Payout Analysis of Livestock Risk Protection Insurance for Feeder Cattle

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ABSTRACT

Monte-Carlo simulation was used to examine net payouts, defined as indemnities received minus premiums paid, to producers purchasing Livestock Risk Protection (LRP) Insurance for Feeder Cattle. Actual policies were utilized that included various purchase dates, coverage levels, and premiums from fall 2007 to spring 2013. Net payouts were estimated for time periods typical of both summer grazing and winter backgrounding at various expected price risk levels. Results suggest that expected net payouts generally became positive when producers perceived a 10 percent chance of a $15 per cwt price decrease. Results also suggested expected net payouts were higher for insurance purchased in the fall than in the spring.

Introduction & Background

Stocker and backgrounding operations have faced serious risk management challenges due to extreme volatility in feeder cattle prices in recent years. Managing this risk is challenging due to the limited availability of risk management options, lack of understanding the risk management tools available (Hall et al., 2003), and scale issues that prevent smaller producers from utilizing potential risk management strategies. While crop insurance is highly developed, readily available, and heavily subsidized for major crops such as corn, soybeans, and wheat, livestock producers have limited risk management opportunities. For years, cash forward contracting and futures/options markets were the only tools available to beef cattle producers. However, cash forward contracting opportunities are limited in many areas and generally unavailable to smaller producers. Likewise, futures/options markets are not well suited for many small producers.

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Further, the use of futures/options as risk management tools have always presented challenges as producers are required to invest considerable time to gain understanding and make decisions with regards to pricing. As a consequence, many beef cattle farmers lack the knowledge and confidence to use futures and options strategies regularly (Hall et al., 2003). Moreover, since feeder cattle contracts are traded in 50,000 pound increments, their use for small producers becomes problematic. Beef cattle producers not marketing tractor trailer sized loads of feeder cattle were either forced to work with other small-scale producers to share futures positions, or be over-hedged by having more pounds of futures contact than they had pounds of cattle.

Livestock Risk Protection (LRP) insurance is a relatively new opportunity for beef cattle producers and offers some clear benefits, particularly for small producers. Purchasing LRP insurance has similar risk mitigation properties as purchasing a put option on the CME©. Producers purchase an insurance policy that pays an indemnity if the CME© feeder cattle index is below a coverage price that they choose on a specified ending date. Much like strike prices, higher coverage levels offer greater risk protection, but also require greater cash outlay for premium costs. When purchased, producers essentially self-insure the difference between the coverage price and the expected ending value. On the ending date of the policy, the producer receives an indemnity on a per-head basis equal to the coverage level minus the actual ending value times the numbers of pounds covered. Again, much like a put option, LRP insurance sets a price floor for feeder cattle subject to basis risk. Since the CME© Feeder Cattle Index is also used to cash settle CME© Feeder Cattle futures contracts, the basis risk between futures/options and LRP coverage is similar. However, basis differences exist in that LRP ending dates will only rarely coincide with feeder cattle futures settlement dates and LRP coverage is also offered in months where no CME© Feeder Cattle contract is traded.

While generally a solid risk management tool, producers should be aware that LRP insurance is less flexible that a put option on the CME© Feeder Cattle futures contract. The indemnity is calculated on the ending date, regardless of when the actual cattle are sold. Since ending dates are offered every four weeks, there will generally be some difference between the ending date and the actual sale date for the feeder cattle. If producers choose to sell cattle after the ending date of the policy, they do not have price protection past that ending date. If they choose to sell cattle before the ending date of the policy, they run the risk of the selling the cattle expecting an indemnity, but watching the market increase between the sale date and the ending date. Further, if cattle are sold more than 30 days prior to the ending date, the insurance policy is considered void after the producer reports this (USDA Risk Management Agency, 2010).

