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Examining how Risk Preferences and Information Affect Livestock Risk Protection Use

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Abstract

United States (US) livestock cattle have several tools to manage price risk such as options contracts, futures contracts, and livestock risk protection (LRP) insurance. However, use of price risk management tools among beef cattle producers has historically been limited despite price risk being one of the primary sources of risk to the United States (US) cattle industry. The purpose of this research is to determine factors associated with the use of options contracts, futures contracts, and LRP insurance. We conducted a survey of US cattle producers and estimated a multivariate probit model to understand what drives the likelihood of use. We find most producers never used any price risk management tools, but LRP was the most used (12.5%), followed by futures contracts (6%) and option contracts (5.5%). Producer age, herd size, risk preferences, perceived effectiveness, and other factors were found to impact adoption. Findings inform industry stakeholders, educators, and policymakers in developing interventions to encourage wider utilization of these tools.

Keywords: Adoption, Beef cattle, Risk Management, Survey

Introduction

As with any commodity, United States (US) beef cattle production is not immune to market fluctuations or price risk, which can cause major economic losses (Hart et al. 2001; Hall et al. 2003; Belasco et al. 2009; Tonsor and Schroeder 2011). Price risk refers to the uncertainty of the expected price of a commodity at its time of sale (Kay, Edwards, and Duffy 2024). To manage the price risk, cattle producers have various price risk management tools at their disposal, such as futures contracts, options contracts, and livestock risk protection (LRP). However, the adoption of these tools by cattle producers has been limited (Hill 2015; McKendree, Tonsor, and Schulz

2021). According to Hill (2015), only 7% of surveyed beef producers utilized LRP to manage price risk, compared to futures (37%) and options (27%) contracts. McKendree, Tonsor, and Schulz (2021) reported similar numbers that only 1% of the cattle producers surveyed used LRP, 20% used options contracts, and 41% used futures contracts.

Several reasons have been attributed to cattle producers not frequently using these price risk management tools. Studies have explored the effectiveness of these tools, but these reports generally show price risk management tools can be effective if properly implemented (Belasco et al. 2009; Feuz 2009; Burdine and Halich 2014; Merritt et al. 2017; Wei 2019; Boyer and Griffith 2023a, 2023b). One of the noted obstacles to using futures and options contracts by cattle producers is that these contracts are not suitable for most cattle operations due to their size. For example, feeder cattle contracts are traded in increments of 50,000 pounds, equivalent to 55 to 71 head of feeder cattle weighing between 700 to 899 pounds. According to the 2017 Census of Agriculture, the average US beef cattle herd consists of 44 head, implying that most US beef cattle producers do not annually market 50,000 pounds of calves (United States Department of Agriculture [USDA] National Agricultural Statistic Service [NASS] 2019). If a producer with less than 50,000 pounds of feeder cattle uses futures and options to hedge, they would over-hedge, which could increase their risk and render these tools ineffective (Griffith 2014). Feuz (2009) and Wei (2019) compared the use of cash market, futures contracts, options contracts, and LRP for small cattle producers. They used simulation models considering various sources of risk. These studies report LRP is most applicable for producers unable to fulfill a 50,000-pound futures contract.

LRP insurance is another tool that cattle producers can use to manage price risk. It is a government-sponsored program to help cattle producer manage economic losses from price

declines. LRP is a price insurance policy cattle producers can purchase daily to insure a minimum price level for a certain period. These policies can be customized by the number of head (between one and 25,000 head per crop year), the insurance periods (13, 17, 21, 26, 30, 34, 39, 43, 47 or 52 weeks), and coverage levels (70-100%) of an expected price at the end of the insurance period, which varies daily by sex, breed, and weight. Purchasers pay a subsidized premium to guarantee a price floor (i.e., coverage price) over an insurance period. LRP policyholders are paid an indemnity payment at the end of an insurance period if the expected price (either Chicago Mercantile Exchange (CME) Feeder Cattle Index or CME live cattle futures price) is lower than the insured coverage price (USDA Risk Management Agency [RMA] 2022a).

Like futures and options contracts, LRP has had limited adoptions which is mostly attributed to the cost of LRP. Studies have shown premium for LRP was frequently higher than the indemnities paid if a payment is triggered (Burdine and Halich 2014; Merritt et al. 2017). Also, Merritt et al. (2017) showed not all LRP contract lengths and coverage levels are equally effective across months due to seasonality of cattle prices. The USDA RMA did, however, increase the LRP premium subsidy for producers in 2019 and 2020 (USDA RMA 2020). Prior to 2019, the premium subsidy for producers was 13% of the total premium and today the subsidy is tiered structured rate ranging between 35% to 55% based on coverage level (USDA RMA 2020). Studies have shown the increased subsidy rate has lowered the premium cost for fed and feeder cattle producers and increased the likelihood of the indemnity being greater than the premium (Boyer and Griffith 2023a, 2023b).

