framework and Methods

This chapter outlines the concepts used for empirical examination of producer's expected risk versus the market expected price risk. It draws from previous work that has examined similar problems and outlines how this study will use these concepts in order to fulfill the objectives presented in chapter one.

4.1 Forwards, Futures and Options Contract Definitions

Forward and futures contracts are similar in that the buyer and seller reach an agreement on a given quality and quantity of a commodity for a specified price. Futures contract differ from forward contracts, however, in that the exchange on which the commodity is traded sets the specifications for the commodity (quality, quantity, date of sale) so that only the price is negotiated between the buyer and the seller. Individual forward contract specifications can vary even if the underlying commodity is the same because the specifications of the contract are negotiated by the buyer and seller along with the price.

Options on futures contracts give the buyer of the option the right, but not the obligation, to buy (call) or sell (put) the underlying futures contract. The price of the option is the premium. The price at which the underlying commodity can be bought or sold is the strike price. Multiple strike prices are available for a single futures contact. The premiums at the differing strike prices can be used to asses the underlying commodity's price risk.

4.2 Black Option Pricing Model

Volatility in stocks and futures markets are commonly estimated in two ways, from historical data and from options prices. Historical volatility estimates are backward looking and use price series from past data to calculate variance or standard deviation values as proxies for a commodity's level of risk. A number of studies have found this type of volatility measurement does not accurately predict actual, or revealed, volatility as compared to models that estimate volatility from option prices. Poon and Granger (2003) summarize the results of numerous studies that compare historical and implied volatilities. Although many of the studies listed by Poon and Granger (2003) estimate the predictive power of stock options, some evaluate options on futures.

Black and Scholes (1973) laid the foundation for option pricing models. Their model stems from the financial sector and calculates the market's value for a of a European call option on stocks. Black (1976) further explored the pricing of options on futures contracts. Acceptance of implied volatility derived from Black's model is mixed. Some studies have found Black's model to be a poor estimate of actual volatility. Theoretically, error is present if arbitrage is not possible or costly to perform. Stock options that trade on multiple platforms and do not close at the same time make arbitrage opportunities difficult and costly and thus are a likely culprit of biased results for the Black-Scholes pricing model. However, since futures trade on the same exchange as the options they underlie, if options are mis-priced traders would have the ability to take advantage of the arbitrage opportunity fairly easily.

Still, some studies have found Black's model to be a poor predictor of actual volatility. Hauser and Neff (1985), Myers and Hanson (1993) and Hilliard and Reis (1999) all found the

Black model to be inferior to historical variance, GARCH models and a model that follows a jump diffusion process, respectively. Jorion (1995), on the other hand, found implied volatility on foreign currency futures to perform better than a GARCH model of historical volatility. Szamany et al (2002) compared the results of 35 commodities' volatility that were estimated using historical volatility and Black's model. They found that the Black model outperformed historical variance estimates for 32 of the 35 commodities including live cattle.

Empirical evidence is somewhat mixed regarding the ability of Black's model to accurately forecast market volatility relative to other estimates of price variance. However, most of the more recent and more comprehensive studies, in terms of scope of markets covered, conclude that implied volatility from Black's model is at least as accurate of a forecast of volatility as other methods. Furthermore, assuming that the live cattle option market is efficient and that Black's model is as accurate a depiction of option premiums as any alternative, its use as a proxy for the market's collective expectation of forward looking price variability is justifiable. Black's model is:

$$OP(F,t) = e^{r(t-T)}[FN(d_1) - SN(d_2)], \tag{4.1}$$

with the conditions:

$$d_1 = \frac{\left[\ln\frac{F}{S} + \frac{\sigma^2}{2}(T-t)\right]}{\sigma\sqrt{(T-t)}}, \text{ and} \tag{4.2}$$

$$d_2 = \frac{\left[\ln\frac{F}{S} - \frac{\sigma^2}{2}(T-t)\right]}{\sigma\sqrt{(T-t)}} \tag{4.3}$$

where, *OP* is the option premium, *F* is the underlying futures price, *S* is the strike price of the option, *T* is the date the option is exercised, *t* is the date the option is bought, *r* is the current risk free interest rate and σ^2 and σ are the variance and standard deviation of the underlying futures contract. The function $N(d_i)$ is the cumulative standard normal probability function and it gives the probability that a value with a standard normal distribution, $N\sim(0,1)$, will be less than d_i

This method allows for estimation of the volatility of the underlying futures price (called the implied volatility). As can be noticed from equations (4.1) – (4.3) if the option premium is known and the only unknown is the underlying futures contract price volatility this value can be found through the Black model. Computing the implied volatility is useful in recovering the market's expectation of the future price of the underlying commodity as well as the expected price distribution of the expected futures price.

The Black model measures the volatility of European options which are different from American options, the options available for the live cattle futures contract. European options can only be exercised at the underlying contract's expiration whereas American options can be exercised at any point during the life of the option up to a set time shortly prior to the underlying commodity's expiration. Since respondents are asked to give their expected price at each contract's expiration the European and American options are equal.

4.3 Stated Price and Probability

This study asks respondents to give expectations of future price and the associated distribution of that price which involves eliciting probability information from the survey participants. Survey formulation can have a significant impact on results. Nelson (1980) defined four methods of eliciting probabilities. The methods defined by Nelson (1980) that give the highest level of precision were the direct estimation and the weighted method. Both give respondents a number of discreet choices for which probabilities are assigned. This research follows Egelkraut et al. (2006) which utilize directly stated probabilities. Hardaker, Huirne and Anderson (1997) state that this method allows for consistency between personal thoughts of uncertainty and the laws of probability.

To elicit price and price distribution information from respondents each individual stated an expected price as well as the probability of the price being higher or lower than their expected price. The survey gives ranges for producers to place a probability that the price would fall into each range. To determine their actual perceived expectation of price which utilizes both the stated expected price and the price probabilities, the median for each range is multiplied by the stated probability for that range and then all are summed.

4.4 Aggregated Methodology

Eales, et al. (1990) gathered price expectations from farmers by asking them to place probabilities that the future cash price and future basis of corn and soybeans would fall into preset ranges. They used the stated prices and basis along with the probabilities to calculate an expected price of the futures contract (*futures price = cash price + basis*). The Black model stems from the assumption that prices are log-normal. The validity of this assumption has been widely debated (see Goodwin and Ker, 2001); however, to comply with the assumptions of the Black model this distributional assumption is maintained. The probability distribution function of the log-normal is:

$$f(\mu) = \left(\frac{1}{\left(\sqrt{2\pi}\right)\bar{\sigma}\mu} \right) \left(e^{-\left[\frac{\left(\ln(\mu)-\bar{\mu}\right)^2}{2\bar{\sigma}^2} \right]} \right), \tag{4.4}$$

where μ is the mean of the natural log of each group's expected price, the natural log of the futures settlement price is $\bar{\mu}$ and Black's implied volatility is $\bar{\sigma}$. The properties of the log-normal distribution give the following first and second moments:

$$\mu_1^{'} = e^{\left(\mu+\frac{1}{2}\sigma^2\right)}, \tag{4.5}$$

and

$$\mu_2^{'} = e^{\left(2\mu+\sigma^2\right)}\left(e^{\sigma^2} - 1\right), \tag{4.6}$$

where, $\mu_1^{'}$ is the first moment and thus the mean and $\mu_2^{'}$ is the second moment which gives the variance. The aggregate mean and variance from each group of survey respondents are μ and σ^2 which are used to find the first and second moments. The mean is an aggregated mean price expectation that is compared to the price the market gives (the futures settlement price for the date of survey elicitation for each group).

Black's implied volatility is an annual measurement and thus the variance from equation (4.6) must undergo further manipulation to arrive at a value that can be compared to Black's implied volatility. The variance from equation (4.6) is the variance for the length of the forecast that survey respondents give. To annualize the variance, equation (4.6) is multiplied by the forecast period in years. For example, if the forecast length is 100 days and there are 252 trading days in a year, then 252 divided by 100 gives the total number of forecasted periods in a year that survey respondents give. Therefore, the aggregated variance is multiplied by this value to find the annualized variance. Then the square root of the annualized variance gives the annualized standard deviation. The annualized standard deviation is comparable to Black's implied volatility.

