Journal of Agricultural and Resource Economics 48(1):31–45 ISSN: 1068-5502 (Print); 2327-8285 (Online)

doi: 10.22004/ag.econ.316752

Subsidy Rate Changes on Livestock Risk Protection for Feeder Cattle

Christopher N. Boyer and Andrew P. Griffith

We determine the impact the 2020 Livestock Risk Protection (LRP) subsidy rate structure has on the probability of LRP having a higher price than the actual cash price. Monthly logit models were estimated to determine these probabilities with the previous and new subsidy rate. The preferred coverage lengths and levels vary across months as does LRP's effectiveness in managing price risk. The new subsidy structure increases LRP's effectiveness as a risk management tool in some months. Results show the LRP contract that provides the best protection by sell month and the impact of the new subsidy rates.

Key words: insurance, policy

Introduction

Cattle producers face various forms of risk, but price risk has been a primary source of risk cattle producers must manage, both historically and more recently, (Mark, Schroeder, and Jones, 2000; Hart, Babcock, and Hayes, 2001; Hall et al., 2003; Belasco et al., 2009; Martinez, Maples, and Benavidez, 2021). It is possible to use futures and option contracts to mitigate risk, but these contracts are traded in 50,000-lb increments. Most US beef cattle producers do not sell 50,000 lb of cattle at a time, making futures and options an inefficient alternative for managing price risk (US Department of Agriculture, 2021c).

Another alternative for managing price risk is Livestock Risk Protection insurance (LRP), which was first made available to producers by the USDA Risk Management Agency (RMA) in 2003 (US Department of Agriculture, 2021a). LRP pays policy holders an indemnity at the time of policy expiration if a cash price index is lower than the insured price, which is set when the policy is purchased. Livestock producers have several options when it comes to selecting coverage levels and coverage length (period). Like most insurance products, premiums for LRP vary with coverage level (how much of an expected price to insure) and length (number of weeks in the future in which to insure a price). Cattle producers can insure as few as one animal with LRP, making it more applicable to smaller producers than futures and options. Fields and Gillespie (2008) also noted that insurance is more familiar than futures or option contracts, and cattle producers are likely more comfortable using insurance.

However, adoption of LRP has been limited (Hill, 2015; McKendree, Tonsor, and Schulz, 2021). One possible explanation for low use is cost: LRP was expensive (Burdine and Halich, 2014; Merritt et al., 2017). In response to the need for better price risk management tools and limited adoption of LRP, premium subsidies were increased in 2019 from 13% of the premium; further increases were made in 2020. The 2020 subsidy rates are based on coverage level. The new subsidy structure is a

Christopher N. Boyer (corresponding author; cboyer3@utk.edu) and Andrew P. Griffith are associate professors in the Department of Agricultural and Resource Economics at the University of Tennessee, Knoxville.
We thank the anonymous reviews and editors for the helpful comments. This study was supported by University of Tennessee AgResearch.

Review coordinated by Dayton M. Lambert.

35% subsidy rate for a coverage level between 95% and 100%, 40% for coverage between 90% and 94.99%, 45% for coverage between 85% and 89.99%, 50% for coverage between 80% and 84.99%, and 55% for coverage between 70% and 79.99% (US Department of Agriculture, 2021a).

This paper provides insight into the impact of the 2020 LRP subsidy rate on price protection for feeder cattle. Specifically, we determine the probability of the LRP insured or net price, which is defined later, being greater than the actual ending price. We explore this answer by month and for various coverage lengths and levels of feeder cattle LRP contracts. We use LRP data from 2014–2018 to estimate monthly logit models to determine the probability of outcomes under the previous subsidy rate and under the new subsidy rate. Results are informative for cow–calf and stocker producers interested in using LRP. These results could help them identify the contract that best fits their needs. Additionally, we determine how effective the new subsidy rates are at improving producers' price protection.

Literature Review

Several studies have analyzed the effectiveness of LRP and compared protection from LRP relative to other price risk management tools (Coelho, Mark, and Azzam, 2008; Feuz, 2009; Burdine and Halich, 2014; Merritt et al., 2017; Wei, 2019). Feuz (2009) evaluated estimated net returns and variability of those returns for cow–calf operations using cash, futures, options, and LRP by simulating expected gross returns from the cash market to the various sources of risk using the different risk management tools. Feuz found that futures hedging eliminates the most variability but stops producers from gaining from positive price swings. LRP was found to be applicable for producers unable to fulfill a 50,000-lb futures contract, which is the majority of cow–calf operations.

Wei (2019) determined which price risk management tools are ideal for small producers while also identifying what market conditions make the risk management tools most advantageous for small feeder cattle producers. Futures contracts were found to be the optimal choice for risk management in times where cattle cash prices are increasing. LRP was preferred by the smallest producers due to their limited output of cattle being a barrier for the futures market. LRP is also more advantageous during periods of price decline as the chance of receiving an indemnity payment increases as price declines.

On the other hand, Burdine and Halich (2014) showed that net payouts (indemnity being greater than the premium cost) increased with a decrease in feeder cattle prices, suggesting LRP was effective at providing a price floor. However, net payouts were negative unless the cattle price dropped more than $15/cwt over the 17-week contract length, which they state is an unlikely drop in a short period of time.

Similarly, Merritt et al. (2017) evaluated LRP for Tennessee feeder cattle and described the LRP net price as the CME FCI price on the day the insurance policy expires plus any indemnity payment minus the cost of the policy. They reported that LRP provide minimum risk protection and there was no clear contract length and coverage level that was optimal, likely leaving producers confused on which contract to purchase. They reported that most contracts were purchased by producers for 13 weeks and only 1.7% purchased LRP contracts longer than 21 weeks. They showed in most situations, a producer would be better off not purchasing LRP. These findings were also supported by producer adoption levels. Hill (2015) stated that 7% of US beef cattle producers have used LRP to manage price risk, a much lower percentage than those who have used of futures and options contracts.

The literature indicates that futures, options, and LRP can be effective price risk management tools, but they need to be properly implemented. Merritt et al. (2017) showed that not all LRP contract lengths and coverage levels are equally effective across months. This study contributes to the literature by helping producers select the contract coverage level and length that helps them best mange price risk. Also, the literature has shown that LRP was expensive (Burdine and Halich, 2014;

Merritt et al., 2017); thus, the subsidy was increased in 2021. This study also contributes to the literature by showing how the change in the subsidy impacts LRP effectiveness.