Another possible explanation that has received little attention is how individual risk preferences impact producers use of price risk management. Recent literature has shown how

risk preferences impact the adoption of practices in row crop production (Ihli et al. 2016; Campbell et al. 2021; Khanal et al. 2021). However, much less is known about risk preferences impact on cattle producers' decisions to use price risk management tools. Fields and Gillespie (2008) included risk preferences in their survey of producers' willingness to purchase a hypothetical livestock insurance product and found more risk averse producers are likely to purchase insurance. McKendree, Tonsor, and Schulz (2021) showed that more risk averse producers were more likely to use price risk mitigation strategies but did not identify differential across the various tools (futures, options, and LRP).

Building from these studies, we determine how risk preferences and other factors impact the use of LRP, futures contracts, and options contracts for managing price risk for cattle production. We conducted a survey of US cattle producers and estimated multivariate probit models to understand what drives the likelihood of adoption. The findings create a basis for educational program for producers in handling price uncertainty and may have consequences for future policy modifications. The paper also broadens the body of knowledge on the acceptance of price risk management among cattle producers.

Data

Data came from a 2022 email survey of US beef cattle producers through Qualtrics (XXX IRB-XX-XXXXX-XX). A list frame of 110,000 US beef cattle producers was purchased from DTN. A total of 22,581 emails were bounced or failed to send, leaving a total of 87,419 email addresses. The survey was administered following Dillman's (2007) method using Qualtrics. A pretest sample of 15 livestock producers and Extension Agents received a survey prior to the launch. The survey questions and format was revised using feedback from the pretest.

Individuals identified with an email address received the survey on June 1, 2022. A reminder email was sent one week following the initial delivery and another reminder was sent a week following that first follow-up email. We received a total of 699 responses of which only 599 were completed surveys resulting in a response rate of slightly less than 1%. While this is a low response rate, it is consistent with other emailed cattle producer surveys which had a response rate of 1.9% (McKendree, Tonsor, and Wolf 2016).

The survey instrument was divided into multiple sections. The first section included questions on livestock numbers, farm size, and how cattle were marketed. The next section included questions about the use of LRP, futures and options contracts. Producers were asked to indicate the barriers of using these tools and their perceived effectiveness of the tools. The next section elicited producers' risk preferences using a stated preference approach (Dohmen et al. 2011). Producers were asked to rate their willingness to take risks in financial matters related to the cattle business from zero (not at all willing) to 10 (very willing). The producers were also asked where they get information about prices and the importance of managing price risk in the cattle business. Finally, producers were asked to provide information about their education, age, and income.

Method

Multivariate Probit Model

A multivariate probit model was estimated to determine factors impacting the likelihood of using LRP, futures contracts, and options contracts. The dependent variables were binary and equal to one if the respondent had used or currently used the given price risk management tool and zero otherwise. To control for any potential correlations among these unexplained factors of adoption

of future contracts, option contracts and LRP, we estimate a multivariate probit model (Greene 2012). The model is generally defined as

$$(1) Y_{ij} = x'_{ij}\beta_j + \varepsilon_{ij}, \quad (j = 1, \dots, m)$$

where Y_{ij} ($j = 1, \dots, m$) represent the binary price risk management use decision for LRP, futures contracts, and options contracts by the i th producer; x'_{ij} denotes a matrix of explanatory variables that impact the adoption of risk management tools; β_j is the vector of coefficients to be estimated; and ε_{ij} is the unobserved error term that are assumed to be multivariate normal distributed (Greene 2012). The model was estimated using `cmp` with Huber-White Sandwich estimator in StataCorp (2013). Variance inflation factor was used to detect if multicollinearity was an issue in the model. Marginal effects were estimated for coefficients estimated with the multivariate probit. While the model coefficients indicate the direction the relationship between the predictors and the dependent variables, they do not directly provide the magnitude or give a practical interpretation often required for decision-making and policy formulation (Wooldridge, 2010). The delta method was used to calculate marginal effects (Greene 2012) in StataCorp (2013).

Hypothesized Variable Signs

Table 1 defines the independent variables included in our analysis and gives a hypothesized sign for the explanatory variables selected for this study. The literature indicates that adoption of risk management tools are likely impacted by producers' characteristics, herd characteristics, farm characteristics, risk preference, cost of using these tools and perceived effectiveness and understanding of these tools and their method of selling cattle.

<<< Table 1 >>>

Producers' characteristics include in our analysis are age, level of education, their household income, and household income that comes from their cattle operation. We expect an increase in age will decrease the likelihood of buying price risk management tools. Studies have reported cattle producers are less likely to adopt new practices with age (Gillespie et al. 2007; Ward et al. 2008; Lambert et al. 2020); however, other studies have shown age does not significantly impact adoption of practices such as grazing management for beef cattle producers (Boyer et al. 2020; 2022). Similar, studies generally show college education increases the likely of cattle producers using various management practices (Pruitt et al. 2012; Lambert at al. 2020; Boyer et al. 2022; Ren et al. 2022); thus, we hypothesis the estimated parameter will be positive. Mixed results are often reported for how household income and percentage of their income coming from the beef cattle operations impacts use of various practices (Gillespie et al. 2007; Lambert et al. 2020; Ren et al. 2022). We are unsure how these variable will impact the use of these tools.