To test the difference of the mean price expectation of each group, equation (4.5), against the market's expectation the student's *t* distribution is calculated:

$$t = \frac{\mu - \bar{\mu}}{\bar{\sigma} / \sqrt{n}}, \tag{4.7}$$

where μ is the mean of the natural log of each group's expected price, the natural log of the futures settlement price is $\bar{\mu}$, Black's implied volatility is $\bar{\sigma}$ and *n* is the total number of respondents for each group and the degrees of freedom equal *(n-1)*. The difference between the estimated group variance, equation (4.6), and the implied volatility resulting from the Black model, equation (4.1), is then tested for statistical significance using the chi-squared test statistic:

$$\chi^2 = \frac{\sigma^2 n}{\bar{\sigma}^2}, \tag{4.8}$$

where σ^2 is the calculated annualized variance from equation (4.6) for each group of participants, $\bar{\sigma}^2$ is the market implied volatility found from Black's model and *n* is the number of respondents in each group. This test uses the number of respondents as the degrees of freedom.

4.5 Methodology for Individual Analysis of Participants

Pease et al. (1993), in a study of crop yield distributions, does not aggregate subjective probabilities. Instead the authors calculate the percentage difference of elicited yields from historical yields (de-trended). The methodology incorporated by the authors is:

$$\%Diff_{i,j} = \left[\frac{\left(H_{i,j} - S_i \right)}{S_i} \right] * 100 \tag{4.9}$$

where *%Diff*$_{i,j}$ is the percentage difference between forecasted yields for farm *i* utilizing forecast method *j* (multiple forecast methods were used). $H_{i,j}$ is the forecasted yield and S_i is the subjective probability of each farm *i*'s yield. This framework allows for more flexibility of the analysis as compared to the aggregation used by Eales et al (1990) in that the analysis is on individual basis and not aggregated.

Although the procedure outlined by Pease et al. (1993) allows for more precise analysis, this study seeks to draw deeper analysis in regard to producer perceptions. The survey responses of the probabilities elicited from respondents is discrete. The implied mean can be extracted from these in the same manner as Eales et al. (1990) by summing the product of the probabilities and the median price from each range. However, the implied variation is still unknown. In order to analyze the difference of each individual producer's expectation of volatility from the market implied expectations, methods to extract the distribution of each survey respondent's directly elicited price distribution must be established. To do this the discrete distribution must be fitted to a continuous distribution. This framework was established by Egelkraut et al. (2006). They use a linear programming routine that minimizes the sum of the squared difference between the elicited probability given by each survey respondent and a fitted probability. The objective function under this framework is:

$$\min_{\theta_i} \sum_{i=1}^{n} \left\{ \left[p_{i,1} - D\left(U_1 \middle| \theta_i\right) \right]^2 + \sum_{j=2}^{m-1} \left[p_{i,j} - \left(D\left(U_j \middle| \theta_i\right) - D\left(U_{j-1} \middle| \theta_i\right) \right) \right]^2 + \left[p_{i,m} - D\left(U_{m-1} \middle| \theta_i\right) \right]^2 \right\}, \tag{4.10}$$

where, $p_{i,j}$ is the probability given by each respondent *i*, *D()* is the fitted cumulative distribution and U_j is the upper bound on each interval *m*. Equation (4.10) when solved will give the parameters of the fitted distribution. The fitted distribution used is a function of the assumptions of the distribution on the underlying elicited prices. Since prices are assumed to be log-normally distributed, this distribution will be used in the objective function in equation (4.10). Therefore the fitted cumulative distribution of the log-normal is:

$$D(x) = \frac{1}{2}\left[1 + erf\left(\frac{\ln(x) - \mu}{\sigma\sqrt{2}}\right)\right], \tag{4.11}$$

where *x* is the median price from each price range defined in the survey, μ and σ are the mean and standard deviation of *x*, respectively, and *erf* is the error function from integration of the normal distribution:

$$erf(z) = \frac{2}{\sqrt{\pi}}\int_0^z e^{-t^2} dt \quad , \tag{4.12}$$

where z is defined in equation (4.11).

The method used by Egelkraut et al. (2006) returns an implied mean and an implied variance for each individual. This method will allow for precise estimation of each individual survey respondents' price and price variability expectations which are compared to the market's expectations. The implied mean returned from the minimization procedure outlined in equation (4.10) is the natural log of the individual's expected price and the standard deviation for the length of the each forecast. As with equation (4.6) the standard deviation returned from equation (4.10) must be annualized for comparison and thus the same calculations are made to achieve this.

4.6 Demographic Influences on Price and Price Variability Expectations

No previous studies that elicited probability expectations reported how the revealed expectations related to various respondent demographic factors. However, a number of studies that explore usage of futures and forward contracts have included variables that determine the impact of certain demographic information on the overall usage of these contracts (Shapiro and Brorsen, 1988; Maukus et al., 2000; Goodwin and Schroeder, 1994; Musser, Patrick and Eckman, 1996; and Sartwell et al., 2000). To determine how demographics are related to market risk perceptions, this prior research that determines how use of futures markets is related to these attributes is used as a foundation of the factors to include in this study.

Common information gathered to evaluate determinants of producer usage of futures markets includes age or experience, education level, size of operation and location. Other less common themes the studies probe respondents for are: information on their leverage (typically by way of a debt-to-asset ratio), if the producer took part in government funded commodity programs, level of diversification, amount of time spent at extension/outreach meetings, and amount of time spent learning about futures or forward contracting. All of these studies report the use of futures and or forward contracts by the respondents. Due to space limitations and in an attempt to keep the survey short the more common demographic data are elicited. The common information collected in this study was respondent’s age, gender, education, location and occupation along with information about the size of their operation and the level of their previous use of futures contracts.

The significance of age or experience on futures market usage varies across studies. Shapiro and Brorsen (1988) find age to be a significant factor however Maukus et al. (1990) did not find the same result. The other studies tested multiple models and age/experience was found to be significant in one or more of the models. Education had a significant impact in all studies with the exception of Goodwin and Schroeder’s (1994) cattle producer model where it did not have a significant effect. Farm size had significant effects for all the studies. The results of location and degree of leverage varied across all the studies and participation in government programs did not have an impact in any of the models.

It is apparent that factors such as age/experience, education and size all effect management decisions and thus it is expected these factors will impact stated price expectation and variability. Age is included instead of experience as age is a proxy for experience and is known with certainty whereas experience is not as certain or requires more time to calculate. Other demographic variables commonly assessed by surveyors which are not listed here are gender and occupation. Determining the effects of these further allows for more precise information dissemination to producer groups.

It has not been shown how these factors impact a producer's outlook on price expectation and price risk in previous literature. To determine the effects of this demographic information on price expectations, the following regression was used:

$$\begin{aligned} \left|\mu_{i,k} - \overline{\mu}_{i,k}\right| &= \alpha_0 + \beta_1 Age_i + \beta_2 Sex_i + \beta_3 Edu_i + \beta_4 Occ_i \\ &+ \beta_5 \operatorname{Re} g_i + \beta_6 Size_i + \beta_7 Fut_i + \beta_8 Conf_i + e_i \end{aligned}, \tag{4.13}$$

where, $\mu_{i,k}$ and $\overline{\mu}_{i,k}$ are the implied mean derived from the fitted distribution for each individual *i* and the futures settlement price, respectively, and *k* is either the nearby or distant contract . The left-hand side of equation (4.13) is the absolute value of the overall error in price expectation of each respondent versus the market. Age_i is the stated age of the *ith* individual. Age is included to incorporate a proxy for the level of experience of the individual. Sex_i is a dummy variable indicating if the individual is male or female (the base gender is female). Edu_i indicates the level of education of the survey respondent where 1 implies the respondent has some high school education but did not graduate, 2 indicates a high school graduate, 3 implies some college training with no degree obtained and 4 indicates a college graduate or higher. Reg_i is a dummy variable specifying the regional location of the survey respondent. The respondents indicated the primary state of operation and this information was then placed in various regions in the United States (Southeast, Midwest, Southern Plains, Northern Plains, West and the base used is the Northeast). Occ_i is a dummy variable indicating the primary occupation. Occupations within the livestock industry given are Cow/Calf operator, Backgrounder, Feedlot operator, Breed or State Representative, Consultant and Livestock Marketing. Other occupations include Crop producer, Veterinarian, Banking and Lending, Agribusiness, Academia, Student and Other (with Other being the base occupation). $Size_i$ indicates the relative size of each operation. Here respondents listed the number of head of cows, feeder and fed cattle sold annually and the number of acres of row crops planted each year. Fut_i is a dummy variable that indicates the level of usage of forward, futures or option contracts for each respondent where possible responses where Often, Some and Never (the base is Never). Lastly, $Conf_i$, is a categorical variable indicating the conference the individual attended (Stocker, Lender, National Cattlemen's Beef Association Annual meeting, High Plains Biofuel CoProduct and Iowa Cattle Risk Management Workshop; where Iowa conference is the base). These conferences are discussed in the previous chapter.