Livestock Risk Protection

LRP can be used to insure between one animal and 12,000 head in one federal crop year (July 1–June 30), with a maximum of 6,000 head on a specific coverage endorsement (Flournoy, 2020). Along with the subsidy changes of 2021, the number of head insured in a crop year increased from 2,000 head and head per specific coverage endorsement increased from 1,000 (Flournoy, 2020). Another change made to LRP was moving the insurance premium payment from the time of purchase to the end of the insurance period (Flournoy, 2020). Producers have two decisions when completing a specific coverage endorsement when purchasing LRP. They must select a coverage length (insurance period) of 13, 17, 21, 26, 30, 34, 39, 43, 47, or 52 weeks, and they need to select a coverage level ranging from 70% to 100% of the expected price at the end of the insurance period. For example, a producer could purchase a 13-week LRP contract for 20 steers guaranteeing a price floor that is 90% of the expected price at termination.

The expected price and premiums change daily. These prices are made specific to steers, heifers, brahman, and dairy cattle weighing less than 600 lb, 600–900 lb, and unborn cattle. The expected price is the anticipated feeder cattle price at the end of the insurance period and is based on the Chicago Mercantile Exchange (CME) Feeder Cattle Index (FCI), which is a cash index for 700–900-lb steers in a 12-state region. Producers select LRP policies with a coverage length ending near the anticipated marketing date for their cattle.

A producer must own insured cattle until 60 days prior to the specific end date for the coverage endorsement, which was recently changed from 30 days (Flournoy, 2020). Cattle can be sold after the end date for the coverage endorsement and receive their indemnity payment without selling their cattle. However, if cattle are sold 60 or more days before the end date of the LRP policy, then their coverage will be terminated and they forfeit any indemnity payment. They will also not receive a refund on the premium.

LRP premiums depend on coverage level, contract length, and date of purchase. Like a put option contract, a higher coverage level provides a higher price floor but has a higher premium. At termination, an actual ending price of the policy is recorded and indemnity payments are calculated. Policy owners wait until the expiration date to know if they will receive an indemnity payment. The indemnity is zero if the coverage price, which is equal to the expected ending price multiplied by the coverage level, is less than the actual ending price. However, if the opposite is true, then the indemnity is the difference between the coverage price and actual ending price. The indemnity payment received could be mathematically defined as

$$I_m(\theta,\delta) = \left\{ \begin{array}{c} \theta \times EP_m - AP_m \text{ if } \theta \times EP_m - AP_m > 0 \\ 0 \text{ if } \theta \times EP_m - AP_m < 0 \end{array} \right\}, \tag{1}$$

where $I_m(\theta,\delta)$ is the indemnity payment (\$/cwt) for the contract expiration month ($m = 1,\ldots,12$) and is a function of the coverage level (θ) and coverage length (δ), EP_m is the expected price at termination and is based on CME FCI price (\$/cwt) at the time of purchase, and AP_m for the actual price at termination (\$/cwt).

Merritt et al. (2017) defined net price as the actual ending price plus any indemnity payment minus the premium cost, which they mathematically present as

$$LP_m(\theta,\delta) = AP_m + I_m(\theta,\delta) - P_m(\theta,\delta) \times (1 - \mu(\theta)), \tag{2}$$

where $LP_m(\theta,\delta)$ is the net price for LRP (\$/cwt), $P_m(\theta,\delta)$ is the premium (\$/cwt) of the contract, and $\mu(\theta)$ is the subsidy rate, which is a function of coverage level since 2020. Producers can benefit

Table 1. Summary Statistics of the Difference in Net Livestock Risk Protection (LRP) Price and Actual Ending Price and Probability Net LRP Price Was Greater Than the Actual Ending Price by Month, 2014–2018

Month	*N*	Average	Std. Dev.	Min.	Max.
Probability net LRP price > actual ending price (%)					
January	230,584	20.4	0.403	0	1
February	191,064	23.4	0.423	0	1
March	271,624	21.6	0.411	0	1
April	169,784	16.4	0.370	0	1
May	242,136	17.1	0.376	0	1
June	277,552	6.6	0.249	0	1
July	337,440	2.5	0.155	0	1
August	355,452	1.7	0.130	0	1
September	137,712	15.6	0.363	0	1
October	180,272	26.8	0.443	0	1
November	141,664	27.6	0.447	0	1
December	168,112	21.5	0.411	0	1
Net LRP price minus actual ending price ($/cwt)					
January	229,938	0.14	7.89	−9.31	50.21
February	191,064	−0.22	6.22	−10.91	39.07
March	271,624	−1.01	5.12	−9.93	28.29
April	169,784	−1.68	4.16	−10.59	29.32
May	241,984	−1.47	4.13	−10.55	28.15
June	277,552	−2.53	2.68	−11.16	15.16
July	337,440	−2.84	2.38	−11.59	15.50
August	355,452	−3.16	2.06	−12.02	11.77
September	137,712	−1.18	5.70	−11.76	27.75
October	180,272	0.81	7.98	−9.23	36.02
November	140,600	0.94	8.22	−9.62	41.69
December	168,112	1.95	11.51	−10.57	62.27

from LRP if the net LRP price is greater than the actual ending price. However, for this to occur, the CME FCI price must decrease from the date of purchase to the day the contract is terminated more than the cost of the LRP.

This paper follows Merritt et al. (2017) in calculating net LRP price under the previous and current subsidy rate structure. Then, we predict probability the net LRP price will be higher than the actual ending price for various coverage levels, contract lengths, and months of termination. We recognize that the premium costs are likely to change under the revised subsidy structure, but we do not know exactly how. This is a shortcoming of this study. Therefore, we assume the impact of the change in subsidy structure, *ceteris paribus*, on the likelihood of LRP providing producers a higher price than the actual ending price. Our results are likely overly optimistic since we do not account for premium increases as the subsidies increase.

Data

LRP insurance data are from the *Livestock Insurance Plans* database (US Department of Agriculture, 2021b), which houses all the daily LRP offerings and ending actual prices. R Studio was used to download the daily offers for US feeder cattle from January 2014 through December 2020. SAS (SAS Institute, Inc., 2003) was used to clean and merge these data, which included effective date (date the insurance was offered), coverage length, expected ending price at purchase, coverage level,

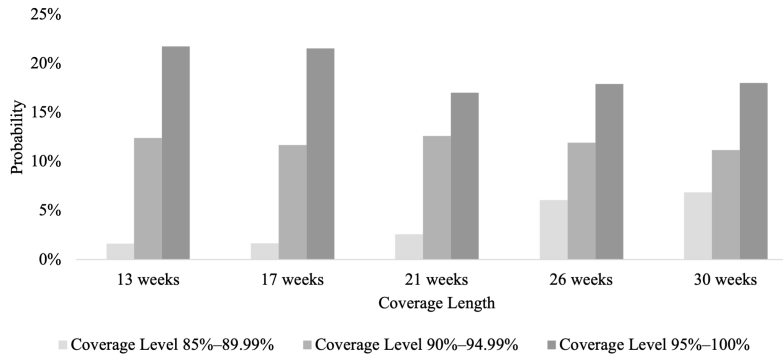

Figure 1. Probability of Net Livestock Risk Protection (LRP) Price Being Greater than the Actual Ending Price by Coverage Levels and Lengths, 2014–2018, with the Pre-2019 Subsidy Structure

coverage price, insurance cost per hundredweight (cwt), ending date of the insurance period, and actual price at termination. We aggregated the daily offerings by month of the expected ending date.