For herd characteristics, we considered what kind of cattle the producers own, and we analyze them as the percent of their own cattle that they classify are cows, stockers, and cattle in a feedlot. McKendree, Tonsor, and Schulz (2021) found that larger feedlot operations were more likely to use price risk management strategies; therefore, we assume a higher percentage of producers with cattle in a feedlot are more likely to use these tools. Also, if the producer marketed cattle in an auction market, we expected these producers to be more likely to use LRP. The market uncertainty of this marketing method might encourage producers to insure against price risk. However, McKendree, Tonsor, and Schulz (2021) reported most producers in their survey primarily sold cattle in the spot market without using price risk management.

Regarding risk, Fields and Gillespie (2008) and McKendree, Tonsor, and Schulz (2021) included risk preferences in their surveys of producers' willingness to manage price risk using various tools. Both these studies found more risk averse producers were more likely to use price risk mitigation strategies. Similarly, Davidson and Goodrich (2023) included a risk preference measurement when trying to understand cattle producers use of pasture, rangeland, and forage insurance and found risk averse slightly impacts use of this insurance product. Therefore, we hypothesized that producers who are more risk averse would be more willing to purchase the price risk management tools used in this study; thus, the sign of the risk preferences parameter estimate was expected to be negative.

We hypothesize that producers' perceived understanding and perceived effectiveness of these price risk management tools could impact the adoption. A greater perceived effectiveness is anticipated to increase the likelihood of using these tools, but we are unsure who a perceived understanding impacts the likelihood of using these tools. Studies have shown that small operations are better off using LRP than futures and options contracts (Wei 2019); thus, we assume that if respondents believe they are too small to benefit from the using price risk management, they are less likely to use them. We also hypothesis that those who check price daily might be more likely to use price risk management.

Result

Summary Statistics

Table 2 provides summary statistics for the variables we analyzed. The mean age of the respondents is calculated at 60 years old. Approximately 50.3% of respondents hold at minimum a bachelor's degree, establishing an equilibrium between individuals with advanced education

and those at other educational levels. Regarding herd composition, we find that the average proportions of cows, stockers, and feedlot cattle stand at 54.9%, 10.5%, and 3.6% respectively. The remaining percentage was cattle reported as calves not yet sold.¹ Noteworthy is the observation that 80.6% of respondents primarily favor traditional auction markets for cattle marketing.

<<< Table 2 >>>

The mean risk preference score was 5.57, which suggests respondents were risk neutral. Producers indicated an average score of 4.61 (out of five) that they agree their operation is too small to benefit from price risk management. The average response to household income coming from cattle farming was a 2.3, which indicates about 20% of the respondents household income came from cattle farming. Concurrently, the calculated average categorized income of 4.59 indicates most the respondents had a household income between \$50,000 to \$100,000. Regarding the frequency of cattle price monitoring, approximately 18.5% of respondents check cattle prices daily.

Figure 1 shows the beef cattle producer's use of price risk management tools. More than 90% of the respondents have never used future contracts or options contracts, and around 82% of the respondents never used LRP for price risk management. Of these tool, more of our respondents had used LRP than futures and options contracts. This is different than what Hill (2015) and McKendree, Tonsor, and Schulz (2021) reported in their studies. Overall, the use of these price risk management tools were like statistics reported in studies, which is majority of producers are not using price risk management tools.

<< Figure 1 >>

¹ This variable was dropped from the analysis to avoid multicollinearity.

As for their understanding of price risk management tools, most of our respondents stated that they have little to no idea about these tools, which is around 59% to 69% (Figure 2). Moreover, very few of our respondents indicated they understand these tools very well (2% to 3%) (Figure 2). These findings suggest that there is a lack of knowledge about price risk management tools among cattle producers. Like their usage of these tools, the lack of understanding is higher for futures and options, 65% and 69% respectively, than LRP (59%). Respondents' perceived effectiveness of using these tools is also low (Figure 3). More than 65% of our respondents have no idea about the effectiveness of these tools. Conversely, 13% to 20% of respondents believe that these tools are effective for managing price risk (Figure 3). Comparing among these tools, LRP is perceived to be the most effective tool (20%) compared to futures and options, which were 16% and 13%, respectively.

<< Figure 2 >>

<< Figure 3 >>

Regression Results

These regression results are presented in Table 3 and marginal effects of these significant factors, as shown in Table 4. Table 3 shows the unexplained factor for the use of LRP, and futures contracts were not statistically correlated. However, the unexplained factors for futures and options contracts as well as for options contracts and LRP were correlated. This is interesting given that LRP functions like a put option contract.

