Real Subsidy, Elusive Harvest: Timing, Frictions, and the Economics of Livestock Risk Protection Arbitrage*

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Abstract

This paper examines whether premium subsidies in the USDA's Livestock Risk Protection (LRP) program create opportunities for "subsidy harvesting," whereby producers pair subsidized insurance coverage with offsetting exchange-traded put options to capture risk-free gains. Combining county-level LRP endorsements with contract-level CME options data from 2011–2025, we find clustering of endorsements around option expiration weeks and show that the potential harvest value turns positive after the 2020 subsidy expansion. Yet, a friction-aware Monte Carlo simulation calibrated to livestock futures and program mechanics (bid-ask and commissions, SPAN margin financing, basis/index rules, and audit penalties) delivers negative expected returns across livestock categories, coverage levels, and producer types. Even under a zero-friction scenario, the returns remain negative, reflecting actuarially fair LRP pricing and option risk premia. Reconciling these findings, we argue that observed clustering may be attributed to institutional timing rather than arbitrage or insurer hedging. This implies that the subsidy is real, but the alleged "subsidy harvest" is not a profitable endeavor.

Keywords: Livestock Risk Protection; subsidy harvesting; expiration clustering; Monte Carlo simulation; put options; market frictions; institutional timing

JEL codes: G22; Q14; Q18

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1. Introduction

The Livestock Risk Protection (LRP) program, administered by the United States Department of Agriculture (USDA) Risk Management Agency (RMA), offers federally subsidized price insurance to cattle and swine producers, covering feeder cattle, fed cattle, and swine against market price declines. Once a niche product with limited uptake, LRP has expanded rapidly in both participation and federal cost after the removal of the $20 million annual funding cap in the 2018 Bipartisan Budget Act, combined with the policy updates for 2019–2020 to tiered subsidies and higher head limits. Today, the program is a central component of the livestock safety net. By 2025, LRP covered over $22 billion in total livestock liability across the three commodities.

The expansion renewed concerns about whether subsidized risk-management instruments create opportunities for strategic use of federal funds. While LRP is designed to help producers manage downside risk, its design may unintentionally enable what the USDA-RMA now defines as subsidy capture: "the practice of exploiting the differences between premium owed by you for an Specific Coverage Endorsement (SCE) and the cost of a privately traded livestock contract such as a put option, for the purpose of your financial gain" (USDA-RMA 2025b). In theory, a producer could purchase subsidized LRP coverage and simultaneously sell an offsetting CME put option, collecting the full market premium while paying only a fraction of the insurance cost. This strategy neutralizes price exposure while preserving the value of the subsidy, raising questions about the program's integrity and whether it transfers federal funds without delivering risk protection.

There is also increasing attention from industry stakeholders to the possibility of subsidy harvesting in LRP. In January 2024, National Hog Farmer reported that some market observers had raised concerns about a small number of producers and their associated agents or brokers engaging in tactics intended to exploit differences between LRP premiums and equivalent CME put-option prices (Baker 2024). Around the same time, Drovers Magazine published commentary emphasizing that any reform of LRP should proceed through a "measured approach" (Speer 2024). The article argued that arbitrary changes could undermine the program's value to producers.

This paper examines whether observed behavior in the LRP program, specifically the timing of endorsements in relation to CME option expirations, is consistent with incentives for subsidy capture through offsetting market trades. Using comprehensive administrative data on all LRP endorsements from 2011 to 2025, merged with contract-level CME option price data, we examine whether the program's structure created financially attractive opportunities for subsidy capture and whether such opportunities appear to influence producer behavior. Our empirical strategy identifies significant clustering of large endorsements around option expiration dates. This pattern closely aligns with regulatory definitions of presumed subsidy capture introduced by USDA-RMA in the 2026 crop year. To assess whether such behavior is financially rational, we simulate the returns to a representative subsidy harvesting strategy under realistic market conditions, incorporating margin requirements, audit risk, and basis uncertainty. The results suggest that while offsetting strategies may appear profitable in theory, they yield lower expected value relative to holding LRP alone once realistic trading frictions and financing costs are included. In that sense, the apparent subsidy cannot be harvested. The results imply that attempts to replicate or offset LRP through exchange-traded positions reduce, rather than enhance, expected net returns. The observed endorsement activity clustering can be interpreted as institutional batching and isolated cases of attempted but economically unviable subsidy harvesting.

Concerns about how premium subsidies may distort producers' portfolio choices in agricultural insurance markets are not new. Goodwin and Smith (2013) outline the general incentive distortions that arise when subsidies alter the relative costs of risk management tools, and Babcock (2015) emphasizes that poorly aligned subsidy structures can lead to inefficient uptake and misallocation of public resources. In livestock markets, prior studies have largely evaluated the performance and adoption of products such as LRP and Dairy Revenue Protection (DRP), examining how these tools affect income variability and participation decisions (e.g., Boyer and Griffith 2022; Burdine and Halich 2014; Feuz 2009; Merritt et al. 2017; Hart et al. 2001; Fields and Gillespie 2008). Few studies, however, have examined how LRP's relationship to exchange-traded derivatives may affect producer incentives.