This paper focuses on 600–900-lb feeder cattle, making the result applicable to cow–calf and stocker operators. This reduced the number of states and excludes Alaska, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Few of the contracts exceeded 30 weeks. This might be explained by a coverage length of 34 weeks or 238 days being a long time for feeder cattle to be owned. Therefore, insurance periods over 30 weeks were excluded. Also, coverage levels under 85% were not analyzed, because they were less than 2% of these data. It is important to state that these data are not LRP policies that were actually sold but those that were offered. Therefore, we are analyzing possible (not actual) purchases of LRP contracts.

In 2019 and 2020, US beef cattle producers traversed two events (Finney County Tyson Foods slaughterhouse fire in August 2019 and COVID-19), resulting in major losses from the cow–calf producer through the feedlot sector (Martinez, Maples, and Benavidez, 2021). Analysis of LRP effectiveness during these two events would be interesting future research. However, this paper focuses on how the change in the subsidy rate impacted LRP effectiveness. Including these two years of data would heavily weight LRP performance during two unexpected events of cattle prices declining rapidly. Therefore, we exclude 2019 and 2020 from this analysis and only consider the 2,703,396 observations in the 2014–2018 data. The years of data used in the analysis include periods of both high and low cattle prices (US Department of Agriculture, 2021c).

Table 1 shows the summary statistics of the difference in net LRP prices and actual ending prices and the probability of net LRP price being greater than the actual ending price by month. The highest likelihood seems to occur from October through March. The likelihood of the net price being greater than the actual ending price in June, July, and August was less than 10%. These probabilities coincide with the difference in net LRP prices and actual ending prices. On average, LRP net price was lower than the actual ending price in 8 of the 12 months; the average price difference was positive from October through January. Figure 1 shows the probability of net LRP price being greater than the actual ending price across coverage levels and lengths. The likelihood of this occurring increased as coverage level increased for all contract lengths. The shorter (13- and 17-week) contracts gave the highest likelihood of LRP price being greater than the actual ending price.

Table 2 shows the summary statistics of LRP premiums and indemnity payments by month. The average cost of LRP ranged from $3.69/cwt (December) to $4.31/cwt (April). The maximums and minimums show that LRP could have been purchased for as little as $0.10/cwt and as much as $14.18/cwt. However, the indemnity payments, the differences in net LRP price and actual ending

Table 2. Summary Statistics of the Livestock Risk Protection (LRP) Premiums and Indemnity Payments by Month, 2014–2018

Month	*N*	Average	Std. Dev.	Min.	Max.
LRP premiums ($/cwt)					
January	230,584	3.98	2.03	0.33	12.63
February	191,064	4.15	2.18	0.16	12.54
March	271,624	4.26	2.20	0.10	11.75
April	169,784	4.31	2.42	0.24	13.44
May	242,136	4.17	2.53	0.18	14.18
June	277,552	3.91	2.49	0.11	13.34
July	337,440	3.80	2.40	0.15	13.60
August	355,452	3.94	2.28	0.27	14.18
September	137,712	3.84	2.19	0.22	13.52
October	180,272	3.94	2.08	0.39	12.28
November	141,664	3.84	2.04	0.26	12.30
December	168,112	3.69	1.97	0.27	12.15
LRP indemnity payment ($/cwt)					
January	229,938	3.59	8.22	0.00	57.48
February	191,064	3.40	6.60	0.00	45.91
March	271,624	2.70	5.51	0.00	33.35
April	169,784	2.07	4.82	0.00	$9.27
May	241,984	2.16	4.84	0.00	38.28
June	277,552	0.87	2.90	0.00	26.04
July	337,440	0.46	2.29	0.00	25.58
August	355,452	0.27	1.50	0.00	22.31
September	137,712	2.16	5.63	0.00	34.13
October	180,272	4.24	8.17	0.00	41.13
November	140,600	4.29	8.46	0.00	49.92
December	168,112	5.16	11.83	0.00	69.45

price, fluctuated from $0.27/cwt in July to $5.19/cwt in December. Some of the maximum payments were as high as $70/cwt, which demonstrates LRP's ability to protect against price risk. Overall, these data demonstrate the variation in LRP contracts across months, coverage levels, and coverage lengths.

Estimation

We estimate a logit model for each month to determine the coverage level and length that gives the highest probability of the net LRP price being greater than the actual price, which is expressed as

$$LRP_m^* = \alpha + \boldsymbol{\beta}_m' \boldsymbol{X} + \varepsilon_m, LRP_m = \left\{ \begin{array}{l} 1 \text{ if } LP_m(\theta,\delta) - AP_m > 0 \\ 0 \text{ if } LP_m(\theta,\delta) - AP_m \leq 0 \end{array} \right\}, \tag{3}$$

where LRP_m^* represents the indicator variable for net LRP price being greater than the actual ending price, $\boldsymbol{X}$ represents a matrix of indicator variables for coverage levels and lengths, $\boldsymbol{\beta}$ represents a vector of coefficients to be estimated, and ε_m is the error term. Similar to Merritt et al. (2017), we include indicator variables for coverage length but differ from their study by making coverage level continuous and interacting it with coverage length. The 30-week contract was dropped in the regression; thus, parameter estimates are interpreted relative to this contract.

