

Management of Cattle Price Risk Using Various Hedging Strategies

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Cattle producers are subject to significant risk due to live cattle price volatility. The purpose of this study is to examine how different hedging strategies have managed this risk over the past twenty-two years (1987 through 2008) and what returns they have yielded. The study compares the results of the cash market, futures hedges, and multiple combinations of options hedging strategies. Following an abstract of the research and a brief description of the procedures and data, is a discussion of the results.

Abstract

There are many different marketing strategies that can be practiced, such as marketing in the cash market or establishing a futures hedge, a simple put options hedge, or an options hedge by taking multiple positions in the options market. In the study, there was not one strategy that provided both the highest returns and the least amount of risk. On average, over all observations, the cash market yielded the highest return over the estimated breakeven price at \$1.37/cwt. It also exhibited the most variability with a standard deviation of \$7.00/cwt, indicating that 68 percent of the time, the return on the cash market was between \$7.00/cwt below and \$7.00/cwt above the \$1.37/cwt return. Comparatively, the futures hedge returned -\$0.18/cwt and had a standard deviation of \$4.23/cwt. The second out-of-the-money put returned \$0.57/cwt, with a standard deviation of \$6.43/cwt. Hedging by buying the second in-the-money put and selling the second out-of-the-money put returned \$1.11/cwt, having a standard deviation of \$5.48/cwt.

When selecting a hedging strategy, several factors need to be considered. First of all, it is important to evaluate the risk and return of a strategy and choose the one that fits your goals. Next, one should evaluate how the strategy compares to using the cash market. For instance, the futures hedge, the first out-of-the-money put hedge, and two of the condor hedges performed better than the cash market 38.6, 17.8, and 54.9 percent of the sale months studied, respectively. Finally, certain strategies historically performed better during certain times of the year. It was determined in the study, selling the cattle between January and May, most strategies were likely to earn a positive return. However, from June to October, most strategies were likely to yield a negative return, reflected by earning a positive return less than half of the years. In this season, a certain condor hedging strategy or the cash market historically provided the best opportunity of earning a positive return. By recognizing this seasonality, you may be able to more effectively hedge your cattle at the placement date to increase the likelihood of quality returns. Live cattle prices are extremely volatile, but through assessing such factors in the market, cattle producers can potentially market the cattle more successfully.

Methods

To conduct the analysis, several procedures and assumptions were used. Different combinations of futures and options hedging strategies are implemented when the cattle enter the feedlot as feeder cattle, and the hedging positions are maintained until the cattle are sold as fed cattle, at which time the hedging decisions are lifted or allowed to expire. In calculating the strategies' returns, the

breakeven cost of production used is from Iowa State University Extension's Estimated Livestock Returns for Finishing No.1 Yearling Steers. From 1987 to 2006, feeder cattle are placed six months prior to the sale date. For 2007 and 2008, feeder cattle are placed five months before the sale date. This change in the feeding period reflects the change in Iowa State University Extension's assumptions on improved feedlot performance. The estimated basis is the previous three-year average of the basis for interior Iowa-southern Minnesota fed cattle for the first half of the sale month. The cash price is the listed price on the first day of the sale month for the interior Iowa-southern Minnesota market as provided by USDA Agriculture Market News. Futures and option prices are the published Chicago Mercantile Exchange closing prices for the first day of each of the placement and sale months for the sale date contract month. The sale date contract month is the nearby month of the sale date.

Options strategies were considered for five strike prices. The at-the-money strike prices are the strike prices nearest to the closing futures price for the sale month. The next two strike prices higher and lower than the at-the-money are also used for potential hedging strategies. Premium prices are the daily closing traded values for each strike price. If premiums were not traded on that day for a strike price, premiums were estimated one of two ways. If there was no time to maturity, meaning that the sale month and the futures contract month were the same, the premium was calculated by finding the difference between the strike price and the futures price. For example, if the sale date futures price was below the strike price, the call premium was zero and the put premium was the difference between the strike and futures prices. If there was still time to maturity, such that the placement or sale month was not the same as the futures contract month, the premium was calculated by using implied volatility in the Black and Scholes Model. Based on the futures price, the calculated implied volatility of the similar at-the-money premium, an assumed risk-free rate of 2 percent, and the strike price, the premium was estimated. If the at-the-money strike price premiums were not being traded, the implied volatility was determined using the nearest strike price in which the premiums were traded.