While LRP is not without challenges, it does offer advantages over purchasing put options. First, premium costs are subsidized at 13 percent and commission to the insurance agent is provided through the program. Second, there is no minimum quantity in which LRP can be purchased. So

smaller producers, or those who wish to purchase downside protection in less than 50,000 pound quantities, can utilize LRP insurance. For this reason, LRP insurance should be analyzed and considered as a price risk management strategy. However, a detailed examination of its potential payout to livestock producers does not appear in the literature and warrants further examination.

Literature Review

Numerous studies have suggested that the use of futures markets is an effective risk management tool for cattle producers (Trapp & Eilrich, 1991; Buhr, 1996; Brake, Anderson, and Coffey, 2006; Routt, 2006). When futures markets are used to manage price risk, market risk is replaced with basis risk. Generally, as long as basis is less variable than overall market prices, risk will be reduced through using futures markets. While LRP basis and futures basis are not the same, both have been found to be similarly affected by fundamental market factors. Much of the magnitude and variability of basis is impacted by adjustments made for cattle outside of the contract specifications, i.e., heifers or lighter cattle (Mark, 2005). LRP basis for fed cattle has actually been found to be smaller and less variable than futures basis (Coelho, Mark, and Azzam, 2008).

In the case of feeder cattle, LRP indemnities are based on changes in the CME© Feeder Cattle Index, which is used to cash settle CME© Feeder Cattle Futures contracts. However, LRP insurance and put options have been found to provide similar levels of risk protection in recent work (Feuz, 2009). This is logical since both provide a flexible level of downside price risk protection, while still offering feeder cattle producers the opportunity to capitalize on rising market prices. Since both offer comparable risk reduction, LRP would appear to be a very viable tool for small feeder cattle producers. While past work has examined the effectiveness of LRP insurance as a risk management tool (Feuz, 2009) and developed deeper understanding of basis differences between LRP insurance and CME© futures (Coelho, Mark, and Azzzam, 2008; Mark, 2005), little work has been done to actually evaluate payouts from the purchase of LRP insurance to manage downside price risk.

This work makes two significant contributions to the LRP insurance literature. First, this work evaluates payouts under various coverage levels to determine what levels of price protection make the most sense for producers given their risk preferences and expectations for variation in final price levels. Secondly, this work examines LRP insurance using actual coverage levels and premiums from 2007 to 2013 to determine if differences existed between producers utilizing LRP as risk management for summer grazing programs versus winter backgrounding programs. This work will benefit producers in making more informed risk management decisions related to marketing cattle and understanding how their expected risk level should impact their insurance purchases. It will also benefit extension specialists and educators as they work with cattle producers in making those decisions.

Methodology

In order to estimate payouts and assess the seasonal aspects of LRP insurance for feeder cattle,

data were collected from the RMA Website (USDA Risk Management Agency, 2013) for actual LRP policy offerings from fall 2007 to spring 2013. Data collected included start date, end date, expected ending price level, coverage level, and premium. In order to maintain consistency and evaluate systems that were likely to be utilized by producers, it was decided to target effective dates near the middle of April to approximate a summer grazing program and the middle of October to approximate a winter backgrounding program. One of the challenges of LRP insurance is that coverage levels and lengths change on a daily basis. So, sufficient data was not always available on the fifteenth of the month. In those cases, the closest date to the fifteenth of each month with the required observations were utilized.

LRP insurance for feeder cattle is offered with a minimum coverage length of 13 weeks and a maximum coverage length of 52 weeks, in four-week intervals. However, when examining the actual offerings it became clear that extremely long coverage levels are rarely offered. The most common coverage lengths offered are 13, 17, and 21 weeks. Further, while longer coverage lengths may be available on a given day, in order to assess LRP insurance for a given system and evaluate alternative coverage levels, multiple coverage levels were needed for a given purchase date. For this reason, the authors chose to analyze a coverage length of 17 weeks, or approximately four months. Longer coverage levels were not feasible due to data limitations.