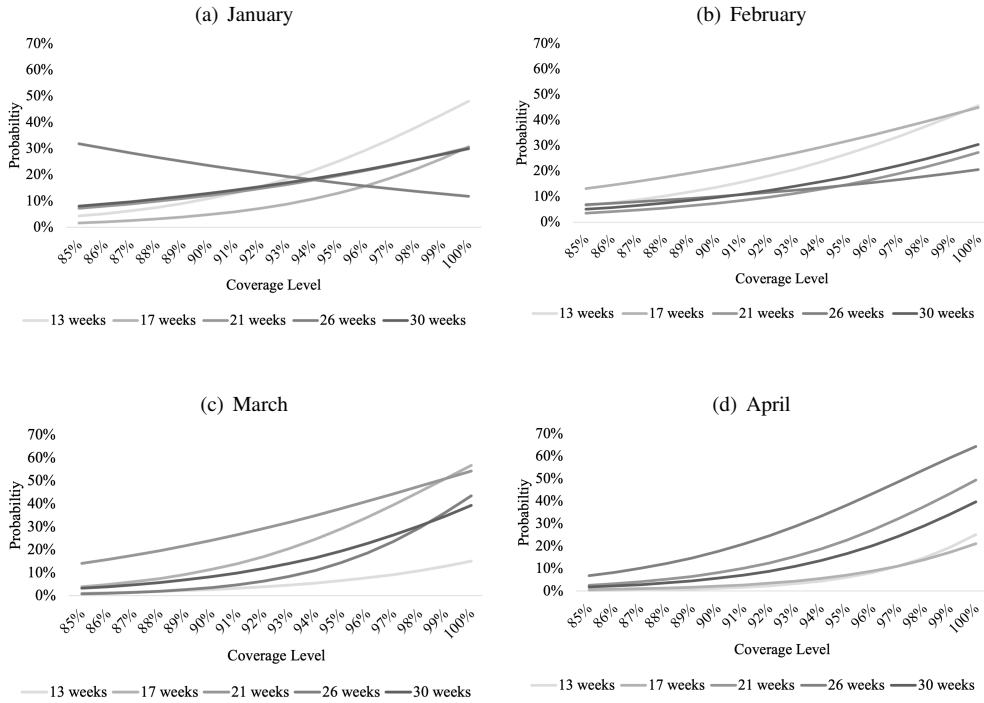

Figure 2. Predicted Probability of Net Livestock Risk Protection Price Being Greater than the Actual Ending Price under the Pre-2019 Subsidy Structure, January–April

Parameter estimates were used to predict the probability the net LRP price was greater than the actual ending price for each coverage length and level in each month. McFadden's R^2 and percentage correctly predicted are presented to show model fit. Equation (3) was estimated using the LOGISTIC procedure in SAS (SAS Institute, Inc., 2003).

Results

Pre-2020 Subsidy Change

Tables 3 and 4 show the estimates of the parameters in the monthly logit models for the likelihood of the net LRP price being greater than the actual ending price under the subsidy structure prior to 2019. Table 3 shows the months of January through June and Table 4 shows July through December results. The number of observations, McFadden R^2, and percentage correctly predicted are also shown. As mentioned, the 30-week contract length was dropped from the model. For January through June, coverage level was significant and positive, indicating an increase in coverage level results in a higher likelihood of the net LRP price being greater than the actual ending price, which matches these data in Figure 1. Most of the parameters were significant for contract length across these months, but signs varied across months for each contract length. These general findings were also true for months of September through December, but fewer parameter estimates were significant in July and August and coverage level was not significant in July (Table 4). Looking at Table 1, we see the average net LRP price is lowest in July and August, suggesting an explanation for this finding.To interpret the regression results, we plot probability of net LRP price being greater than the actual ending price by month for each contract length and coverage level, which are shown in Figures 2 (January–April), 3 (May–August), and 4 (September–December). By month, the contract length with the highest likelihood of the net LRP price being greater than the actual ending price varies

Table 3. Estimated Parameters from Monthly Logit Model for the Probability the Net Livestock Risk Protection Price Is Greater Than the Actual Ending Price for January–June, 2014–2018, with the Pre-2019 Subsidy Structure

Parameter	January	February	March	April	May	June
Intercept	−11.42**	−14.93**	−20.13**	−24.36**	−22.17**	−30.61**
Coverage level	10.57**	14.11**	19.69**	23.94**	21.73**	28.98**
13-week	−8.84**	−1.91**	−0.12	−9.66**	2.93**	−34.44**
17-week	−11.07**	3.52**	−2.77**	−2.00**	−6.48**	−11.40**
21-week	−0.90**	−1.58**	7.12**	0.37	−11.30**	7.24**
26-week	17.71**	5.14**	−10.60**	3.62**	1.88**	21.51**
13-week × coverage level	9.61**	2.56**	−1.18**	8.98**	−3.29**	33.42**
17-week × coverage level	11.10**	−2.89**	3.48**	1.10**	6.21**	12.24**
21-week × coverage level	0.92**	1.43**	−6.52**	0.02	10.60**	−7.30**
26-week × coverage level	−18.87**	−5.67**	10.78**	−2.61**	−1.29**	−21.76**
No. of obs.	230,584	191,064	271,624	169,784	242,136	277,552
R^2	0.066	0.075	0.146	0.136	0.121	0.070
Correctly predicted (%)	67.6	68.1	76.6	77.5	76.1	78.8

Notes: Double and triple asterisks (**, ***) represent significance at the 5% and 1% levels, respectively.

Table 4. Estimated Parameters from Monthly Logit Model for the Probability the Net Livestock Risk Protection Price Is Greater Than the Actual Ending Price for July–December, 2014–2018, with the Pre-2019 Subsidy Structure

Parameter	July	August	September	October	November	December
Intercept	−4.73	−43.91***	−25.43***	−12.37***	−14.41***	−13.27***
Coverage level	−3.23	39.66***	24.12***	11.80***	13.88***	12.49***
13-week	3.89	3.61	5.06***	−5.02***	2.72***	−17.30***
17-week	4.30	8.18	0.50	−0.82**	−4.82***	−5.40***
21-week	3.10	42.55**	15.83***	5.59***	3.41***	12.19***
26-week	−10.85	−71.17	5.89***	−2.51***	16.05***	4.43***
13-week × coverage level	−8.02	−1.56***	−3.87***	5.86***	−2.33***	18.25***
17-week × coverage level	−8.47	−6.48	0.67	0.87**	5.38***	5.80***
21-week × coverage level	−6.82	−50.34**	−16.26***	−5.77***	−3.74***	−12.88***
26-week × coverage level	16.94	73.25	−6.10***	2.19***	−16.41***	−4.65***
No. of obs.	337,440	355,452	137,712	180,272	141,664	168,112
R^2	0.064	0.028	0.100	0.063	0.068	0.077
Correctly predicted (%)	89.3	83.9	74.7	65.7	65.9	68.7

Notes: Double and triple asterisks (**, ***) represent significance at the 5% and 1% levels, respectively.

as well as the probabilities. The two pieces of information we discuss by month are the contract length and the coverage level with the highest probability of the net LRP price having a greater price outcome than the actual ending price. These results help producers decide whether LRP should be purchased for a given marketing month and, if yes, what contract length and coverage level should be purchased. In January, the 13-week contract length with greater than 95% coverage provides the highest likelihood (50%) of net LRP price being greater than the actual ending price. The 13- and 17-week contracts provide a similar likelihood at higher coverage levels when marketing in February, but the probability is 45%. If marketing in March, the 17- or 21-week contract with higher coverage levels would be preferred and have a 54% chance that net LPR price will be greater than the actual ending price. April and May results show the 26-week contract is preferred and net LRP price has a 64% and 54% chance, respectively, of being greater than the actual ending price at 100% coverage.