Over the twenty-two years and 264 individual monthly observations studied, different types of marketing strategies were examined. The first marketing approach considered was to remain in the cash market from placement until the sale date when the fed cattle were sold on the cash market. A futures hedge was also examined. The hedge was established when the cattle were placed on feed as feeder cattle by selling a futures contract at the closing futures price on the placement day. Then, the hedge was lifted at the sale date by buying a live cattle futures contract, and then selling the cattle on the cash market.

Four different futures options hedging strategies were also studied. First, the simplest was to buy a put option for the premium traded on the placement date. At the time of sale, the option was sold if it had value, or it was allowed to expire if its value was zero and the cattle were sold on the cash market. The resulting price is the cash price plus the gain or loss in the put value, less commissions. Five put hedges were examined:

- buy the at-the-money put
- buy the first in-the-money put
- buy the second in-the-money put
- buy the first out-of-the-money put
- buy the second out-of-the-money put

An options fence strategy was considered as well. It was implemented by buying a put and selling a call option at a strike price above that of the put's strike price. By selling the call, the call premium was collected. This sale raised the price floor set by the put option. However, by selling the call, when the sale date futures price was above the call's strike price, a price ceiling was established on the hedge, limiting higher prices. This would have resulted because selling the call would require selling a futures contract at the strike price and paying the difference between the futures and strike prices. Between the two strike prices, the strategy follows the cash price less the put premium, plus the call premium.

The next hedging strategy studied was the put spread. First, a put option was bought and then another put was sold at a strike price below that of the put that was bought. Selling the lower strike price put collects its premium, such that the net premium paid for the put that was bought, was reduced. This raised the price floor, and it also established the overall price nearer to cash, if the sale date futures price was above the strike price of the put that was bought. However, the strategy did not completely hedge against lower prices. If the sale date's futures price was below the strike price of the put that was sold, the difference between the futures and strike prices was paid. This would remove the price floor and the hedger would be subject to the risk of lower prices, yet the net price would typically be above the cash price.

The condor strategy was the final strategy studied. Overall, three positions were taken in the futures market. First, a futures contract was sold at the placement date's futures price to establish a base hedge price. Then, an out-of-the-money put and call were sold. Taking these positions resulted in collecting two premiums. Therefore, it increased the base price set by the futures hedge. However, if the futures price was either higher or lower than the call or put strike prices respectively, the net price decreased. Price volatility was only hedged between the two strike prices.

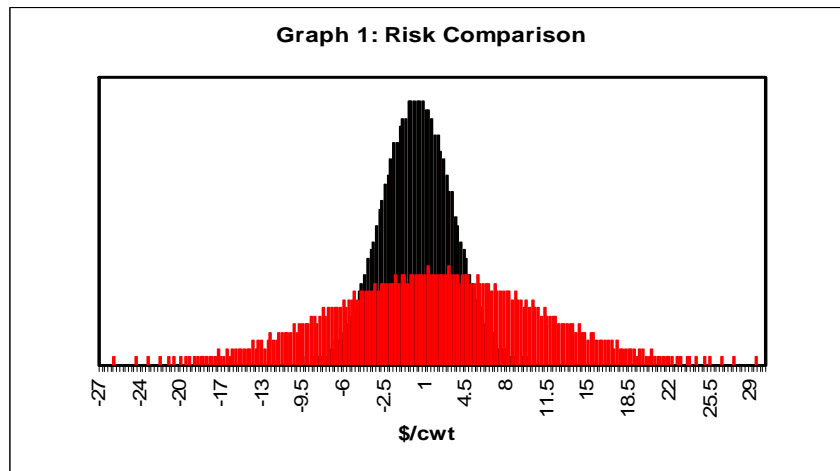
These cash, futures hedge, put hedge, options fence, put spread, and condor methods were considered in marketing the cattle. See Appendix A for the details on the specific strategies studied for the methods. See Appendix B for graphical representations on how the strategies react to different futures prices.