In a similar context, the demographic information can provide insight into each individual's perceptions of price variability. Under this framework the following expression will be used:

$$\begin{aligned} \left|\sigma_{i,k} - \overline{\sigma}_{i,k}\right| &= \alpha_0 + \beta_1 Age_i + \beta_2 Sex_i + \beta_3 Edu_i + \beta_4 Occ_i \\ &+ \beta_5 \operatorname{Re} g_i + \beta_6 Size_i + \beta_7 Fut_i + \beta_8 Conf_i + e_i \end{aligned}, \tag{4.14}$$

where, $\sigma_{i,k}$ and $\overline{\sigma}_{i,k}$ are the implied standard deviation derived from the fitted distribution for each individual *i* and Black's measure of market volatility, respectively, and *k* represents either the nearby or distant contract. The left-hand side of equation (4.14) is the absolute value or the overall error in price expectation of each respondent versus the market. The right-hand side parameters are the same as in equation (4.13).

Using dummy variables to capture categorical information in a single equation, as compared to multiple equations for each category, essentially pools numerous equations into one. This framework, then, assumes that the variances across these multiple models are the same; however, this is not likely to be true. So, including dummy variables increases the chance that heteroscedasticity will be present in the equation (4.13) and (4.14). Therefore, White's test for heteroscedasticity was conducted for each model. If heteroscedasticity was present each model's standard errors were corrected according to White's method for consistent variances.

To test if the categorical dummy variables used to describe an individuals' occupation, regional location and their relative use of the futures market were significant as a group for equations (4.13) and (4.14) an F-test was performed with the following hypothesis:

$$H_0 : \beta_1 = \beta_2 = \cdots = \beta_m = 0, \qquad (4.15)$$

where, β_i is the coefficient for each m occupation included in the model. This hypothesis is representative of all groups of categorical variables; therefore, β_i also represents the coefficients for each region, level of futures use and conference.

4.7 Chapter Summary

This chapter has produced the current framework by which research in this area has been conducted. This study used direct estimation to gather respondents' expectation of price and probabilities of live cattle prices. The price and probability information was used to formulate price expectations and price variability expectations at an aggregate level for each group that was surveyed and for each individual respondent. This chapter has also examined one of the well established models for extracting market volatility. This model is used as a proxy for the actual risk in the market. Group and individual expectation were compared to this actual market expectation of risk. This framework allows for a more thorough understanding of the perceptions of price and price risk for various individuals. Lastly, the results of individual perceptions are used along with the demographic information to quantify how these characteristics impact their expectations.

CHAPTER 5 - Results

Chapter three outlined the data collection process from which survey participants gave their expectations of future live cattle prices for nearby and distant futures contracts as well as probabilities that the price would be higher and lower than their expected price. These data were analyzed according to the methods laid out in chapter four. First, each group's price and price probability information was aggregated and tested against the market's expectations. Secondly, each individual participant's price and price probability expectations were fitted to a log-normal distribution so that they could be analyzed against the market's expectations observation by observation. Finally, the information gathered from the individual analysis along with the demographic information gathered from each respondent was estimated through regression analysis. The results of this analysis are presented in this chapter.

5.1 Results of Aggregated Analysis

Each group's price and price probability expectation were complied and aggregated. Under the assumption of log-normal prices, the log-normal distribution properties were used to find the mean price and variance for each group. The group's expectation of price was then compared to the futures market settlement price and each group's price variance was compared to Black's implied volatility.

5.1.1 Aggregated Price Difference Results

To identify the error of price expectation present for each group, the average of the natural log of each group's expected price was subtracted from the natural log of the futures settlement price on the day the survey was elicited. The difference was tested using a student's *t* distribution. The results of the comparison between the stated price expectations and the market expectations are reported in table 5.1. The majority of the group's expected prices were not significantly different from the futures settlement price reported on the date of elicitation. Given the amount of market information that is readily available, this is not surprising. Two groups, however, reported expected prices that were significantly lower than the market (at the 10 percent level), the KSU Stocker Conference and the National Cattlemen's groups. Ignoring statistical significance for a moment, table 5.1 shows that all but two group forecast differences are negative implying that participants typically are pessimistic in regard to the expected fed cattle price for a future date relative to the live cattle futures market.

5.1.2 Aggregated Price Variance Results

Group price volatility is reported in table 5.2. Each group's aggregate volatility is calculated from equation (4.6). These group level volatilities are then compared to Black's measure of market implied volatility. The difference between the two was calculated and the chi-squared test was used to test if each group's expected level of risk was significantly different from the market's expectation of risk. Of the twelve volatility estimates eleven are significantly different from Black's implied volatility at the 5 percent level or better. Only the distant price risk expectation of the KSU Stocker Conference group was not statistically different from Black's implied volatility.

Table 5.1 Difference of Aggregated Expected Prices of Survey Respondents Versus the Market Price of Fed Cattle[1]

Group	Futures Price	Group Calculated Lognormal Price	Futures Price	Group Calculated Lognormal Price
	Nearby		Distant	
KSU Risk and Profit Conference	$95.48	$93.66	$98.80	$94.59
KSU Stockers Conference	$100.20	$97.93	$101.12	$97.58 *
KSU Agricultural Lenders Conference	$96.62	$96.23	$98.70	$95.67
National Cattlemen's Beef Association Annual Meeting	$96.05	$94.60	$97.33	$94.70 *
High Plains Bio-Fuels CoProduct Conference	$94.95	$94.95	$97.45	$95.10
Iowa Cattle Risk Management Workshop	$91.93	$94.56	$97.68	$97.51

* indicates significance at the 10% level

[1] Each group's expected price and the market's expected price are not significantly different

[2] The test was conducted using the natural log of the prices not the actual prices reported here, the test is:

$$t = \frac{\mu - \bar{\mu}}{\bar{\sigma} / \sqrt{n}}$$

where μ is the mean of the natural log of each group's expected price, the natural log of the futures settlement price is $\bar{\mu}$, Black's implied volatility is $\bar{\sigma}$ and n is the total number of respondents for each group with *(n-1)* degrees of freedom.

Table 5.2 Survey Respondents Calculated Aggregated Volatility Versus Black's Implied Volatility of Fed Cattle Price

Group	Black Implied Volatility	Aggregate Group Volatility	Black Implied Volatility	Aggregate Group Volatility
	Nearby		Distant	
KSU Risk and Profit Conference	10.82%	5.90% ***	13.15%	22.46% ***
KSU Stockers Conference	13.31%	8.09%***	13.44%	2.96%
KSU Agricultural Lenders Conference	13.95%	16.31%**	13.46%	29.56% ***
National Cattlemen's Beef Association Annual Meeting	13.80%	6.96%***	13.22%	22.68% ***
High Plains Bio-Fuels CoProduct Conference	15.25%	9.09%***	14.24%	24.31% ***
Iowa Cattle Risk Management Workshop	14.63%	3.51%***	14.89%	7.42% ***

*** and ** indicate significance at the 1% and 5% level, respectively

The magnitude of the group implied volatilities for the near term contract as compared to the more distant expectation varied from group to group; however typically groups' expectation of near term price risk was underestimated and overestimated for more distant price risk expectations. The Risk and Profit, Stockers, NCBA, Bio-Fuel and Iowa cattlemen conference participants reported lower volatilities for the nearby contract, whereas the Lenders reported larger expected volatilities for the nearby contract. Larger price risk expectations were found for the distant forecast for all groups excluding the Iowa cattlemen, which reported a lower perceived risk, and the Stocker conference respondents whose measure of market risk was not statistically different from the market. Black's implied volatility, however, followed a pattern of lower values for the August and September dates, then the opposite was true for the October and February meetings and then it switched again for the March dates.