It was decided that purchase dates used in the analysis must offer coverage for 17 weeks at three different coverage levels: high, medium, and low. The high coverage level was determined to be 97-100 percent of expected ending value. The medium coverage level was set at 94-97 percent of expected ending value. The low coverage levels included levels 90-94 percent of expected ending value. By examining these three ranges of coverage levels, the authors were able to more fully explore risk management strategies available to stocker and backgrounding operations by considering various levels of price risk protection.

Once data were collected, Monte-Carlo simulation was utilized to generate possible outcomes for Actual Ending Values, indemnities, and net payouts from utilization of LRP insurance. Net payouts are defined as the indemnity received minus the premium paid per head. The distribution of outcomes was assumed to be normal[1] with a mean equal to the expected ending value.

The most crucial assumption made in the analysis was the variability in price by which expected payouts would be evaluated. Since LRP insurance establishes a price floor on the Actual Ending Value, greater price variability would mean greater likelihood of reaching that price floor and receiving an indemnity. Ultimately, when a producer chooses to purchase LRP insurance they are doing so because they feel the downside price risk is sufficiently large to justify paying the premium to establish this minimum price level. Consequently, it is this expected downside price risk as anticipated by the individual producer that is key in determining if the LRP premium is worth the cost. The time period from 2007 to 2013 was a time period when feeder cattle prices were generally increasing, but price

variability was also very high due to the influence of grain prices, weather conditions, and other factors. These factors no doubt influence producer risk perceptions.

Thus, this study also sought to build upon previous work by examining expected net payouts from LRP insurance under various assumptions about price variability as anticipated by the producer. It has been established in the literature that there is an implied volatility in option prices (Black and Scholes, 1973), but this concept is not readily accessible or understood by livestock producers. To aid in decision making, we sought to develop an easy-to-use method where producers could understand how the price risk they perceive affects the expected LRP payouts and the implications that may have on the coverage levels they are considering.

In order to address this need, net LRP insurance payouts were examined under four different price-risk levels. To make these risk levels easily understood by producers, they were expressed in terms of a 10 percent chance that the price would fall by a certain level: $10.00 per cwt, $12.50 per cwt, $15.00 per cwt, and $17.50 per cwt. Payouts were then simulated for each coverage level and time period. Table 1 shows the relationship between 10 percent risk levels described above and the standard deviations of the normal distributions associated with them. In order to better understand the expected price outcomes, figure 1 depicts the expected price distribution of an LRP policy with an expected ending value of $150.52 per cwt and a 10 percent chance of a $15 decrease in price. The 10 percent levels will be referred to for the remainder of the discussion.

Actual ending values were estimated with Monte Carlo Simulation using 5,000 iterations each for time period (April and October), coverage level (high, medium, low), and 10 percent price risk level ($10.00, $12.50, $15.00, and $17.50 per cwt). For each iteration, an indemnity (if applicable) was calculated and added to the premium cost to estimate a net payout for LRP insurance. By analyzing the insurance product in this way, producers can not only see the minimum price floor they establish, but also can see how purchasing the insurance would affect their return over a large number of potential outcomes.

Tables 2 and 3 show the average coverage levels and premiums for the mid-April and mid-October effective dates, respectively, used in the analysis. Coverage levels were similar between the two time periods. The largest difference existed in the low coverage level range, which was simply a function of the coverage levels that were offered. While premiums for April effective dates were a bit higher than premiums for October, the differences were relatively small, which would imply an expectation of similar risk levels.

Results

Results from simulations are reported in Tables 4-7. Table 4 reports results from the lowest risk level examined, that associated with a 10 percent chance that the price could drop by $10 or more. Note that at this risk level the average net payouts for the three coverage levels for both April and

October are negative, meaning that premiums exceeded indemnities on average. The range is from -$10.20 to -$6.56. Another way to interpret these average payouts is the amount the producer is paying on average to establish a price floor and reduce their risk exposure. For example, if in April the expected ending price is $150 and the producer chooses a medium coverage level (95.51%), he/she would establish a price floor of $143.27. The net cost (indemnity minus premium) would be $9.18 per head for this level of price protection. Also note that average net payouts in October exceed that of April for all three coverage level ranges.