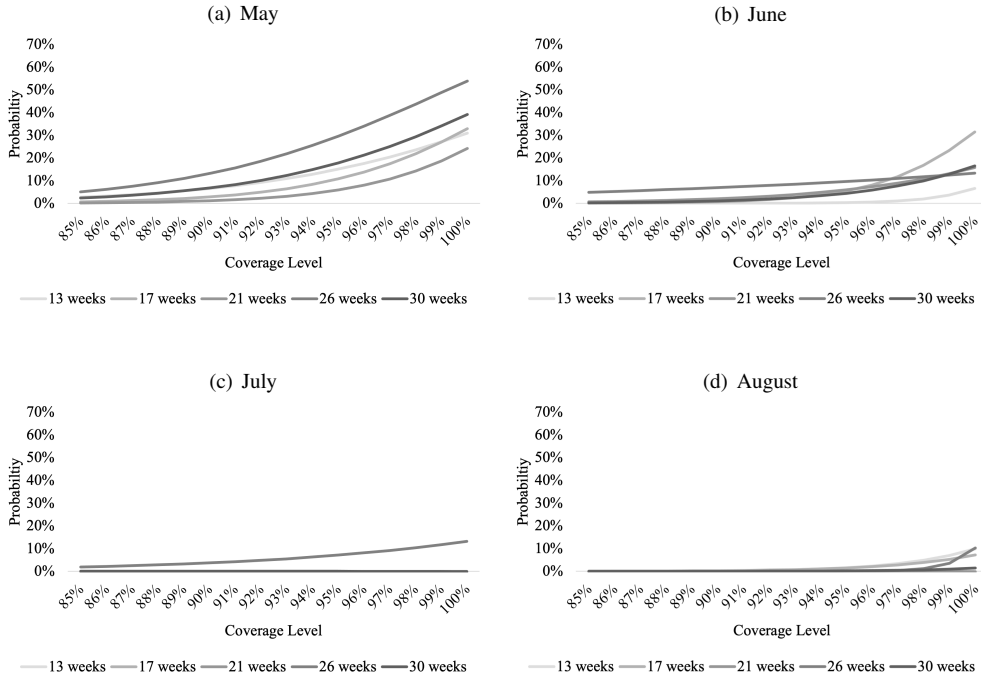

Figure 3. Predicted Probability of Net Livestock Risk Protection Price Being Greater than the Actual Ending Price under the Pre-2019 Subsidy Structure for May–August

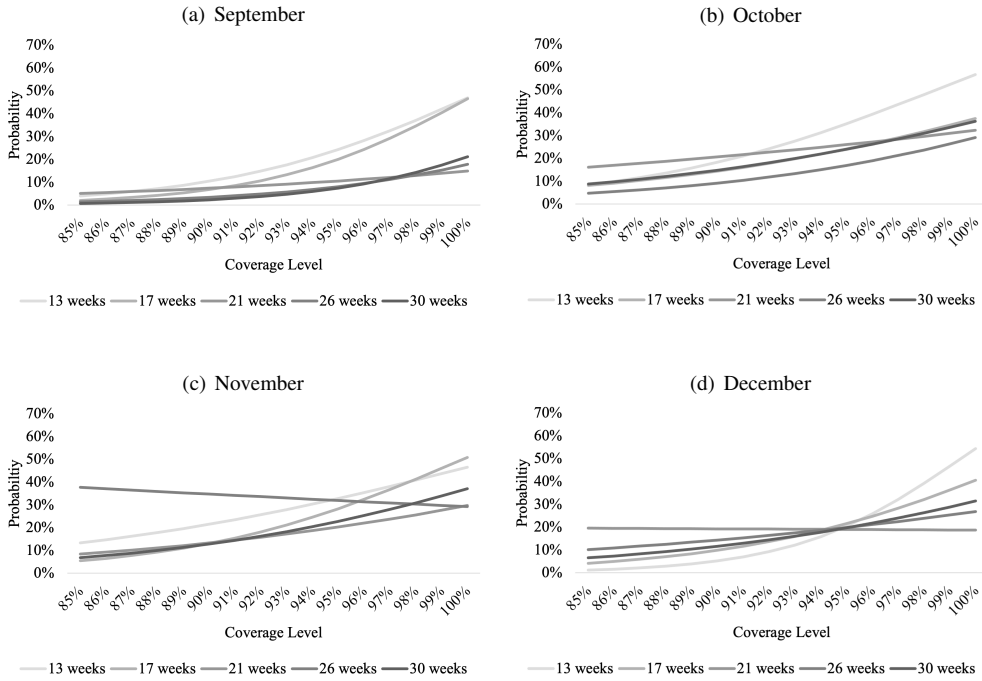

Figure 4. Predicted Probability of Net Livestock Risk Protection Price Being Greater than the Actual Ending Price under the Pre-2019 Subsidy Structure for September–December