The lowest difference (from an absolute value standpoint) of the groups for the nearby contract was reported by the Agricultural Lenders (0.02 percentage points) who overestimated the level of risk and the largest difference of price volatility was reported by the Iowa cattlemen (0.11 percentage points). This group largely underestimated the market price risk as compared to the Black implied volatility. The smallest difference from the market for the distant contract was given by the Iowa cattlemen (0.07 percentage points) and the largest difference from the market was the Agricultural Lenders (0.16 percentage points).

5.2 Results of Individual Analysis

More specific analysis is gleaned when each respondent's price expectation and distribution are determined and compared to the market. Table 5.3 reports the average results from equation (4.10) for each group. The majority of individuals overestimated fed cattle price risk of nearby contracts. However, the opposite is revealed for the distant months where all groups underestimate the level of risk prevalent in the market. In regard to price expectations table 5.3 shows that all but one group underestimate the expectation of price as compared to the live cattle futures contract settlement on each survey date for both the near and distant contract months.

Table 5.3 Average of Individual Expectations Across Each Survey Group and Market Expectations

Group	Futures Settlement Price	Individual Implied Price	Black Implied Volatility	Individual Implied Volatility	Futures Settlement Price	Individual Implied Price	Black Implied Volatility	Individual Implied Volatility
	Nearby				Distant			
KSU Risk and Profit Conference	$95.48	$91.01	10.82%	15.51%	$98.80	$91.65	13.15%	7.74%
KSU Stockers Conference	$100.20	$96.02	13.31%	15.92%	$101.12	$95.88	13.44%	10.44%
KSU Agricultural Lenders Conference	$96.62	$94.08	13.95%	15.55%	$98.70	$93.95	13.46%	10.24%
National Cattlemen's Beef Association Annual Meeting	$96.05	$92.01	13.80%	12.40%	$97.33	$91.96	13.22%	7.17%
High Plains Bio-Fuels CoProduct Conference	$94.95	$92.61	15.25%	11.29%	$97.45	$92.81	14.24%	5.98%
Iowa Cattle Risk Management Workshop	$91.93	$92.02	14.63%	22.56%	$97.68	$94.93	14.89%	8.61%

An example of an individual's implied mean and standard deviation resulting from equation (4.10) is shown as a cumulative distribution function (CDF) in figure 5.1. This figure shows the stated probabilities that the individual reported in the survey as well as the continuous lognormal CDF that is found from the minimization procedure in equation (4.10). Figure 5.2 depicts the same individual's stated and fitted (implied) curve along with the Black model's implied volatility that corresponds with the given respondent.

Figure 5.1 Individual Producer's Stated and Implied Cumulative Density Function

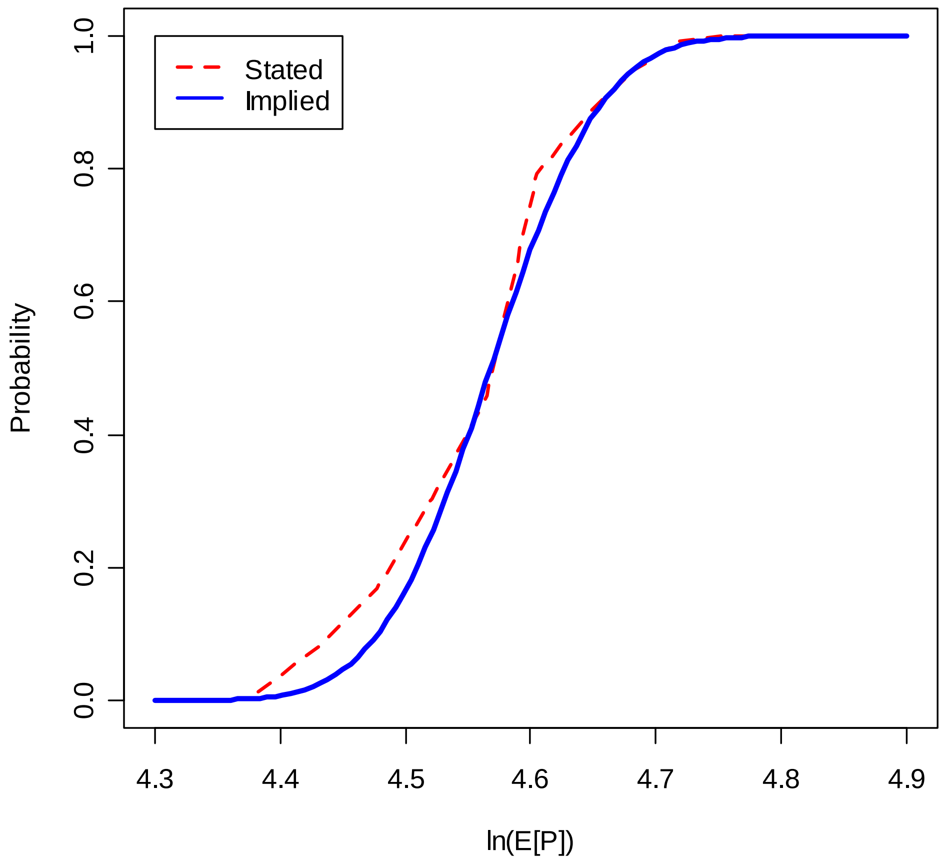
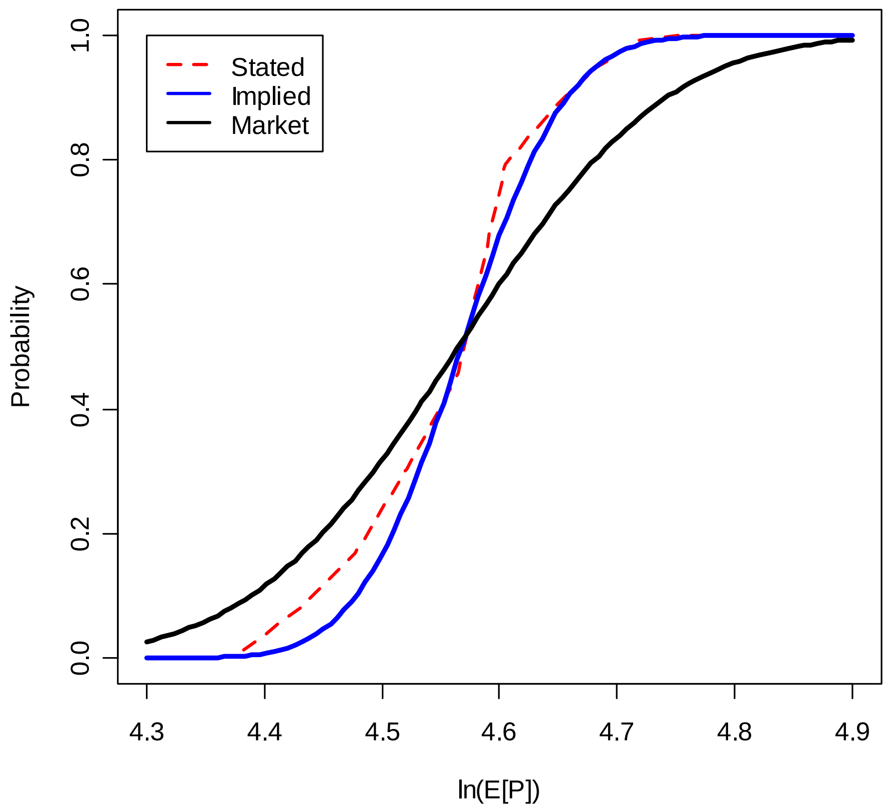


Figure 5.2 Individual Producer's Stated and Implied Cumulative Density Function as Compared to Black's Cumulative Implied Volatility



5.2.1 Results of Price Differences

Equation (4.10) returns an implied mean for each individual respondent based on their stated expected price and price distribution. The implied price resulting from equation (4.10) is different from the actual price they give as an expectation and the price resulting from summing the probabilities and prices stated in the survey. As a whole, respondents tended to state that prices were more likely to be below their expectation as opposed to being higher than their expected price. Therefore, their distributions were typically skewed left. This would explain the finding that prices tended to be lower as probability expectations were included.