Table 5 reports simulation results from the next risk level, a 10 percent chance that price will fall by at least $12.50. The range now for average net payout is from -$4.49 to -$2.93. Using the same example above, this net cost of coverage would effectively drop from $9.18 to $4.49 per head. Notice that all other payouts are higher (less negative) at this risk level, which is logical as the price floor would be reached more often. Greater probability of larger price decreases means that indemnities are more likely to be received, which increases the average net payout. Once again, consistent with Table 4, net payouts for October effective dates exceed those of April.

Table 6 reports results from the next risk level and assumes that the producer perceives a 10 percent chance that price falls by $15 per cwt. The range now for average net payout is from -$.45 to +$2.68. At this perceived risk level, expected average payouts actually are positive for all but the low coverage level and the April purchase date. This means that on average, indemnities would exceed premiums if this was the true risk level, and the producer would actually expect the insurance to increase their returns on average.

Results from this risk level also present another noteworthy finding. Note that at the two lower risk levels reported in Tables 4 and 5, lower coverage levels yield the highest (or least negative) payouts. This is logical as lower price risk means less chance of indemnity, and therefore the smaller amounts spent on premium result in higher average payouts. However, as can be seen in Table 6, risk levels have increased enough that the higher coverage levels start to yield the highest net payouts. This will be discussed further in the conclusions section that follows.

Table 7 reports payouts for the highest risk level, a 10 percent chance of a $17.50 price decrease. Note that in Table 7 all expected payouts are positive suggesting that individuals who perceived that much price risk should purchase LRP insurance. Expected payouts range from $3.62 per head for the low coverage level on the April purchase date to $8.47 for the high coverage level October purchase date. Once again, at these risk levels, the purchase of LRP is actually expected to increase returns and higher coverage levels are again associated with greater expected net payouts.

Conclusions

This work provides a fresh perspective on LRP insurance that has not previously been discussed in the literature. While most work focuses on risk reduction and price floors, this work focuses on

expected payouts when LRP is purchased. While risk reduction and price floors are important, producers need to better understand how implementation of a risk management strategy will affect their returns over time. Results suggest that once the 10 percent risk level reaches $15 per cwt, net payouts become positive and producers would expect purchase of LRP to actually increase their net returns over time based on premiums from the last six years. For producers who perceive this level of price risk to exist, LRP would seem a logical risk management strategy as it would appear that their perceived price risk level exceeds that implied by LRP premiums over the last six years. Producers should ask themselves what level of price risk they perceive and use that to guide their decision making.

However, it is also important that producers understand that a negative expected payout, such as those associated with the lowest two risk levels presented in Tables 4 and 5, doesn't necessarily mean that LRP insurance should not be purchased. To illustrate this point, consider the lowest risk level evaluated, that associated with a 10 percent chance of a $10 per cwt price decrease. Note that the medium coverage level, mid-October purchase date is associated with an expected net payout of -$7.55 per head, which simply means that on average, premiums exceed indemnities by $7.55 per head. However, negative net payouts are expected with most insurance products. Insurance is not generally purchased to make money, but to protect an individual from highly adverse outcomes. So, a risk averse producer might decide that they are willing to give up $7.55 per head on average to eliminate a portion of the downside price risk by setting an effective price floor. This point is likely even better illustrated in Table 5 where producers are giving up less than $5 per head on average by purchasing the insurance. These types of risk management decisions are very much dependent on the risk preferences of the individual and on his financial ability to absorb losses. Analysis such as this helps frame these decisions in a practical way producers can understand.