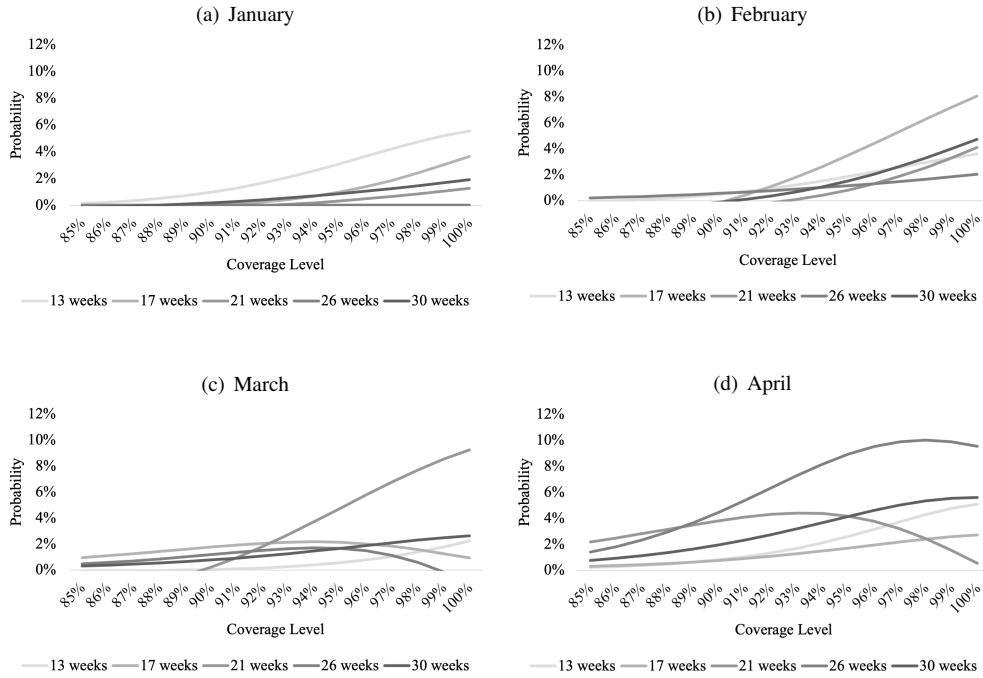

Figure 5. Predicted Probability Change of Net Livestock Risk Protection Price Being Greater Than the Actual Ending Price with the 2020 Subsidy Structure for January–April

June, July, and August results (Figure 3) suggest that LRP might not be a preferable option for producers marketing in these months. The likelihood of an LRP contract providing a higher price than if they did not purchase LRP was low. Results from September through December suggest that the 13- and 17-week contracts at high coverage levels would provide the highest likelihood of net LRP price being greater than the actual ending price. The highest likelihood of LRP providing a higher price than would be received if not purchasing LRP was 47% in September, 57% in October, 55% in November, and 54% in December. Results indicate that LRP's level of risk protection varies across months and LRP might not be an effective risk management tool for some producers based on their production system and marketing months. For example, a cow–calf producer with a fall-calving herd that sells calves at weaning in June or July might not consider using LRP since protection is minimal. However, a spring-calving cow–calf operation that sells weaned calves in October or November might consider buying a 13- or 17-week LRP contract if they believe prices will fall in the next 90–120 days. Overall, these are similar probabilities and patterns as those shown for Tennessee data in Merritt et al. (2017).

2020 Subsidy Change

The same regressions were then estimated assuming the tiered subsidy structure introduced in 2020, and Tables 5 and 6 show the results of the logit models. Table 5 shows the months of January through June and Table 6 shows July through December results. For January through June, parameter results were like pre-2020 subsidy structure results. Coverage level was positive and significant, and signs varied for contract length across these months. A noticeable change from the pre-2020 subsidy structure is coverage level was also significant and positive in July.

To show the impact of the subsidy structure change, we plot the change in probability of net LRP price being greater than the actual ending price by month for each contract length and coverage level, which are shown in Figures 5 (January–April), 6 (May–August), and 7 (September–

Table 5. Estimated Parameters from Monthly Logit Model for the Probability the Net Livestock Risk Protection Price Is Greater Than the Actual Ending Price for January–June, 2014–2018, with the 2020 Subsidy Structure

Parameter	January	February	March	April	May	June
Intercept	−12.07***	−17.00***	−20.14***	−23.25***	−20.24***	−28.42***
Coverage level	11.31***	16.39***	19.81***	23.06***	19.98***	27.04***
13-week	−9.24***	−0.74**	−1.48***	−7.90***	4.50***	−30.09***
17-week	−11.89***	2.57***	−1.46***	−1.39**	−4.65***	−7.59***
21-week	−0.98***	−2.02***	3.80***	3.33***	−12.69***	4.76***
26-week	18.36***	6.73***	−7.24***	1.30***	0.30	17.10***
13-week × coverage level	10.14***	1.32***	0.24	7.25***	−5.07***	29.14***
17-week × coverage level	12.00***	−1.84***	2.09***	0.41	4.33***	8.32***
21-week × coverage level	0.97***	1.85***	−2.92***	−3.15***	12.29***	−4.60***
26-week × coverage level	−19.61***	−7.35***	7.26***	−0.08	0.41	−17.36***
No. of obs.	230,584	191,064	271,624	169,784	242,136	277,552
R^2	0.078	0.092	0.159	0.146	0.120	0.078
Correctly predicted (%)	68.8	69.8	77.2	76.7	74.3	77.6

Notes: Double and triple asterisks (**, ***) represent significance at the 5% and 1% levels, respectively.

Table 6. Estimated Parameters from Monthly Logit Model for the Probability the Net Livestock Risk Protection Price Is Greater Than the Actual Ending Price for July–December, 2014–2018, with the 2020 Subsidy Structure

Parameter	July	August	September	October	November	December
Intercept	−381.00**	−35.27**	−25.53**	−11.78**	−14.35**	−14.11**
Coverage level	377.70**	31.13**	24.26**	11.22**	13.85**	13.44**
13-week	380.10**	−13.92**	5.16**	−4.14**	3.90**	−17.28**
17-week	−1,410.00**	6.40	0.61	−0.31	−5.83**	−5.43**
21-week	286.90**	33.80	15.41**	5.01**	3.35**	10.51**
26-week	366.00**	−40.19**	5.99**	−2.72**	15.99**	5.27**
13-week × coverage level	−388.80**	16.33**	−4.01**	4.95**	−3.57**	18.29**
17-week × coverage level	1,413.60**	−4.85	0.56	0.33	6.53**	5.83**
21-week × coverage level	−285.10**	−41.69*	−15.73**	−5.18**	−3.71**	−11.06**
26-week × coverage level	−364.30**	42.16**	−6.24**	2.46**	−16.38**	−5.60**
No. of obs.	337,440	355,452	137,712	180,272	141,664	168,112
R^2	0.081	0.034	0.100	0.059	0.071	0.086
Correctly predicted (%)	87.2	82.8	74.5	65.1	66.1	69.3

Notes: Double and triple asterisks (**, ***) represent significance at the 5% and 1% levels, respectively.

December) relative to the previous subsidy structure. These figures show the increase or decrease in the likelihood of net LRP price being greater than the actual ending price from the new subsidy structure. With the exception of March, the preferred contract length by month under the old subsidy structure was the same as that under the new subsidy structure. That is, the new subsidy structure did not impact the contract length and coverage level, which is most likely to have a higher net price than actual ending price. However, for March, a contract length of 21 weeks (63% with 100% coverage) had a higher likelihood under the subsidy structure, which differs from the 17-week contract, having the highest likelihood with the old subsidy structure.