Table 5.4 reports the results from the implied mean found from equation (4.10. All but one price forecast is below the futures settlement price for the date of each survey (the nearby expectation of the Iowa Cattlemen's group is higher than the market price, though not significantly different). All prices were not significantly different from the market's price using a student's *t* distribution. Half of the nearby forecasts were significantly lower than the futures settlement price and all but one was significantly lower for the distant time horizon (at the 10 percent level or higher). Therefore, producers are typically pessimistic in regard to price.

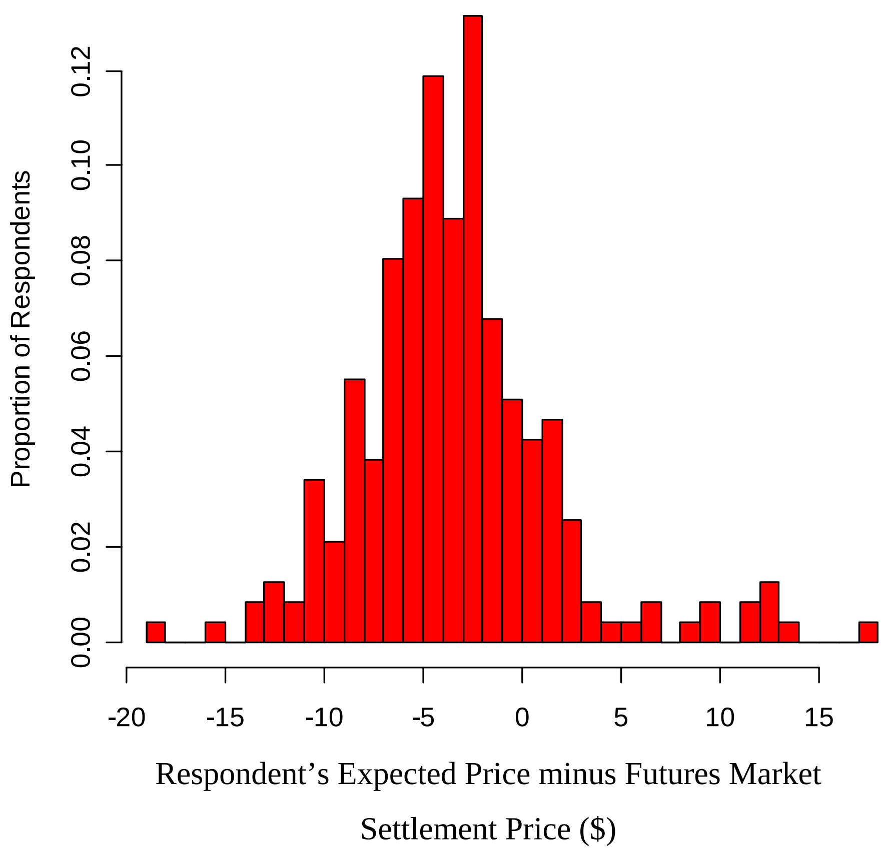
Table 5.4 Futures Settlement Price on Survey Date, Implied Lognormal Price, and Stated Price Across Each Group

Group	Futures Price	Lognormal Implied Price		Futures Price	Lognormal Implied Price	
	Nearby			Distant		
KSU Risk and Profit Conference	$95.48	$91.01	**	$98.8	$91.65	**
KSU Stockers Conference	$100.2	$96.02	**	$101.12	$95.88	***
KSU Agricultural Lenders Conference	$96.62	$94.08		$98.7	$93.95	*
National Cattlemen's Beef Association Annual Meeting	$96.05	$92.01	***	$97.33	$91.96	***
High Plains Bio-Fuels CoProduct Conference	$94.95	$92.61		$97.45	$92.81	**
Iowa Cattle Risk Management Workshop	$91.93	$92.02		$97.68	$94.93	

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively

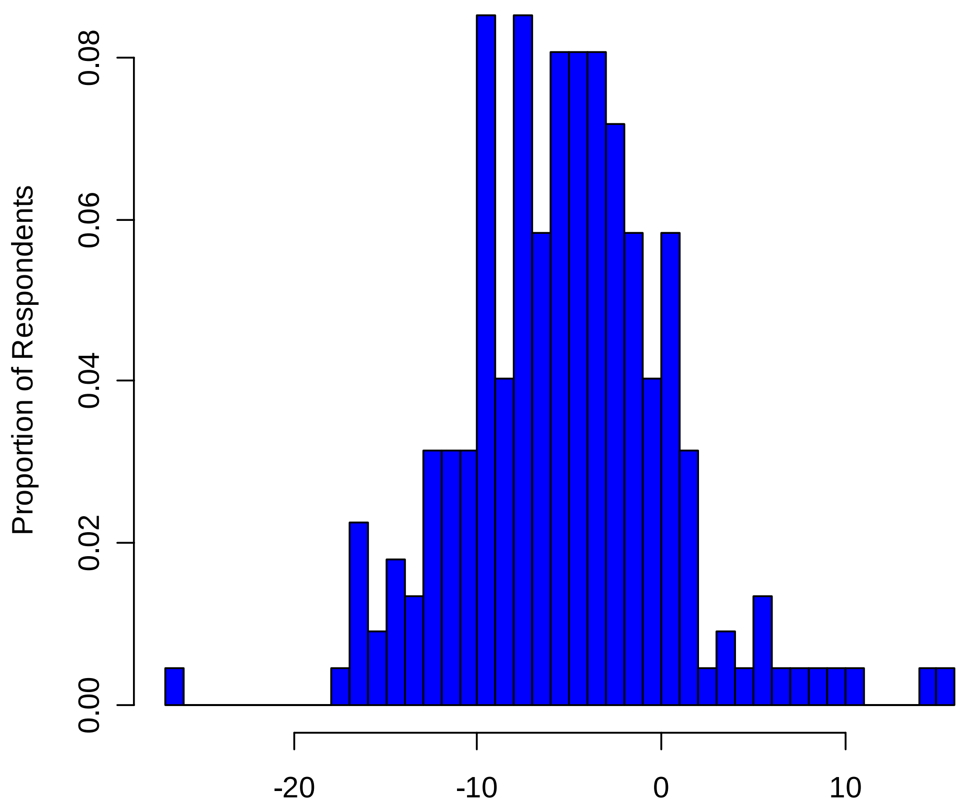
Figure 5.3 shows the distribution of individual price expectations minus the market's expectation for the near term. Most respondents (58.5 percent) have an implied price that is within $5 above or below the market expected price. Even more respondents (75.8 percent) have an implied price that is between $7 below to $5 above the market expected price. Few respondents (1.3 percent) were outside of $15 above or below the market expected price. Also, as shown in figure 5.3, the distribution of price difference is centered to the left of zero (below zero). This result supports the findings reported in table 5.4. Once again, respondents' were typically pessimistic in regard to their expectation of future price as compared to the market.

Figure 5.3 Distribution of Individual Implied Price Minus Futures Settlement Price for the Nearby Contract



The distribution of individual implied price expectation minus the market expectation for the distant forecast is reported in figure 5.4. This figure shows a wider distribution of differences of prices as compared to the nearby contract. Respondents whose price difference is within $5 above or below the market price account for 43.9 percent. Furthermore, 57.8 percent of the respondents distant month implied price is between $7 below and $5 above the market expected price. Lastly, more individuals (4.5 percent) had an implied price that outside the range of $15 above or below the market price as compared to the near time horizon. As noted for the nearby forecast, producers' tend to be pessimistic about future price expectation for distant months as well.

Figure 5.4 Distribution of Individual Implied Price Minus Futures Settlement Price for the Distant Contract



Respondent's Expected Price minus Futures Market Settlement Price ($)

5.2.2 Results of Price Variability Differences

Table 5.5 reports the average annualized implied standard deviation resulting from equation (4.10). On average, producers typically overestimated price risk of nearby contracts, however three of the six group's averages were not significantly different from Black's implied volatility using the chi-squared test statistic. The distant months were always underestimated by respondents and, on average, all were statistically different from Black' implied volatility at the 10% significance level or higher.