Another key finding that was mentioned briefly in the results section involved expected payouts by coverage level. LRP indemnities are received when the ending value of the CME© Feeder Cattle Index is below the coverage level on the ending date. So, the expected likelihood of that index decreasing has a large impact on the frequency and magnitude of those indemnities and thereby the net payout. When expected risk levels are relatively small, like those evaluated in Tables 4 and 5, lower coverage levels yield the highest net payouts. This occurs because fewer indemnities are received at lower expected risk levels and lower coverage levels are associated with smaller premium outlays. It also suggests that the price risk implied by the LRP premiums in this study were greater than those depicted in Tables 4 and 5.

However, as risk levels increase, as is shown in Tables 6 and 7, higher coverage levels start to become more attractive. High price risk levels mean greater probability of price decreases and more frequent indemnities. Further, higher coverage levels set higher price floors, which means that on average indemnities are larger as less price

decrease is self-insured by the producer. This work suggests that based on premiums from 2007-2013, higher coverage levels yield greater net payouts as 10 percent risk levels reach $15 per cwt. This also suggests that price risk levels evaluated in Tables 6 and 7 exceeded the risk levels implied by the premiums for those coverage levels.

Finally, it is worth discussing the differences in payouts between April purchase dates and October purchase dates. While feeder cattle are marketed year-round, two common systems are summer stockering and winter backgrounding. Summer stocker operators purchase calves in the spring as grass becomes available and sell those calves as feeders in late summer/early fall. Winter backgrounders purchase calves in the fall, when they are at their seasonal lows, and winter them on purchased feeds and/or stockpiled forage through the winter. In this analysis, April LRP purchase dates were intended to approximate summer stockering while October LRP purchase dates were intended to approximate winter backgrounding.

It is of significance that expected payouts for October LRP purchases exceeded those of April in every scenario shown in Tables 4-7. This was the case when coverage levels and premiums were slightly higher for the April purchase dates as in the high and medium coverage level scenarios, but was also the case for the low coverage level scenarios where coverage levels and premiums were actually higher for October purchase dates. This most likely speaks to the actual price risk expected in each system.

As discussed earlier, LRP premiums are based on feeder cattle option premiums on the CME©. These premiums should reflect expected risk levels in the market if the market is operating efficiently since the length of coverage in both cases is 17 weeks and coverage levels have been set as close to each other as the data would allow. The fact that payouts for October purchase dates exceeded that of April purchase dates at the same risk levels suggest that lower price risk levels are expected, and reflected in premiums, for policies purchased in October. It is worth discussing the logic in this finding.

While many factors have the potential to affect feeder cattle prices, corn prices have long been established to be one of the most significant (Dhuyvetter & Schroeder, 2000; Anderson & Trapp, 2000; Trapp & Eilrich, 1991; Buccola, 1980). Insurance placed in mid-April for 17 weeks would have an ending date in mid-August. This represents a time period when corn is being planted and yields are being made. During this time, numerous planting progress and crop condition reports are received on the corn crop as well as the June Acreage report and most likely the initial August estimate of the overall size of the crop. Numerous factors during this time could affect the anticipated size of the corn crop, the price of corn, and ultimately feeder cattle prices.

At the same time, LRP insurance purchased in mid-October for 17 weeks would be associated with an ending date in mid-February. This time period is associated with further estimates of the size of the corn crop and the final January crop production report. While there is certainly potential for corn price to change in response to these indicators, there

is not as much potential for price impact as there is during the spring and summer months. For this reason, it seems logical that less feeder cattle price risk exists during the fall and winter as during the spring and summer growing seasons. The findings in Tables 4-7 provide an opportunity to depict price risk for the two seasons in a unique way.

Summary

This work makes a significant contribution to the literature as it examines expected payouts from LRP Insurance, which had not been previously evaluated in the literature. Expected payouts are estimated under multiple coverage levels and expected risk levels and the work also addresses likely differences in payouts and risk levels for summer stocker operators and winter backgrounders. Results suggest that net payouts are moderately negative at low risk levels associated with a 10 percent chance of price decreasing by $10 per cwt. As the 10 percent risk level increases to $12.50 per cwt, expected payouts increase but remain slightly negative. Once the 10 percent risk level reaches $15 per cwt, payouts generally become positive and higher premium, higher coverage level policies net higher expected payouts. These findings speak to the importance of perceived risk levels when LRP insurance is considered and when coverage levels are chosen.