Results

Hedging is still subject to basis risk, or the risk that the basis will not be at the same level as was expected when the hedge was established on the placement date. While the hedging strategies do not hedge against all risk, they do hedge against the most volatile price risk. In the 264 observations, on average, the actual basis was greater than the estimated basis by \$0.11/cwt. The standard deviation of the difference between the actual and the estimated basis was \$3.09/cwt. Therefore, 95 percent of the time, or two standard deviations (\$6.18/cwt), the real basis will fall within \$6.07/cwt below and \$6.19/cwt above the basis estimated at the placement date. This risk was significantly lower than that of the cash market. At the cattle placement date, the futures price for the contact month of the expected sale date was noted. This price indicated the estimated futures price for the sale date. On average, the actual futures price was above the estimated futures price by \$1.40/cwt, and after adding in the basis risk, the actual cash price was above the estimated cash price by \$1.51/cwt on average. The difference between the actual and the estimated cash prices had a standard deviation of \$8.93/cwt, which is the standard deviation of the basis volatility

plus the standard deviation of the futures price volatility. As a result, 95 percent of the time, or within two standard deviations (\$17.86/cwt), the actual cash price is between \$16.35/cwt below and \$19.37/cwt above the estimated cash price. Hedging consequently reduces the overall risk of marketing significantly. However, several of the options hedging strategies do contain some price risk at extreme sale date futures prices.

Graph 1 shows the probability distribution of the estimated basis and the estimated cash price at placement compared to the actual values at sale. This indicates the amount of observations that are within a price range of the actual basis or the actual cash price, respectively. The black distribution in the middle is a representation of the difference between the actual and estimated basis. Compared to the red, more spread out distribution, which is the representation of cash market risk, the basis difference falls in a narrower range. Consequently, the basis is estimated with much more certainty than the cash market, and hedging thus reduces risk.



The red represent the cash market risk while the black represents the basis risk.

Table 2 summarizes the results of the twenty-two year simulation for cash, futures, and the two most profitable of the option strategies. The abbreviations are defined in Appendix A. The strategies are compared on the average and variation of returns, premium cost, and distribution of returns. The distribution of returns are analyzed at three levels, including the percent of time returning \$2/cwt below the breakeven price or higher, the percent of the time earning a positive return, and the percent of the time returning more that \$2/cwt above the breakeven price. Net returns are defined as the profit (or loss) over the breakeven price, less all futures and options transaction costs.

The average net premium, as shown in Table 2, calculates the initial cost of the hedging strategies, except for the broker commissions, by considering the premiums paid and/or collected. For example, the condor strategies collected two premiums, such that the average net premiums were significantly positive, indicating collecting the premiums and no initial cost. Examining the 2OTMP/1OTMC strategy, while the put premium was paid by taking that position, on average, the call premium that was collected from selling the first out-of-the-money call was above the premium paid for the put. Therefore, a net premium of \$0.42/cwt was collected, instead of paid, for taking those options positions. The remaining strategies had an initial cost, as their average net premiums were negative.

Table 2 also examines how these most profitable strategies performed over the breakeven price, also called the net profit or return. From the 264 observations, on average, selling in the cash market at the sale date yielded the highest average return, at \$1.37/cwt. The cash market also presented a positive return over the breakeven price most frequently, at nearly 60 percent of the time (months). However, the cash market was the most volatile. It had 68 percent of the observations falling \$7.00/cwt above or below the average return, as noted by its standard deviation. In comparison, the most risky of the hedging strategies was the ATMP/1OTMP bear put spread. Its standard deviation was \$6.55/cwt. The lower standard deviations of the hedging strategies showed that the strategies were effective in price risk reduction.

With the lowered risk, hedging also reduced the average return. After cash, the three most profitable strategies were the 2ITMP/2OTMP, ATMP/1OTMC, and 2OTM strategies. All returned less than \$1.11/cwt above the breakeven price. These three strategies also had the relatively higher maximum returns and the relatively higher frequency of returns at the three levels. Futures, on average, was the least profitable as it returned \$0.18/cwt below the breakeven price, but it had the least risk, with a standard deviation of \$4.23/cwt.