Table 5.5 Black's Implied Volatility and Implied Log-normal Volatility Across Each Group

Group	Black Implied Volatility	Log-normal Implied Volatility	Black Implied Volatility	Log-normal Implied Volatility
	Nearby		Distant	
KSU Risk and Profit Conference	10.82%	15.51% ***	13.15%	7.74% ***
KSU Stockers Conference	13.31%	15.92% **	13.44%	10.44% **
KSU Agricultural Lenders Conference	13.95%	15.55%	13.46%	10.24% *
National Cattlemen's Beef Association Annual Meeting	13.80%	12.40%	13.22%	7.17% ***
High Plains Bio-Fuels CoProduct Conference	15.25%	11.29% **	14.24%	5.98% ***
Iowa Cattle Risk Management Workshop	14.63%	22.56%	14.89%	8.61% *

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively

The results reported in table 5.5 are contrary to what is reported in table 5.2 which gives the results of the aggregate analysis. Referring back to equation (4.6) the variance that is calculated from the second moment of the log-normal distribution is a function of both the average expected price and variance of each group's stated prices. Given this the results of the aggregate analysis is likely biased since they are based on the prices reported by each group. On the other hand the results from equation (4.10) are based solely on each individual's stated price distribution.

Table 5.6 reports the percentage of respondents from each group that either over- or underestimated price risk. The majority of the first, second and final group overestimated risk whereas a large majority of the fourth and fifth group underestimated price risk. For the distant forecast, an overwhelming majority of respondents underestimated the risk inherent in the market. In this time horizon approximately 88 percent of all individuals underestimated price risk and more than 95 percent of the individuals participating in the NCBA and Bio-Fuel Coproduct groups underestimated price risk. This corresponds with the results reported in table 5.5 which shows these two groups having the lowest average price volatility.

Table 5.6 Percentage of Respondents That Either Overestimate or Underestimate Price Risk Compared to Black's Implied Volatility

Group	Overestimate Price Risk	Underestimate Price Risk	Overestimate Price Risk	Underestimate Price Risk
	Nearby		Distant	
KSU Risk and Profit Conference	61.54%	38.46%	20.83%	79.17%
KSU Stockers Conference	57.14%	42.86%	21.15%	78.85%
KSU Agricultural Lenders Conference	48.15%	51.85%	18.52%	81.48%
National Cattlemen's Beef Association Annual Meeting	41.33%	58.67%	2.86%	97.14%
High Plains Bio-Fuels CoProduct Conference	23.81%	76.19%	2.50%	97.50%
Iowa Cattle Risk Management Workshop	66.67%	33.33%	20.00%	80.00%

Figure 5.5 and 5.6 give the distribution of all individuals' implied standard deviation minus Black's implied volatility for the nearby and distant contracts, respectively. The six groups were fairly spilt in regard to over- or underestimation of price risk expectation and so it is not surprising that the distribution is centered around zero. A small number (3.3 percent) of the deviations from the market are 20 percentage points and higher. From figure 5.6 it is shown that the majority of respondents underestimated price risk when the time horizon is larger, which is in line with the values reported in table 5.5, however the range of the differences in price risk was lower than that found for the nearby contract.

Figure 5.5 Distribution of Individual Implied Standard Deviation Minus Black Implied Volatility for the Nearby Contract

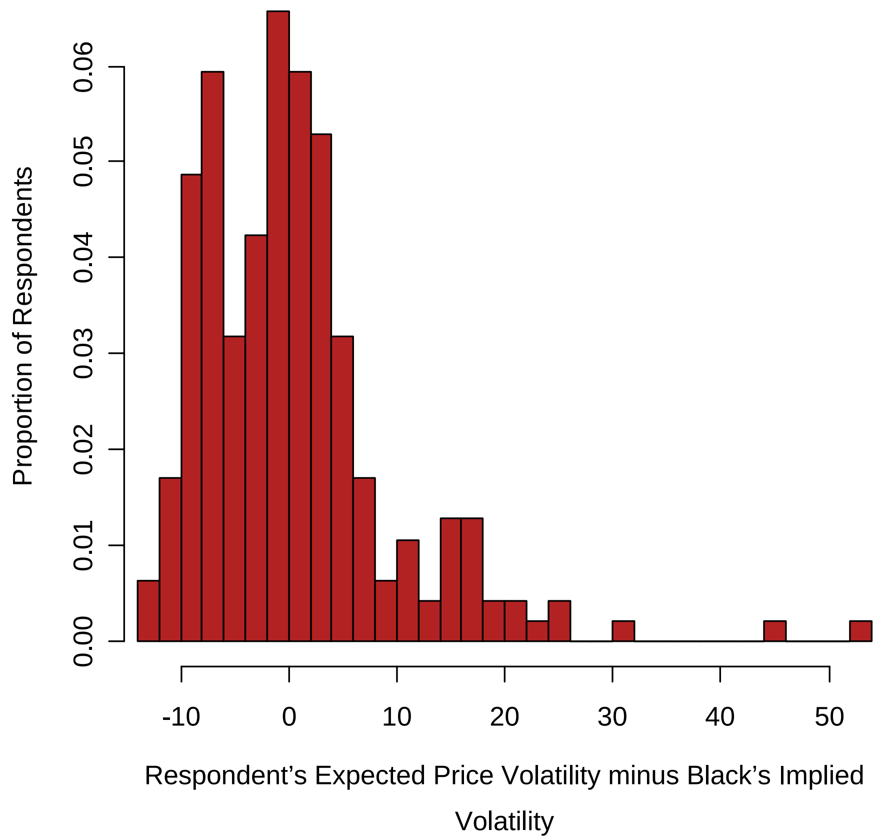
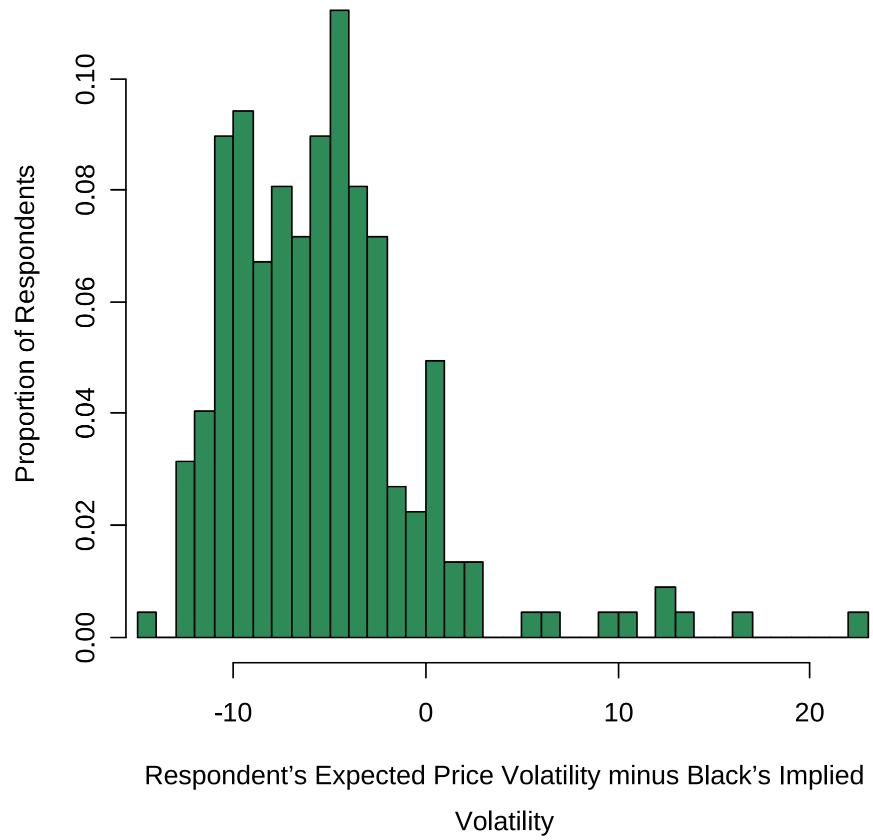


Figure 5.6 Distribution of Individual Implied Standard Deviation Minus Black Implied Volatility for the Distant Contract



5.3 Demographic Factor Impacts

Equations (4.13) and (4.14) were estimated to determine the effect of the demographic information gathered from each survey on the difference of price expectation and price risk expectation from the market. Furthermore, F-tests were used to determine if categorical variables for the occupation, location, futures use and conference attended were significant as a group in each model. Table 5.7 reports the results of the models whose dependent variable is the absolute value of the difference of participants' implied expected price from the market expected price represented by the futures settlement price for each survey date. The results of the demographic data's influence on volatility error is reported in table 5.8.