Additionally, this work examines policies purchased in both the spring and fall, as it simulates stocker and backgrounding operations. At similar coverage and risk levels, net payouts are higher for fall/winter programs than spring/summer programs, suggesting that risk levels implied by LRP premiums are likely higher for spring/summer programs. This is most likely to be the result of increased corn price variability during the spring and summer months.

As producers consider their risk management options, LRP should be considered, especially for producers whose scale is too small to utilize 50,000 pound futures and option contracts. In addition to considering the risk reduction effects, this work provides a framework whereby producers can also consider how perceived price risk levels affect likely payouts and desired coverage levels. This provides a more complete consideration of the many factors that should enter in the LRP purchase decision.

Endnotes

1 Various Beta distributions were also explored but the most common forms had similar results compared to the normal distribution. Thus, only the normal distribution was used in the final analysis.

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Table 1. Standard Deviations for the Normal Distribution and the Associated 10 Percent Risk Levels

Standard Deviation	10% Chance Ending Value Decrease by…
$6.079	$10.00 per cwt
$7.599	$12.50 per cwt
$9.119	$15.00 per cwt
$10.638	$17.50 per cwt

Table 2. Descriptive Statistics, mid-April Purchase Dates

Coverage Level	% Coverage Level	Premium per CWT	Premium per Head
High	**98.88%**	**$3.84**	**$28.83**
Medium	**95.56%**	**$2.30**	**$17.25**
Low	**91.63%**	**$1.24**	**$9.28**

Table 3. Descriptive Statistics, mid-October Purchase Dates

Coverage Level	% Coverage Level	Premium per CWT	Premium per Head
High	**98.73%**	**$3.64**	**$27.32**
Medium	**95.51%**	**$2.18**	**$16.34**
Low	**92.93%**	**$1.49**	**$11.20**

Table 4. Net Payout per Head: $10 – 10 Percent Risk Level

Net Payout per Head (Insurance Payment less Premium) 10%: $10.00 per cwt decrease		
Coverage Level	**Mid-April Purchase Date**	**Mid-October Purchase Date**
High	($10.20)	($8.83)
Medium	($9.18)	($7.55)
Low	($6.76)	($6.56)
Note: 17 week coverage lengths, effectives dates as close to 15th of month as possible		

Table 5. Net Payout per Head: $12.50 – 10 Percent Risk Level

Net Payout per Head (Insurance Payment less Premium) 10%: $12.50 per cwt decrease		
Coverage Level	**Mid-April Purchase Date**	**Mid-October Purchase Date**
High	($4.46)	($3.09)
Medium	($4.49)	($2.81)
Low	($3.98)	($2.93)
Note: 17 week coverage lengths, effectives dates as close to 15th of month as possible		

Table 6. Net Payout per Head: $15.00 – 10 Percent Risk Level

Net Payout per Head (Insurance Payment less Premium) 10%: $15.00 per cwt decrease		
Coverage Level	**Mid-April Purchase Date**	**Mid-October Purchase Date**
High	$1.32	$2.68
Medium	$0.56	$2.27
Low	($0.45)	$1.29
Note: 17 week coverage lengths, effectives dates as close to 15th of month as possible		

Table 7. Net Payout per Head: $17.50 – 10 Percent Risk Level

Net Payout per Head (Insurance Payment less Premium) 10%: $17.50 per cwt decrease		
Coverage Level	**Mid-April Purchase Date**	**Mid-October Purchase Date**
High	$7.12	$8.47
Medium	$5.81	$7.54
Low	$3.62	$5.90
Note: 17 week coverage lengths, effectives dates as close to 15th of month as possible		

Figure 1. Distribution for Price 10 Percent Chance Price Falls by $15 Expectation