Table 2. Summary of the Average Net Premium and Returns, 1987-2008

Strategy	Average Net Premium (\$/cwt)	Net Profit by Strategy (\$/cwt):				% Greater Than Breakeven -\$2 ₁	% Breakeven or more	% Greater Than Breakeven \$2 ₂
		Average	Standard Deviation	Minimum	Maximum			
Cash	NA	1.37	7.00	-17.88	36.65	68.9	59.8	46.6
Futures	NA	-0.18	4.23	-12.16	16.85	70.1	47.0	28.8
Puts:								
2OTM	-1.36	0.57	6.43	-19.12	35.37	65.9	51.9	39.8
1OTM	-1.95	0.41	6.16	-16.04	35.02	64.0	51.1	38.6
Fence:								
2OTMP/2OTMC	-0.23	0.22	4.90	-16.00	19.47	67.0	53.4	37.5
2OTMP/1OTMC	0.42	0.09	4.60	-15.25	18.30	67.0	53.4	32.2
Spread:								
2ITMP/2OTMP	-3.72	1.11	5.48	-13.57	33.93	74.6	58.7	40.5
ATMP/1OTMP	-0.78	0.92	6.55	-18.25	35.83	69.3	55.3	41.7
Condor:								
Fut/2OTMP/1OTMC	5.09	0.44	4.78	-16.78	14.86	72.0	56.1	40.5
Fut/1OTMP/2OTMC	7.03	0.13	4.61	-15.95	13.81	68.2	53.8	36.4

₁ % of the time that the strategy returned a net price of \$2/cwt below the breakeven price or higher

₂ % of the time that the strategy returned more than \$2/cwt over the breakeven price

Table 3 evaluates the comparison of the different hedging strategies to selling on the cash market at the sale date. As discovered from Table 2, over all of the observations from the twenty-two years, cash provided the highest average return over breakeven, but it also had the most risk. Due to this price risk, hedging becomes an important part of marketing the cattle. Several hedging strategies did as well or better than cash due to the hedge reducing price risk in individual months. Of the most profitable strategies studied in Table 2, Table 3 identifies that the ATMP/1OTMP bear put spread was \$0.44/cwt below the cash market on average. Also, the strategy had a net price at

\$2/cwt below the cash market or higher 100% of the time, but it only beat the cash market 28.8 percent of the time. Also, it was never more than \$2/cwt over the cash market. The condor strategies provided the highest frequency of beating the cash market, with each having done better than cash 54.9 percent of the time. Additionally, these strategies were more than \$2/cwt above the cash market most often, at 46.6 percent and 41.3 percent of the time. However, even though the condor methods were better than cash with the highest frequency, contrasted to the other strategies, they also had the highest deviation from cash, noted by their \$7.77/cwt and \$6.83/cwt standard deviations and significantly large negative returns. In determining how to hedge the live cattle price risk, both returns over breakeven and how the strategy performs compared to cash are important considerations.

See Appendix C for the analysis of all potential hedging combinations studied over all observations. The table looks at the averages, standard deviations, and ranges for the net prices received from each strategy, the return over the breakeven selling price, and the comparison of each method to the cash market.

Table 3. Comparison of Hedging Strategies to the Cash Market, 1987-2008

Strategy	Difference From the Cash Market (\$/cwt):				% Greater Than Cash -\$2 ₁	% Better Than Cash	% Greater Than Cash \$2 ₂
	Average	Standard Deviation	Minimum	Maximum			
Cash	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Futures	-1.55	5.84	-27.23	27.83	53.0	38.6	23.5
Puts:							
2OTM	-0.80	2.04	-4.25	20.15	84.5	12.9	6.8
1OTM	-0.96	2.53	-4.90	21.25	70.1	17.8	9.8
Fence:							
2OTMP/2OTMC	-1.15	3.66	-22.67	23.85	75.8	20.5	8.7
2OTMP/1OTMC	-1.28	4.15	-23.02	24.68	67.8	36.4	10.2
Spread:							
2ITMP/2OTMP	-0.25	2.79	-4.22	5.52	62.9	43.6	25.8
ATMP/1OTMP	-0.44	0.78	-1.87	1.20	100.0	28.8	0.0
Condor:							
Fut/2OTMP/1OTMC	-0.93	7.77	-47.15	14.15	64.0	54.9	46.6
Fut/1OTMP/2OTMC	-1.23	6.83	-47.05	11.62	65.5	54.9	41.3

₁ % of the time that the strategy returned a net price of \$2/cwt below the cash price or higher

₂ % of the time that the strategy returned more than \$2/cwt over the cash market