<< Table 3 >>

<< Table 4 >>

For LRP, our analysis demonstrates a significant positive correlation with the percentage of cows in the herd. A one percent increase in the respondent's herd being cows increased the likelihood of using LRP by 0.14% suggesting that cow-calf producers were more likely to utilize LRP. If the respondent has a higher perceived understanding of LRP, they were more likely to use LRP. A one-unit increase in the Likert scale value of understanding increased the likelihood of use by 5%. Additionally, if the respondent had a higher portion of their household income coming from their cattle operation, they were more likely to use LRP, suggesting that higher reliance on cattle operations for income increases the likelihood of using LRP. Producers who check cattle prices daily were 5% more likely to use LRP.

In the case of futures, we observe producer with more their cattle in the feedlot were more likely to use futures contracts. A one percent increase in cattle owned in the feedlot increased the likelihood of use by 0.06%. Also, we see that risk preferences were positively correlated with use of futures contracts, which diverges from our hypothesis that more risk-averse producers would be inclined towards insurance-like tools. This result suggests that producers more open to taking risks are more likely to use futures as a price risk management strategy. This differs from the literature (Field and Gillespie 2008; McKendree, Tonsor, and Schulz 2021) but Hellerstein, Higgins, and Horowitz (2013) found that more risk seeking producers were more likely to buy insurance. Similar to LRP, an increase in perceived understanding and the daily checking of cattle prices increases the likelihood of using futures contracts. Combining these two results about risk and price checking, it appears those who are actively monitoring the market and more risk tolerant might be more inclined to use future market contracts to manage price risk. If a respondent believes their operation is too small to benefit from price risk management, they were 0.9% less likely to use future contracts. Unique to

futures contracts, the more effective futures contracts were to managing price risk, the more likely the respondents were to use futures contracts.

Like futures contracts, an increase in the percentage of cattle owned in a feedlot increased the likelihood of using options contracts. Moreover, if the respondent believed their operation was too small to benefit from price risk management, they were less likely to use options contracts. An increased understanding in options in options contracts and daily market monitoring, both showing positive relationships with the adoption of options. This finding aligns with those for LRP and futures contract use.

Understanding of these various price risk management tools is positive and significant across the tools. This indicates that further understanding or education can facilitate the use of price risk management by cattle producers. Also, those who are checking prices daily are more likely to use tools. This suggests that educating producers on the importance of frequent price monitoring could also increase the use of use. Finally, an interesting finding for policy makers is while futures and options contracts less likely to be used by respondent who believe their operation was too small to benefit from the price risk management, LRP use was not impacted by this variable. Thus, this could indicate size is not a barrier for respondents in this survey to use LRP. This is encouraging since LRP was developed for the small livestock farmers.

Conclusion

The US livestock industry is often confronted with large economic losses due to price uncertainty. Cattle producers have various price risk management tools available to use to help manage price risk but historically adoption has been low. The purpose of this research is to determine factors associated with the use of options contracts, futures contracts, and LRP

insurance. To do this, we conducted a survey of US cattle producers asking them about their use of these tools and estimated a multivariate probit model to understand what drives the likelihood of use. The contribution of this work is to help identify barriers to use as well as ways to encourage adoption.

The findings of this research indicate that beef cattle producers have limited usage, understanding, and perceived effectiveness of price risk management tools. The survey data reveals that most respondents have never utilized future contracts, options contracts, or LRP for price risk management. The regression shows understanding factors such as age, education, household income, daily activities, cow percentage, and understanding play significant roles in influencing the utilization and perception of price risk management tools among producers.

These findings have important implications for both policymakers and industry stakeholders. Efforts should be made to educate and raise awareness among beef cattle producers regarding the benefits and usage of price risk management tools, with particular emphasis on futures and options. Enhancing understanding and knowledge in this area can contribute to improved risk management practices and potentially better financial outcomes for producers. Additionally, promoting the perceived effectiveness of LRP may encourage its adoption and utilization among cattle producers.

References

- Belasco, E., M. Taylor, B. Goodwin, and T. Schroeder. (2009). Probabilistic Models of Yield, Price, and Revenue Risks for Fed Cattle Production. *Journal of Agricultural and Applied Economics*, 41, 91-105.
- Bishu, K. G., S. O'Reilly, E. Lahiff, and Steiner, B. (2018). Cattle farmers' perceptions of risk and risk management strategies: evidence from Northern Ethiopia. *Journal of Risk Research*, 21(5), 579-598.