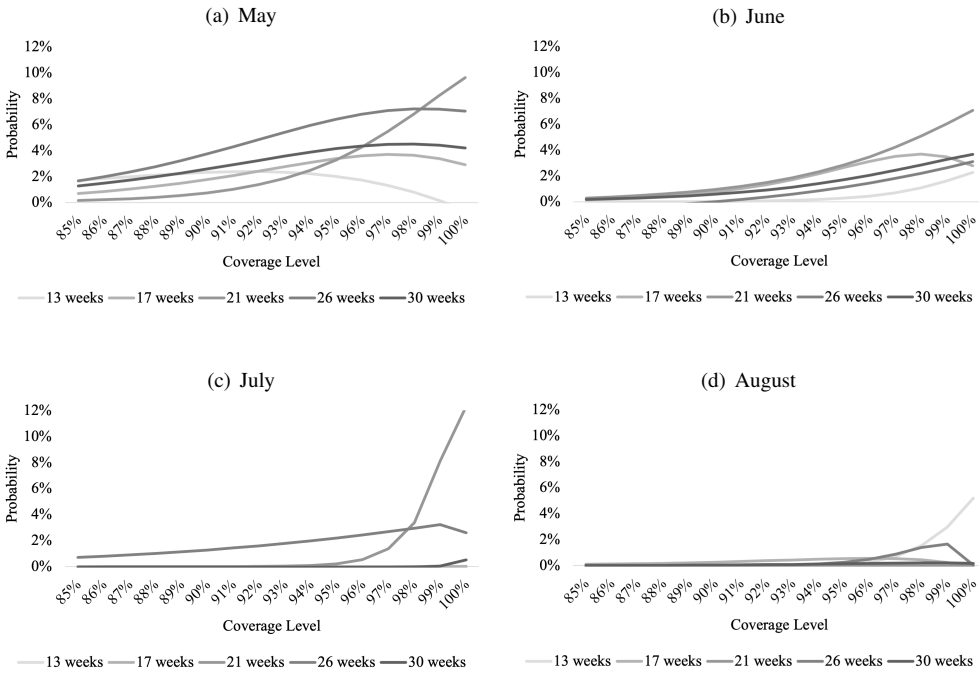

Figure 6. Predicted Probability Change of Net Livestock Risk Protection Price Being Greater Than the Actual Ending Price with the 2020 Subsidy Structure for May–August

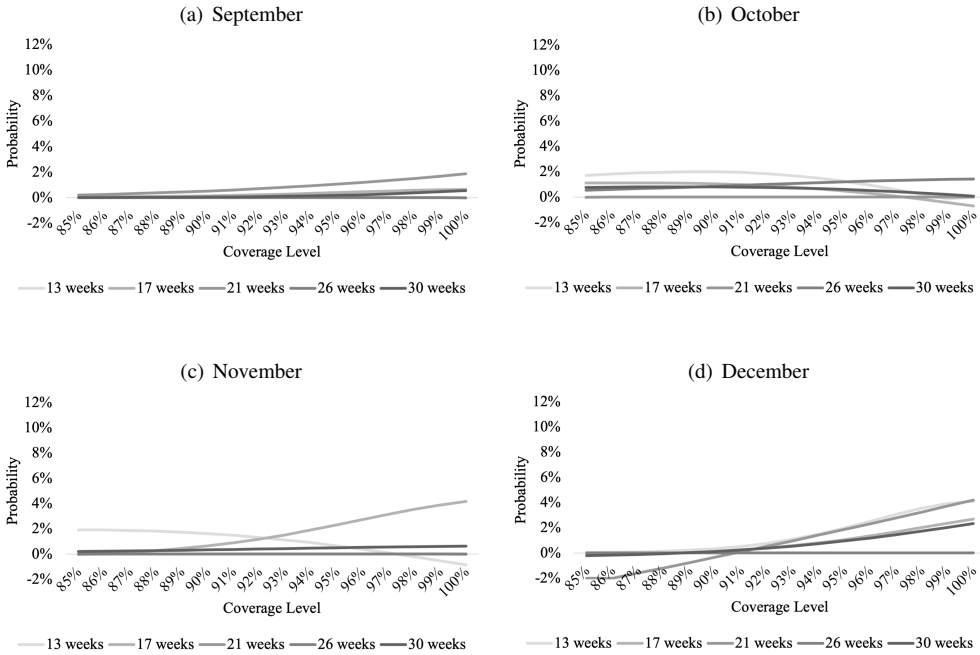

Figure 7. Predicted Probability Change of Net Livestock Risk Protection Price Being Greater Than the Actual Ending Price with the 2020 Subsidy Structure for September–December

Table 7. Average Livestock Risk Protection (LRP) Premium Cost for Producer ($/cwt) with the Pre-2019 and 2020 Subsidy Structure

Coverage Length	Pre-2019 Subsidy Structure	2020 Subsidy Structure	Change
Coverage level 85%–89.99%			
13 weeks	1.14	0.72	0.42
17 weeks	1.48	0.94	0.54
21 weeks	1.81	1.14	0.66
26 weeks	2.20	1.39	0.81
30 weeks	2.55	1.61	0.94
Coverage level 90%–94.99%			
13 weeks	1.88	1.29	0.58
17 weeks	2.36	1.63	0.73
21 weeks	2.76	1.90	0.86
26 weeks	3.27	2.26	1.02
30 weeks	3.57	2.46	1.11
Coverage level 95%–100%			
13 weeks	3.98	2.97	1.01
17 weeks	4.50	3.36	1.14
21 weeks	4.94	3.69	1.25
26 weeks	5.47	4.09	1.38
30 weeks	5.86	4.38	1.48

The impact of the new subsidy structure varied across months. In January and February, the likelihood of net LRP price being greater than the actual ending price increased by 1% to 6%, but March, April, and May experienced possible increases in the probability as high as 10%. An interesting finding is that the new likelihood of a net LRP price being greater than the actual ending price was 74% at 100% coverage for the 26-week contract ending in April and 63% for the 21-week contract ending in March. The 26-week contract is a long contract (182 days) but might make sense for a producer who backgrounds cattle. However, the 21-week contract (147 days) ending in March might be effective for stocker operations that graze cattle in the winter. The new subsidy structure was less impactful for September through December. The likelihood did increase by up to 4% for some contracts.

Table 7 shows the average producer premium (total premium minus the subsidy) for both subsidy structures by coverage levels and lengths. This table demonstrates the impact of the change in LRP subsidy structure. These decreases were between $0.42/cwt and $1.48/cwt, depending on the coverage level. However, it is not known how much producer premiums decreased with the subsidy change, because we do not know how the premium structure changed under the new subsidy structure.