Returns over the breakeven selling price tend to display some seasonality. This is reflected in Appendix D, which looks at the twenty-two observations for each sale month in the study. It reports the average return, in bold, and the percentage of time there was a positive return over the breakeven selling price. For instance, during the month of May, the futures averaged a return of \$2.67/cwt and yielded a positive return 72.7 percent of the time. For eight of the twelve months, the cash market had the highest average return, as denoted by the black shaded cells. For the other four months, May through July and November, the highest average return was held by one of the other strategies, typically by the 2ITMP/2OTMP bear put spread. Even though cash usually had the highest average return, it did not always have a positive return with the highest frequency of time. At least a couple strategies of each of the put, fence, spread, and condor methods, along with the

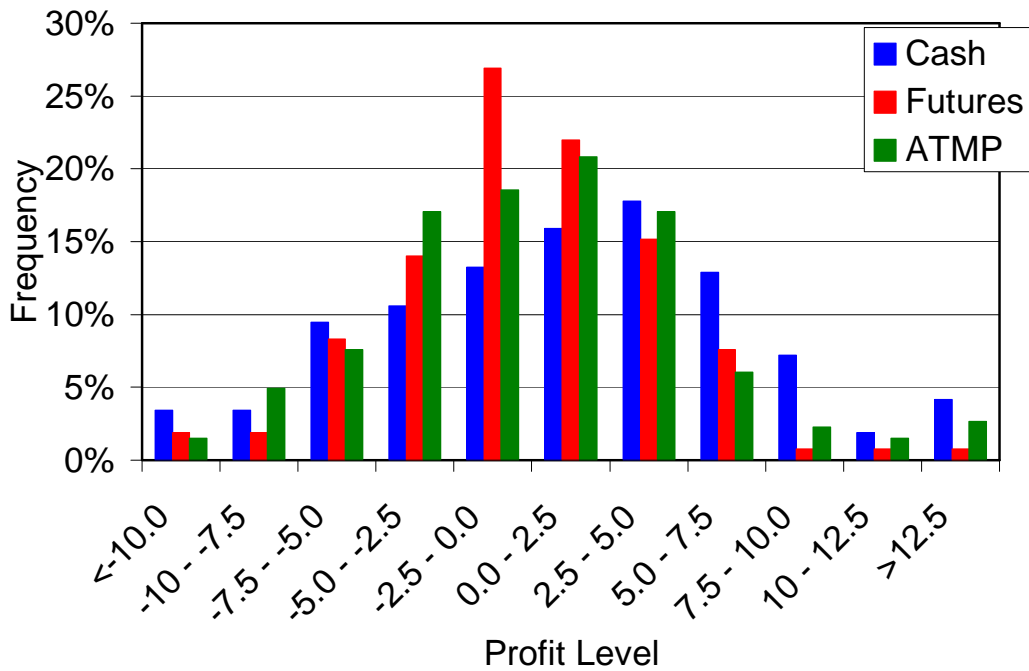
futures and cash methods, had one month of earning the highest percentage of positive returns. These are identified by the gray shaded cells.

Several trends can be noted from Appendix D. First of all, from January through June, nearly every strategy had a positive average return and contributed to a positive return more than half of the time (a frequency greater than fifty percent). January through March, the bear put spread strategies and the cash market provided the highest percentages of positive returns. In April and May, most of the marketing approaches had relatively high frequencies of positive returns. However, June initiated a downward tendency in the frequency of positive returns and lower average returns. The trend lasted through October. During this period, the condor method, especially the Fut/2OTMP/1OTMC strategy, and the cash market provided the highest percentage of positive returns. All except for a couple strategies earned less than the breakeven price more than half of the time. In September and October, every strategy, on average, returned less than the breakeven selling price. During the last two months of the year, the live cattle market began to recover. The appendix indicates that certain marketing tools may have advantages at different times of the year.