- Boyer, C.N., K.L. DeLong, A. P. Griffith., and C.C. Martinez. 2024. “Factors Influencing United States Cattle Producers Use of Livestock Risk Protection.” *Agricultural Economics* <https://doi.org/10.1111/agec.12838>
- Boyer, C.N., K.E. Cavazos, J.A. Greig, and S.M. Schexnayder. 2024. “Influence of Risk and Trust on Beef Producers’ Adoption of Precision Livestock Farming” *Computers and Electronics in Agriculture* 218:108641
- Boyer, C. N., and A. P. Griffith. (2023a). Subsidy Rate Changes on Livestock Risk Protection for Feeder Cattle. *Journal of Agricultural and Resource Economics*, 48(1), 31-45.
- Boyer, C. N., and A. P. Griffith. (2023b). Increasing Livestock Risk Protection Subsidies Impact on Producer Premiums. *Agricultural Finance Review*, 83(2), 201-210.
- Boyer, C.N., D.M. Lambert, A.P. Griffith, and C.D. Clark. 2022. “Factors Influencing Use and Frequency of Rotational Grazing for Beef Cattle in Tennessee.” *Journal of Agricultural and Applied Economics* 54(2):394-406.
- Boyer, C.N., D.M. Lambert, A.P. Griffith, C.D. Clark, and B. English. 2020. “Seasonal Hay Feeding for Cattle Production in the Fescue Belt.” *Journal of Agricultural and Applied Economics* 52:16-29.
- Boyer, C.N., E. Park, A.P. Griffith, K.L. DeLong, and C.C. Martinez. 2023. “Feeder and Fed Cattle Purchases of Livestock Risk Protection” *Agricultural Finance Review* 83(4/5):720-733.
- Burdine, K. H., and G. Halich. (2014). Payout Analysis of Livestock Risk Protection Insurance for Feeder Cattle. *Journal of the American Society of Farm Managers and Rural Appraisers*, 160-173.
- Cameron, A.C. and Trivedi, P.K. (2005) *Microeconometrics: Methods and Applications*. Cambridge University Press, New York. <http://dx.doi.org/10.1017/CBO9780511811241>
- Campbell, K., C. N. Boyer, D. M. Lambert, C. D. Clark, and S. A. Smith. (2021). Risk, Cost-Share Payment, and Adoption of Cover Crops and No-Till. *Journal of Soil and Water Conservation*, 76(2), 166-174.
- Davidson, K. A., and B. K. Goodrich. (2023). Nudge to Insure: Can Informational Nudges Change Enrollment Decisions in Pasture, Rangeland, and Forage Rainfall Index Insurance? *Applied Economic Perspectives and Policy*, 45(1), 534-554.
- DeLong, K. L., K. L. Jensen, A. P. Griffith, C. N. Boyer, and C. C. Martinez. (2023). Feeder Cattle Genomic Tests: Analyzing Cattle Producer Adoption Decisions. *Journal of the Agricultural and Applied Economics Association*, 2, 334-349.

- Dillman, D. A. (2007). *Mail and Internet Surveys: The Tailored Design Method* (2nd ed.). John Wiley & Sons Inc.
- Dohmen, T., A. Falk, D. Huffman, U. Sunde, J. Schupp, and G. G. Wagner. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, 9(3), 522-550.
- Field, D., and J. Gillespie. (2008). Beef Producer Preferences and Purchase Decisions for Livestock Price Insurance. *Journal of Agricultural and Applied Economics*, 40, 789-803.
- Gillespie, J., S.A. Kim, and K. Paudel. "Why Don't Producers Adopt Best Management Practices? An Analysis of the Beef Cattle Industry." *Agricultural Economics* 36(2007):89-102.
- Goodwin, B. K., and T. C. Schroeder. (1994). Human capital, producer education programs, and the adoption of forward-pricing methods. *American Journal of Agricultural Economics*, 76, 936-947.
- Griffith, A. P. (2014). *Livestock Risk Protection Insurance (LRP): How it Works for Feeder Cattle*. University of Tennessee Extension Publication W312.
- Greene, W. H. (2002). Convenient Estimators for the Panel Probit Model: Further Results. NYU Working Paper No. EC-02-06. Retrieved from SSRN: <https://ssrn.com/abstract=1292652>
- Hall, D. C., T. O. Knight, K. H. Coble, A. E. Baquet, and G. F. Patrick. (2003). Analysis of Beef Producers' Risk Management Perceptions and Desire for Further Risk Management Education. *Review of Agricultural Economics*, 25, 430-448.
- Hart, C. E., B. A. Babcock, and D. J. Hayes. (2001). Livestock Revenue Insurance. *Journal of Futures Markets*, 21, 553-580.
- Hill, S. (2015). *Exploring Producer Perceptions for Cattle Price and Animal Performance in the Stocker Industry* (Master's thesis). Department of Agricultural Economics, Kansas State University.
- Ihli, H. J., B. Chiputwa, and O. Musshoff. (2016). Do changing probabilities or payoffs in lottery-choice experiments affect risk preference outcomes? Evidence from rural Uganda. *Journal of Agricultural and Resource Economics*, 41, 324-345.
- Khanal, A. D., A. K. Mishra, and G. Lien. (2021). Effect of Risk Attitude and Risk Perceptions on Risk Management Decisions: Evidence from Farmers in an Emerging Economy. *Journal of Agricultural and Resource Economics*, forthcoming.
- Lambert, D.M., C.D. Clark, L.J. Medwid, S.A. Hawkins, and H.A. McClellan. 2020. "Best Pasture Management Practice Adoption and Sediment Abatement." *Journal of Agricultural and Applied Economic* 52:204-221.