5.3.1 Demographic Factors' Impact on Price Difference

Equation (4.13) was estimated with the absolute difference of each individual's implied mean price from the futures settlement price on the left hand side. The demographic factors discussed in chapter three are included as explanatory variables on the right hand side of equation (4.13). The model was estimated for the near and distant price forecast error. The results of equation (4.13) for the two contracts are listed in table 5.7.

The majority of these factors have no significant impact on the difference in respondent expected price and market expected price. Age is positive and significant for the nearby contract model at the 10 percent level implying that as a producer gets older their ability to correctly forecast price decreases by $0.03 per year. Higher levels of education tend to increase price expectation error. As an individual obtains more education the error in their price expectation increases by $0.62.

Few occupations had a significant influence on price error. For the nearby forecast backgrounders and agribusiness tended to reduce price error by $2.25 and $2.11, respectively. However none were significantly different from zero for the distant contract. As crop acreage increases price error is reduced by $0.37 for the nearby contract. For the distant price expectation, error is reduced as cow herd size increases and the number of calves backgrounded increases by $0.16 and $0.08, respectively.

Table 5.7 Regression Results of Demographic Factors' Impact on Producer Price Expectation Error[1]

	Near Contract Price Difference Model		Distant Contract Price Difference Model
Intercept	$0.25		$2.87
	(0.13)		(1.05)
Age	$0.03	*	$0.00
	(1.73)		(0.02)
Gender	-$0.43		-$0.07
(1=male, 0=female)	(0.46)		(0.06)
Education	$0.62	**	$0.37
	(1.97)		(0.70)
<u>Occupation</u>			
Cow/Calf	-$0.72		-$0.04
	(0.56)		(0.02)
Backgrounder	-$2.25	*	-$0.95
	(1.94)		(0.50)
Feedlot	-$2.08		-$1.22
	(1.61)		(0.54)
Agribusiness	-$2.11	*	-$0.63
	(1.90)		(0.34)
Academia	-$1.35		$0.86
	(1.13)		(0.41)
F-statistic	1.49		0.64
<u>Regional Location</u>			
Midwest	$1.03		$0.27
	(1.13)		(0.19)
Southern Plains	$4.30		$3.94
	(2.69)		(1.53)
F-statistic	0.74		0.03

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively

[1] t-statistics are in parentheses

Table 5.7 Regression Results of Demographic Factors' Impact on Producer Price Expectation Error[1] (Continued)

	Near Contract Price Difference Model		Distant Contract Price Difference Model	
Operation size				
Annual Cow Inventory (1,000 hd)	-\$0.05		-\$0.16	**
	(0.91)		(2.53)	
Feeder Sold Per Year (1,000 hd)	\$0.02		-\$0.08	**
	(0.85)		(2.40)	
Fed Cattle Sold Per Year (1,000 hd)	\$0.00		\$0.00	
	(0.09)		(0.84)	
Crop Acres Planted Per Year (1,000 ac)	-\$0.37	*	\$0.21	
	(1.76)		(0.49)	
Prior Futures Use				
Use Futures Some	-\$0.03		-\$1.01	
	(0.05)		(1.63)	
Use Futures Often	\$1.56		-\$1.14	
	(1.40)		(1.10)	
F-statistic	1.2039		1.6257	
Conference Attended				
Stocker Conference	\$3.34	**	\$2.59	
	(2.38)		(1.07)	
Lenders Conference	\$4.30	***	\$3.94	
	(2.69)		(1.53)	
NCBA	\$2.95	***	\$2.82	*
	(2.85)		(1.96)	
Biofuel Conference	\$2.77	**	\$3.60	
	(2.02)		(1.49)	
F-statistic	2.64	**	1.55	
Adjusted R^2	0.0101		(0.0131)	

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively
[1] t-statistics are in parentheses

From table 5.7, prior use of futures contracts did not significantly reduce price expectation error for either nearby or distant time horizons. Variables included accounting for the conference that each respondent attended did impact the price error model for the nearby contract. The base group in equation (4.13) was the Iowa Cattlemen, and all other groups had larger price error as compared to this base group. Stocker conference participants had a price expectation error of $3.34 higher than the Iowa Cattlemen. Lender and NCBA conference participants had increased price forecast error of $4.30 and $2.95, respectively. The Biofuel conference attendees had a larger error of $2.77 compared to the Iowa group.

5.3.2 Demographic Factors' Impact on Price Volatility Difference

Equation (4.14) was estimated with the absolute difference of each individual's implied mean price from the futures settlement price on the left hand side. The demographic factors discussed in chapter three are included as explanatory variables on the right hand side of equation (4.14). The model was estimated for the near and distant price volatility error. The results of equation (4.14) for the two contracts are listed in tables 5.8.

From table 5.8, it is shown that males have a larger error as compared to females. Males missed the price risk in the market by 1.7 and 1.2 percentage points, respectively, as compared to females. Age and education level did significantly impact the level of price risk error. An individual's occupation did not reduce or increase price risk expectation error as compared to the base. None of the variables were significantly different from those classified as 'other' occupations. Midwest producers reduced price risk error by 1.6 percentage points in the nearby time frame, but no other regional impact is seen.

Operation size does impact the level of price volatility error. Producers with larger cow herds reduced price risk error by 0.22 percentage points for near term forecast and by 0.14 percentage points for more distant months. Larger backgrounders reduced price risk error by

0.12 and 0.09 percentage points for the nearby and distant months, respectively. Increased crop acres also reduce price volatility error. Increasing the number of acres planted by 1,000 acres reduced price risk error by 0.87 and 0.55 percentage points for the near and distant moths, respectively. Larger feedlot operators increased the level of price risk error. These individuals reported increased price risk error of 0.015 and 0.009 percentage points (per 1,000 head sold each year) for the nearby and distant contract, respectively.

Using futures often did reduce price volatility expectation error by 1.53 percenatge points for the distant month. No other futures contract use experience, however, had any significant impact on price risk expectation error.

The conference that individuals attended had significant impact for the nearby price risk error. All individuals that attended the Stocker, Lender, NCBA and Biofuel conference had larger price expectation error as compared to the Iowa Cattlemen, but in regard to price risk expectation these participants reduced the level of error. Stocker and Lender conference attendees reduced the amount of price risk error by 10.33 and 8.55 percentage points, respectively, for the nearby contract. NCBA and Biofuel conference participants reduced the amount of error for the nearby time horizon by 8.65 and 10.12 percentage points respectively.

Table 5. 8 Regression Results of Demographic Factors' Impact on Producer Price Volatility Error[1]

	Near Contract Varability Difference Model		Distant Contract Varability Difference Model	
Intercept	14.8840	***	7.8771	***
	(4.17)		(3.25)	
Age	0.0158		-0.0081	
	(0.64)		(0.47)	
Gender	1.6777	*	1.1729	*
(1=male, 0=female)	(1.89)		(1.68)	
Education	-0.5422		-0.1737	
	(0.74)		(0.40)	
<u>Occupation</u>				
Cow/Calf	-0.4910		0.0772	
	(0.34)		(0.09)	
Backgrounder	1.5973		0.9915	
	(0.94)		(1.25)	
Feedlot	-0.4644		-0.2799	
	(0.30)		(0.28)	
Agribusiness	-0.1115		0.4676	
	(0.09)		(0.61)	
Academia	-1.2144		-0.4730	
	(0.99)		(0.57)	
F-statistic	0.88		0.78	
<u>Regional Location</u>				
Midwest	-1.6611	*	-0.9054	
	(1.68)		(0.99)	
Southern Plains	-8.5524		-1.4161	
	(2.81)		(0.67)	
F-statistic	3.65		0.69	

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively

[1] t-statistics are in parentheses

Table 5.8 Regression Results of Demographic Factors' Impact on Producer Price Volatility Error[1] (Continued)