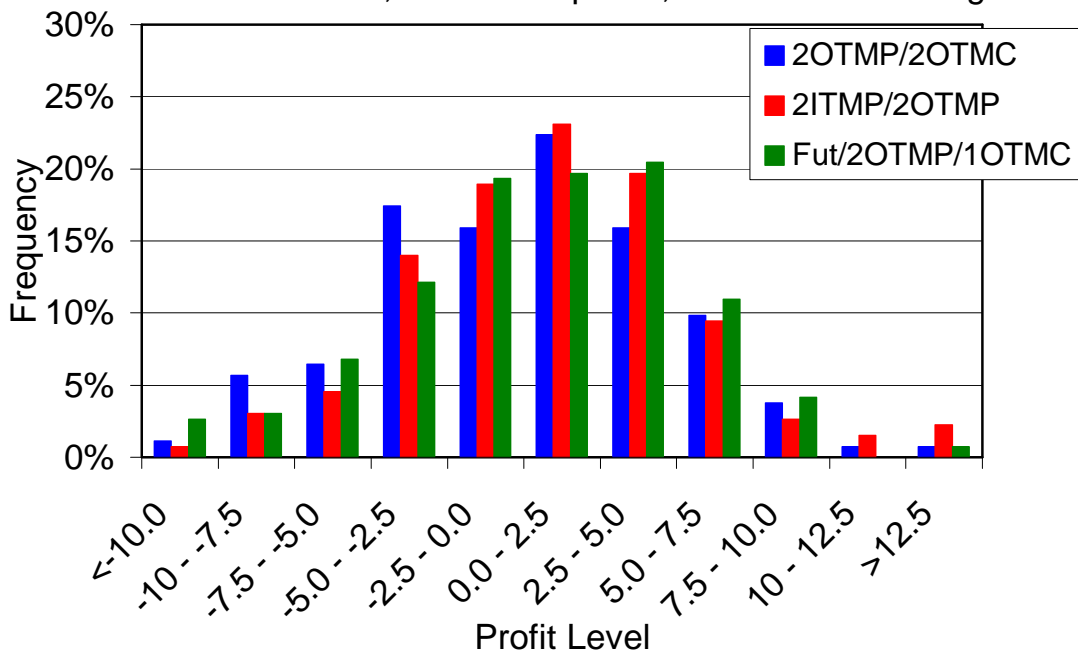
Graph 2 indicates the frequency distribution of different profit levels over the breakeven selling price for the cash, futures hedge, and at-the-money put hedge marketing approaches for the two hundred sixty-four observations. The frequency distribution is a representation of how often one of the strategies earns a return within a specified level. For example, according to the graph, the futures hedge returned between \$2.50 and \$5.00/cwt for just more than 15 percent of the observations. Overall, the cash market displayed the most variation in returns. Forty-four percent of the time, the cash market returned more than \$2.50/cwt, returned less than the -\$2.50/cwt profit level 27 percent of the time, and was in the -\$2.50 to \$2.50/cwt profit range 29 percent of the time. Compared to the cash market, the hedging strategies reduced the variation in returns. For instance, the futures hedge reduced the range as it returned between -\$2.50 and \$2.50/cwt 49 percent of the time. The ATMP strategy also had a similar result. The graph shows how cash had the greatest risk, which was also demonstrated with it having the highest standard deviation in its returns.

Graph 3 represents the frequency distribution for the most profitable of the options fence, bear put spread, and condor methods of hedging. These hedging strategies also narrowed the range of profit levels compared to the cash market. The 2OTMP/2OTMC options fence was within the -\$2.50 to \$2.50/cwt profit level 38.3 percent of the time, and the 2ITMP/2OTMP bear put spread was within the same range 42 percent of the time. The condor strategy earned such a return 39 percent of the time. Therefore, the extreme high and low profits were taken less frequently than in the cash market.

Graph 2: Frequency of Profit Levels Using Cash, Futures Hedge, and ATM Put Hedge Strategies



Graph 3: Frequency of Profit Levels Using the Most Profitable Fence, Bear Put Spread, and Condor Strategies



In conclusion, there are many different marketing strategies that can be practiced, including marketing in the cash market, establishing a futures hedge, and utilizing one of the many different options hedging strategies. As it has been noted, there is not one strategy that provides both the highest returns and the least amount of risk. Rather, hedging strategies have a lower return, but are much less risky as they are only subject to the basis risk. Comparatively, the cash market is extremely variable as it is subject to both the basis and futures price risk. When selecting a hedging strategy, several factors need to be considered. First of all, it is important to evaluate the risk and return of a strategy and choose the one that fits your goals. Next, one should evaluate how the strategy compares to using the cash market. Finally, certain strategies historically performed better during certain times of the year. By recognizing this seasonality, you may be able to more effectively hedge your cattle at the placement date to increase the likelihood of quality returns. Live cattle prices are extremely volatile, but through assessing such factors in the market, cattle producers can potentially market the cattle more successfully.