- McKendree, M. G. S., G. T. Tonsor, and C. A. Wolf. (2016). "Similarities and Differences of Animal Welfare Perceptions between U.S. Cow-Calf Producers and the Public," 2016 Annual Meeting, February 6-9, 2016, San Antonio, Texas 230018, Southern Agricultural Economics Association.
- McKendree, M. G. S., G. T. Tonsor, and L. L. Schulz. (2021). Management of Multiple Sources of Risk in Livestock Production. *Journal of Agricultural and Applied Economics*, 53(1), 75-93. doi:10.1017/aae.2020.31
- Merritt, M. G., A. P. Griffith, C. N. Boyer, and K. E. Lewis. (2017). Probability of Receiving a Payment from Feeder Cattle Livestock Risk Protection. *Journal of Agricultural and Applied Economics*, 49(3), 363-381.
- Mishra, A. K., and H. S. El-Osta. (2002). Managing risk in agriculture through hedging and crop insurance: what does a national survey reveal? *Agricultural Finance Review*, 62, 135-148.
- Pruitt, R.J., Gillespie, J.M., Nehring, R.F., and Qushim, B. 2012. "Adoption of technology, management practices and production systems by U.S. beef cow-calf producers." *Journal of Agricultural and Applied Economics* 44(2): 203-222.
- Ren, Y., D.M. Lambert, C.N. Boyer, C.D. Clark, and A.P. Griffith. 2022. "Adoption of Warm Season Grasses by Beef Cattle Producers in the Fescue Belt." *Journal of Agricultural and Resource Economics* 47(1):190-208.
- Sherrick, B. J., P. J. Barry, P. N. Ellinger, and G. D. Schnitkey, G. D. (2004). Factors influencing farmers' crop insurance decisions. *American Journal of Agricultural Economics*, 86(1), 103-114.
- StataCorp. (2013). *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP
- United States Department of Agriculture National Agricultural Statistic Service. (2019). Quick Stats. Retrieved from https://www.nass.usda.gov/Quick_Stats/
- United States Department of Agriculture Risk Management Agency. (2020). USDA Announces Increased Subsidies and Other Improvements to the LRP Program. Retrieved from <https://www.rma.usda.gov/en/News-Room/Press/National-News-Archive/2020-News/2020-News/USDA-Announces-Increased-Subsidies-and-Other-Improvements-to-the-LRP-Program>
- United States Department of Agriculture Risk Management Agency. (2021a). Livestock Insurance Plans. Retrieved from <https://www.rma.usda.gov/Policy-and-Procedure/Insurance-Plans/Livestock-Insurance-Plans>

- Ward, C. E., M. K. Vestal, D. G. Doye, and D. L. Lalman. 2008. Factors Affecting Adoption of Cow-Calf Production Practices in Oklahoma. *Journal of Agricultural and Applied Economics* 40(3): 851-863.
- Wei, H. (2019). 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). Department of Agricultural Economics, Oklahoma State University.
- Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data*. The MIT Press. <http://www.jstor.org/stable/j.ctt5hhcfr>
- Zulfiqar, F., R. Ullah, M. Abid, and A. Hussain. (2016). Cotton production under risk: a simultaneous adoption of risk coping tools. *Natural Hazards*, 84, 959-974.

Table 1. Names and Definitions of Independent Variables

Variable	Description	Sign
Age	Age of the respondent	-
Education	= 1 if the producer had at least a bachelor's degree; 0 otherwise	+
Cattle Income	Estimated percentage of household income that came from beef cattle operation in 2021 ranging from zero to six with zero being 0% to 19.99% and six being 80% to 100%	+/-
Household Income	Respondents total taxable household income for 2021 categorized as integers ranging from 0 to 10 with zero less than \$10,000 and 10 being greater than \$500,000	+/-
Cow%	Percentage of total head of Cow in their herd	+/-
Stocker%	Percentage of total stocker purchased and raised in their herd	+/-
Feedlot%	Percentage of total cattle in a feedlot in their herd	+
Traditional auction	=1 if the respondent primarily marketed their cattle in a traditional auction market	+
Risk Preference	Willingness to take on risk in the cattle business with 1 being Scale of willingness to take risk with 0 is not at all willing to take risks to 10 being very willing to take risks, scale	-
Effectiveness	Respondents' perceived effectiveness of risk management tools ranging from a scale of 1 (no idea) to 7 (extremely effective)	+
Understanding	Respondents' understanding of the risk management tools ranging from a scale of 1 (no idea) to 7 (extremely well)	+
Small	Respondents stating their agreement with the statement that their cattle operation is too small to benefit from price risk management with one being completely disagree and five being completely agree	-
Daily	=1 if producers indicated they check cattle prices daily and zero otherwise	+

Table 2. Descriptive statistics of variables

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Age	595	59.047	12.787	26	89
Education	599	0.503	0.500	0	1
Cattle Income	599	2.323	2.225	0	10
Household Income	599	4.591	2.190	0	9
Cow%	594	0.549	0.231	0	1
Stocker%	594	0.105	0.237	0	1
Feedlot%	594	0.036	0.128	0	1
Traditional Auction	599	0.806	0.395	0	1
Risk Preference	599	5.566	2.958	0	10
Small	599	4.611	2.000	1	7
Daily	599	0.185	0.389	0	1