	Near Contract Varability Difference Model		Distant Contract Varability Difference Model	
Operation size				
Annual Cow Inventory (1,000 hd)	-0.2191	**	-0.1365	***
	(2.54)		(2.64)	
Feeder Sold Per Year (1,000 hd)	-0.1175	***	-0.0917	***
	(4.01)		(4.71)	
Fed Cattle Sold Per Year (1,000 hd)	0.0151	*	0.0091	**
	(1.68)		(2.38)	
Crop Acres Planted Per Year (1,000 ac)	-0.8684	**	-0.5508	*
	(2.35)		(1.74)	
Prior Futures Use				
Use Futures Some	-1.5785		-0.8721	
	(1.44)		(1.36)	
Use Futures Often	-1.8765		-1.5323	**
	(1.60)		(2.09)	
F-statistic	1.4476		2.3328	*
Conference Attended				
Stocker Conference	-10.3270	***	-2.2135	
	(4.03)		(1.19)	
Lenders Conference	-8.5524	***	-1.4161	
	(2.81)		(0.67)	
NCBA	-8.6453	***	-1.1794	
	(4.18)		(0.77)	
Biofuel Conference	-10.1150	***	0.6807	
	(4.26)		(0.39)	
F-statistic	5.01	***	5.44	***
Adjusted R^2	0.0450		0.0585	

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively
[1] t-statistics are in parentheses

5.4 Chapter Summary

This chapter has reported the results of all equations and models outlined in the previous chapter. First, data were aggregated and analyzed at a group level. Aggregated group price expectations were numerically lower than the futures settlement price for each survey date; however all but two were not statistically different from the market's expectation. Aggregated group volatility on the other hand was different for the majority of the groups. Typically nearby contract price risk expectation was underestimated and distant contract price risk expectation was overestimated.

Individual respondent's discreet stated price and price distribution information was fitted to a continuous distribution and an implied mean and standard deviation were determined. These were compared to market price and price risk measures. Respondent's expectation of price tended be lower than the market's expectation; and this was further evidenced in the distribution of the individual differences. These showed both forecasts to be below that of the market. The averages of the individual volatilities resulting from each fitted distribution were significantly different from the market for the distant contract. Each of these price risk expectations were lower than the measure given by Black's model.

Conflicting results arose between the aggregate and individual analysis for price volatility expectations. This is likely due to the way in which the aggregate variance is calculated. The aggregate variance takes into account both the average group expected price and the variance calculated from the expected price of the individuals in each group whereas the individual analysis examines each individuals' expected price and expected price distribution separately. Therefore, the aggregate volatility is likely biased upward by price expectations that are well above or below the median (i.e., outliers) of the group. This method gives a group variance estimate that does not adjust for expected price level differences across individuals. For example, if a group of ten individuals reports prices that are wildly different they will have a large group variance even though, from an individual standpoint, they might not believe this to be the case. Separating expected price from expected price variability on an individual level is a contribution of equation (4.10).

Demographic data were used to show the impact of this information on overall error of price forecast and price risk expectations. Results of the different demographic data varied. Representatives of breed or state cattle organizations had the lowest price forecasting error and cow calf producers had the largest error (excluding the base). Breed and state representatives had the lowest price risk error for the nearby contract. Livestock marketers had the largest level of price risk error for the distant time horizon. Respondents from the Southeast reported the largest price risk expectation error for both contracts. The size of backgrounding operations tended to lower price volatility error for both forecast whereas the number of fed cattle sold each year increased the risk expectation error in the distant month. Lastly, prior use of risk management tools for the most part did not have an impact on error in either price or price volatility expectation.

CHAPTER 6 - Conclusions and Implications

6.1 General Conclusions

A number of studies have reported that collectively groups of individuals can correctly predict events. This study supports these findings, under aggregate analysis, as each group's price expectation did not differ significantly from the market expected price as given by the futures settlement price (respondents' expectation of prices tended to be lower, though not significantly, than the market). When examined individually, producers tended to underestimate price for distant months, though. Their ability to correctly gauge price risk was not shown to be true either. For nearby months, respondents generally overestimated the level of risk when compared to the Black model's measure of market risk. On the other hand, for more distant forecast horizons, respondents tended to underestimate the level of risk in the market.

6.1.1 Aggregate Conclusions

For the most part price expectations of the survey respondents did not differ significantly from the market. This is not surprising given the increases in communication technology that allows individuals to stay astute of the market on a daily, and some instances hourly, basis. The majority of the participants underestimated the market volatility of the nearby contract and overestimated risk for the distant term. These results should be approached with caution though given that they conflict with the results found in the individual analysis. In determining which method (aggregate or individual analysis) is likely to be correct we refer back to equation (4.6) where it is seen that the aggregate measure of price volatility stems from participants' expectation on price. The variance calculated using equation (4.6) is a function of both the average group price and the variance of those prices. Therefore, the results from the aggregated analysis are most likely biased by a large group variation in expected prices.

6.1.2 Individual Conclusions

When analyzed individually respondents still tended to correctly estimate price for short forecast, however underestimated price for longer time horizons. For the nearby contracts producers typically overestimated the level of risk inherent in the market. This is possibly linked to the current nature of the forecast (the average forecast was 37 days). For example, producers might be actively involved in the current market and have assets and cost already tied up and therefore their perceived current risk are much greater than risk they have not faced yet (in the distant months). The price risk expectation of distant forecast (approximately 119 days) was generally lower than the market implied. This might explain the reason that few producers utilize risk management products. Since the nearby contract is a relatively short time period, it is usually too late to utilizing the risk reducing function of futures despite the correct perceptions of risk by producers. However, if producers underestimate level of risk that the market is predicting, as they do for distant forecasts, then they might feel that the cost of minimizing their risk exposure is too high and thus not seek these tools to reduce their risk.

6.2 Demographic Conclusions

Regression equations were estimated to quantify the impact of factors on price expectation and price risk error. Results varied across the four models and were discussed at length in the previous chapter. Drawing firm conclusions on how different demographic factors impact price forecast and price risk expectation error is difficult. Given the low R-squared resulting from each model, it appears that this type of information is not a good indicator of an individual's ability to correctly predict price or price risk.

6.2 Final Comments

This research has assessed the ability of producers to gauge cattle market price risk. By way of a survey producers stated their price and price risk expectations. Overall producers overestimated the level of risk apparent in the current market while underestimating the risk of more distant horizons. These results might explain the risk management strategies of cattle producers. Survey participants understood, and in some instances overestimated, near term price risk. Producers at this stage have cattle on feed and are likely astute to the daily market events. This would explain their understanding of the risk at this stage. Furthermore, given that the feeding process can range from 120 to 180 days, the relatively short time span for this forecast (about 37 days) is likely to late for producers to mitigate their risk. However, producers underestimate the level of risk for the distant forecast at a time when they should be attempting to offset this risk (about 119 days). Since they underestimate the risk it might be that these individuals consider risk management tools to be too expensive. For example, if the market considers the level of risk to higher than a producer thinks it is, the price associated with hedging is high given that the risk level is low in the producer's mind.

This study has contributed to the literature in that no previous research estimating distributions for producer's perception of cattle price risk exists. More importantly, it has analyzed, from individual perspective, the amount error present in cattle producer's expectations of price risk as compared to the market's expectation. Furthermore, this research has utilized producer specific demographic data to estimate the degree to which factors such as age, education, occupation, location, operation size and risk management usage history impact the level of error in price risk.

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Appendix A - Survey Example

Cattle Price Expectation Survey

Please take a few moments to complete this survey. Your cooperation is greatly appreciated.

1. Age ________ **2. Gender:** M F **3. State Operation Located In:** ______________________

4. Education: (circle one)

- Some High School
- High School Graduate
- Some College
- College Graduate or higher

5. Which best describes your primary occupation: (circle one)

Cow/Calf	Veterinarian	Banking/Lending
Backgrounder	Consultant	Agribusiness
Feedlot	Livestock Marketing	Real Estate
Row Crop	Academia/Extension	Student
Association Representative		

6. Please describe your operation: (if applicable)

Brood cows maintained	________________ hd/yr	Fed Cattle Sold	________________ hd/yr
Feeder Cattle Sold	________________ hd/yr	Row Crops	________________ acres/yr

7. Do you use futures markets: Never Sometimes Often

Please give your best guess of the price you expect on the stated dates for the two live cattle contracts listed below and then list the chances that the price will be within the given ranges. Your probabilities should add to 100%.

Example:
Weather forecasters often use probabilities. For example, tomorrow's expected high might be 40 degrees. But there is a chance the temperature will actually be higher or lower. Maybe there is 40% chance the high will be between 35 and 45, a 15% chance it will be between 45 and 55 and a 5% chance it will be between 25 and 35. Probabilities exist for all temperatures and together these should sum to 100%.