Conclusions

LRP was introduced in 2003 to provide livestock producers a tool to protect against price risk. While this insurance policy was helpful in ways to small producers, adoption has been limited. In 2020, USDA RMA changed the subsidy structure of LRP to lower the cost, encouraging adoption of this tool. The objective of this study was to determine the impact of the 2020 subsidy rate on LRP price protection for feeder cattle producers by estimating the probability of the net LRP price being greater than the price producers would receive if they did not purchase insurance. We use LRP data from 2014–2018 to estimate monthly logit models to determine the probability of

outcomes under the previous subsidy rate and under the new subsidy rate. Results are informative for producers in selecting a LRP contract that is most effective in the month they market cattle as well as understanding how effective the new subsidy rates are at improving producers' protection.

The study shows that LRP contract lengths and coverage levels that provide the most protection vary across months in which cattle are sold. The level of protection offered by LRP varies across months as well. For example, feeder cattle producers selling cattle in June, July, and August do not appear to gain much protection from LRP. However, purchasing LRP in other months will result in a higher price than not purchasing LRP 50% to 60% of the time. With the new subsidy structure, these same conclusions were found, but the study shows the likelihood the net LRP price being greater than the actual ending price increased in some months. For example, spring marketed feeder cattle benefited the most from this new subsidy structure.

The new subsidy structure appears to be helpful by lowering the cost of LRP assuming the formula for premiums stays the same with the new subsidy structure. The lower cost increased the likelihood of the net LRP price being greater than the actual ending price in some months when contracts expired. However, LRP contracts terminating in June, July, and August did not appear to be that effective for producers even under the new subsidy structure. It might be interesting to explore how premiums vary across months and if these premiums accurately reflect risk. Future research might also explore how these lower premium costs and higher likelihood of net LRP price being greater than the actual ending price impacts producer adoption of LRP and how a producer might select a LRP contract to match their production system. These types of data would likely need to be collected through a producer survey specifically about price risk management. This could develop a discussion about how producers' needs vary by region, how various production systems match with LRP alternatives, and how LRP could be modified to better impact all producers.

[First submitted April 2021; accepted for publication November 2021.]

References

Belasco, E. J., M. Taylor, B. Goodwin, and T. Schroeder. "Probabilistic Models of Yield, Price, and Revenue Risks for Fed Cattle Production." *Journal of Agricultural and Applied Economics* 41(2009):91–105. doi: 10.1017/S1074070800002571.

Burdine, K. H., and G. Halich. "Payout Analysis of Livestock Risk Protection Insurance for Feeder Cattle." *Journal of the American Society of Farm Managers and Rural Appraisers* 2014(2014): 1–14. doi: 10.22004/ag.econ.197103.

Coelho, A. R., D. R. Mark, and A. Azzam. "Understanding Basis Risk Associated with Fed Cattle Livestock Risk Protection Insurance." *Journal of Extension* 46(2008):1RIB6.

Feuz, D. M. "A Comparison of the Effectiveness of Using Futures, Options, LRP Insurance, or AGR-Lite Insurance to Manage Risk for Cow-calf Producers." 2009. Paper presented at the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, April 20–21, St. Louis, Missouri. doi: 10.22004/ag.econ.53046.

Fields, D., and J. Gillespie. "Beef Producer Preferences and Purchase Decisions for Livestock Price Insurance." *Journal of Agricultural and Applied Economics* 40(2008):789–803. doi: 10.1017/S1074070800002339.

Flournoy, R. H. *Product Management Bulletin: PM-20-064*. Washington, DC: US Department of Agriculture, Risk Management Agency, 2020. Available online at https://www.rma.usda.gov/en/Policy-and-Procedure/Bulletins-and-Memos/2020/PM-20-064.

Hall, D. C., T. O. Knight, K. H. Coble, A. E. Baquet, and G. F. Patrick. "Analysis of Beef Producers' Risk Management Perceptions and Desire for Further Risk Management Education." *Review of Agricultural Economics* 25(2003):430–448. doi: 10.1111/1467-9353.00148.

Hart, C. E., B. A. Babcock, and D. J. Hayes. "Livestock Revenue Insurance." *Journal of Futures Markets* 21(2001):553–580.

Hill, S. *Exploring Producer Perceptions for Cattle Price and Animal Performance in the Stocker Industry*. Master's thesis, Kansas State University, 2015.

Mark, D. R., T. C. Schroeder, and R. D. Jones. "Identifying Economic Risk in Cattle Feeding." *Journal of Agribusiness* 18(2000):331–344. doi: 10.22004/ag.econ.14712.

Martinez, C. C., J. G. Maples, and J. Benavidez. "Beef Cattle Markets and COVID-19." *Applied Economic Perspectives and Policy* 43(2021):304–314. doi: 10.1002/aepp.13080.

McKendree, M. G. S., G. T. Tonsor, and L. L. Schulz. "Management of Multiple Sources of Risk in Livestock Production." *Journal of Agricultural and Applied Economics* 53(2021):75–93. doi: 10.1017/aae.2020.31.

Merritt, M. G., A. P. Griffith, C. N. Boyer, and K. E. Lewis. "Probability of Receiving a Payment from Feeder Cattle Livestock Risk Protection." *Journal of Agricultural and Applied Economics* 49(2017):363–381. doi: 10.1017/aae.2016.44.

SAS Institute, Inc. *SAS/ETS® User's Guide, Version 9.1*. Cary, NC: SAS Institute, Inc., 2003. Available online at http://support.sas.com/documentation/cdl/en/statug/63962/HTML/default/viewer.htm.

US Department of Agriculture. *ADM Livestock*. Washington, DC: US Department of Agriculture, Risk Management Agency, 2021a. Available online at https://ftp.rma.usda.gov/pub/References/adm_livestock/.

———. *Livestock Insurance Plans*. Washington, DC: US Department of Agriculture, Risk Management Agency, 2021b. Available online at https://www.rma.usda.gov/Policy-and-Procedure/Insurance-Plans/Livestock-Insurance-Plans.

———. *Quick Stats*. Washington, DC: US Department of Agriculture, National Agricultural Statistics Service, 2021c. Available online at https://www.nass.usda.gov/Quick_Stats/.

Wei, H. *A Comparative Analysis of Expected Utility of Futures, Options, and Livestock Risk Protection Insurance: Which Hedging Tool Is Desirable for Small, Medium, or Large Sized Feeder Cattle Producers Whose Farms Are Low, Average, or High Management Risk*. Master's thesis, Oklahoma State University, 2019.