Table 3: Parameter estimates from multivariate probit analysis

Parameters	LRP		Futures		Options	
	Estimates	Standard error	Estimates	Standard error	Estimates	Standard error
Age	0.005	0.007	0.019	0.012	0.013*	0.008
Education	0.214	0.179	0.067	0.295	0.276	0.278
Cattle Income	0.096**	0.035	0.038	0.050	0.057	0.052
Household Income	0.041	0.043	0.049	0.612	0.105*	0.056
Cow%	1.129**	0.552	-0.499	0.770	-0.188	0.871
Stocker%	0.643	0.473	0.287	0.640	-0.065	0.613
Feedlot%	0.516	0.670	1.156*	0.694	1.213*	0.679
Traditional Auction	0.142	0.219	-0.149	0.307	0.497*	0.293
Risk Preference	0.028	0.033	0.112**	0.047	0.004	0.042
Effectiveness ^a	-0.011	0.057	0.158**	0.052	-0.031	0.083
Understanding ^b	0.438***	0.052	0.203**	0.070	0.348***	0.085
Small	-0.042	0.042	-0.150**	0.058	-0.145**	0.048
Daily	0.362*	0.216	0.772**	0.313	0.895***	0.243
Intercept	-	0.760	-	1.253	-4.454***	1.020
Rho 1 & 2	0.281					
Rho 1 & 3	0.605**					
Rho 2 & 3	0.731***					

Note: *p < 0.10; **p < 0.05; ***p < 0.01

^a Represents Respondents' perceived effectiveness of risk management tools ranging from a scale of 1 (no idea) to 7 (extremely effective)

^b Represents Respondents' understanding of the risk management tools ranging from a scale of 1 (no idea) to 7 (extremely well)

Table 4 : Marginal effects for the price risk management tools

Parameters	LRP		Futures		Options	
	Estimates	Standard error	Estimates	Standard error	Estimates	Standard error
Age	0.006	0.001	0.001*	0.001	0.001	0.001
Education	0.025	0.022	0.004	0.017	0.015	0.016
Cattle Income	0.011**	0.004	0.002	0.003	0.003	0.003
Household Income	0.005	0.005	0.003	0.003	0.006*	0.003
Cow%	0.136**	0.065	-0.029	0.045	-0.01	0.049
Stocker%	0.078	0.056	0.017	0.037	-0.004	0.034
Feedlot%	0.062	0.081	0.067	0.041	0.067	0.036
Traditional Auction	0.017	0.026	-0.009	0.018	0.027*	0.016
Risk Preference	0.003	0.004	0.006**	0.002	0.000	0.002
Effectiveness ^a	-0.001	0.006	0.009**	0.003	-0.002	0.005
Understanding ^b	0.053***	0.005	0.012***	0.004	0.019***	0.004
Small	-0.005	0.005	-0.009**	0.003	-0.008**	0.003
Daily	0.043*	0.026	0.044**	0.017	0.049***	0.011

Note: *p < 0.10; **p < 0.05; ***p < 0.01

^a Represents Respondents' perceived effectiveness of risk management tools ranging from a scale of 1 (no idea) to 7 (extremely effective)

^b Represents Respondents' understanding of the risk management tools ranging from a scale of 1 (no idea) to 7 (extremely well)

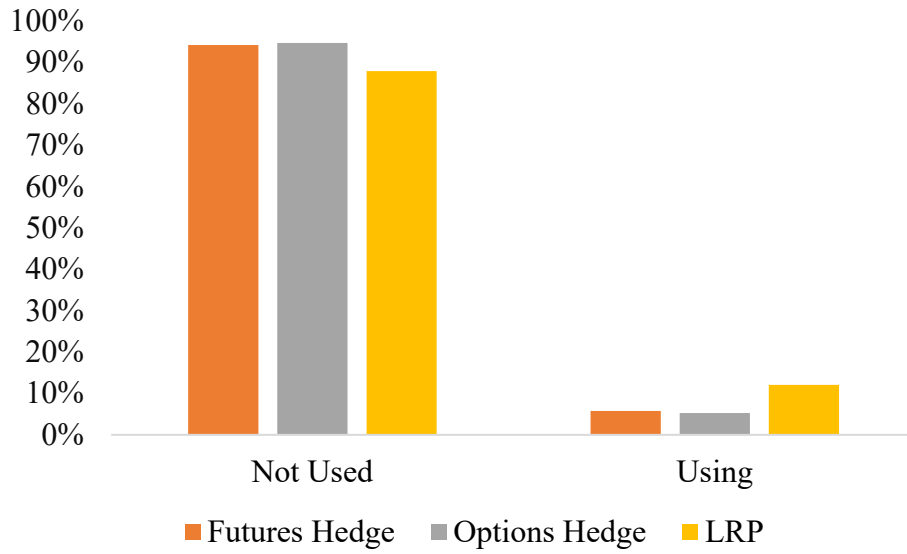


Figure 1 : Beef Cattle Producers' Use of Price Risk Management Tools

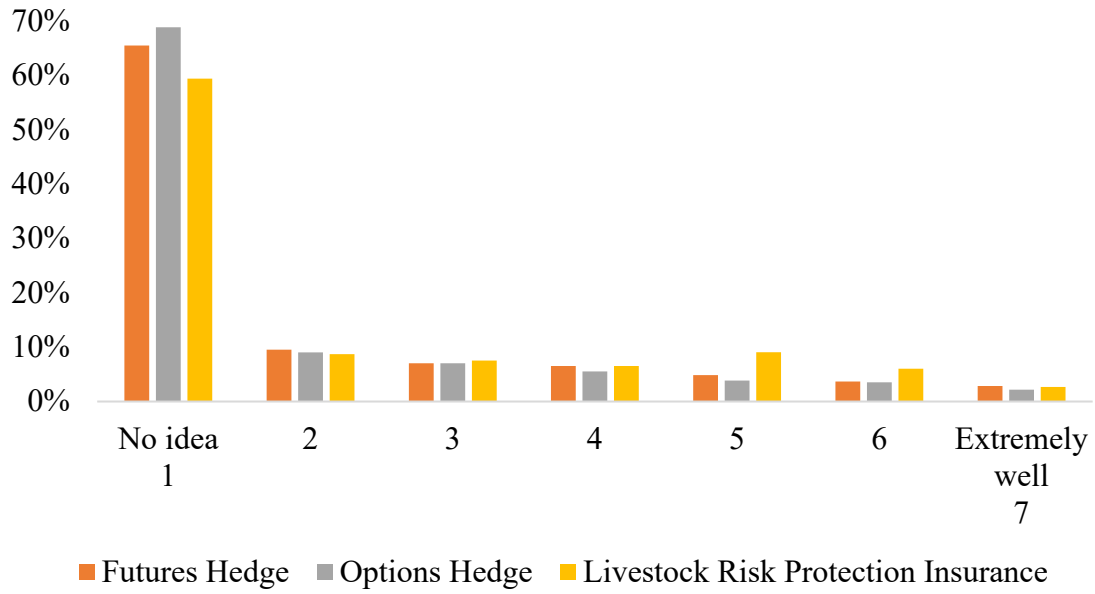


Figure 2 : Beef Cattle Producers' Understanding of Price Risk Management Tools

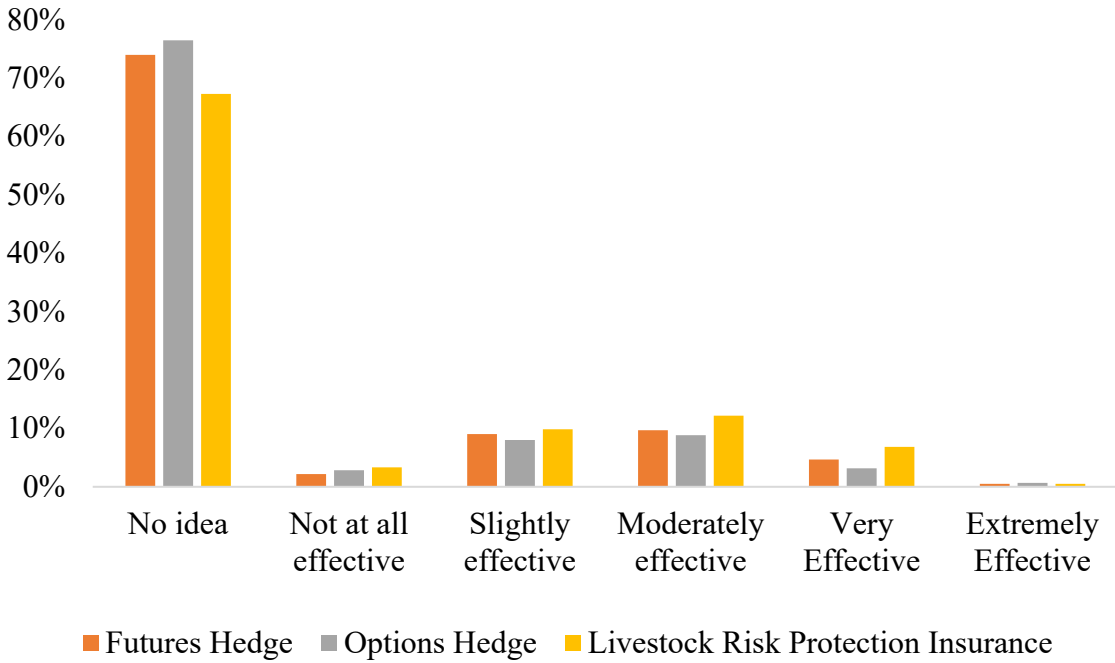


Figure 3: Beef Cattle Producers' Perceived Effectiveness of Price Risk Management Tools