Understanding this gap is important because LRP is structurally equivalent to a short position in an exchange-traded put option, meaning its economic value can be benchmarked directly against CME option prices. When premium subsidies are large, such equivalence raises the question of how producers respond to perceived pricing advantages between subsidized insurance and private derivatives. Recent research highlights that these decisions are not always straightforward. Boyer et al. (2024), using a survey experiment, find that producers with higher risk tolerance are more likely to purchase LRP coverage. This counterintuitive pattern suggests that insurance uptake may reflect motivations beyond standard risk aversion. While the Boyer et. al study does not directly examine cross-market behavior, these findings raise the possibility that some producers, especially those who are more risk-tolerant, may be more attentive to the pricing relationships between subsidized insurance and private derivative markets. Feuz (2025) analyzes LRP endorsement data from 2011–2024 and reports increased contract volume on expiration dates that coincide with CME put-option expirations, particularly for feeder cattle and swine. The study describes these patterns as indicative of a potential vulnerability in program design, noting that subsidized LRP premiums may, in certain instances, be lower than the market value of comparable CME options.

Our paper makes three contributions to the literature. First, we provide new empirical evidence showing that large LRP endorsements cluster significantly around CME put option expiration dates. This pattern resembles the regulatory definition of presumed subsidy capture identified by USDA-RMA in 2026 and succeeding crop years. Second, we assess the financial plausibility of such behavior by simulating the returns to a range of plausible offsetting strategies that could, in principle, replicate or neutralize LRP coverage. The analysis is calibrated to observed CME prices and endorsement characteristics, incorporates realistic frictions, including basis risk, margin financing, transaction costs, and audit risk. Third, we explore how institutional arrangements, such as coordination through brokers or advisory services, might help explain temporal clustering even in the absence of positive expected returns, thereby reconciling the empirical evidence of strategic timing with the simulation results showing no positive expected returns.

2. Institutional Background

Unlike most crop insurance products, which insure against yield or revenue losses, Livestock Risk Protection (LRP) is designed specifically to cover price risk. Producers select a coverage price, the minimum price they wish to protect, and an endorsement length, which can range from 13 to 52 weeks. If the actual ending value, determined from a national cash-settlement index, falls below the coverage price, the program pays an indemnity equal to the difference between the coverage price and the actual ending value. This payoff structure makes an LRP contract economically equivalent to a long put option on the corresponding futures price (Diersen 2004).

For much of its history, participation in LRP was modest. The Federal Crop Insurance Act limited total funding for livestock insurance plans to $20 million per fiscal year, which placed a hard ceiling on program size. On February 9, 2018, the Bipartisan Budget Act of 2018 removed this limitation, and a series of reforms followed quickly thereafter (Glauber 2022). In July 2019, USDA-RMA increased the flat subsidy rate from 13%–20%. One year later, USDA-RMA introduced a five-tier subsidy schedule, with rates ranging from 35% at the highest coverage levels (95%–100%) to 55% at lower coverage levels (70%–79.99%), alongside increased per-producer and per-endorsement head limits (Parsons 2021). These adjustments made the program accessible to larger operations that had previously been constrained. These changes effectively decreased producer-paid premiums. Using daily LRP offering data from 2017–2021, Boyer and Griffith (2022) estimate that the 2019 subsidy increase lowered average premiums by $1.31/cwt for feeder cattle and $0.79/cwt for fed cattle. The 2020 expansion reduced costs further by $0.11/cwt–$0.59/cwt for feeder cattle and $0.16/cwt–$0.77/cwt for fed cattle, depending on coverage level. Because higher coverage levels start from a larger base premium, the same percentage subsidy results in a larger absolute reduction in cost, even though the relative rate increase is greater for lower coverage levels.

The response in program participation was immediate. As shown in Figure 1, the number of LRP policies sold increased sharply across all three commodities after the 2020 changes. By 2025, feeder cattle endorsements had exceeded 35,000 annually, fed cattle approached 15,000, and swine, although smaller in scale, followed a similar upward trend. Federal subsidy expenditures show a similar pattern: they were negligible before 2020 but reached nearly $420 million by 2025. The pace and scale of these changes suggest that higher subsidy rates not only expanded participation but also encouraged the purchase of higher coverage levels. The sharp increase in participation and subsidy expenditures aligns with earlier evidence that agricultural insurance demand responds significantly to premium subsidies (Goodwin 1993; Serra et al. 2003).

While these reforms achieved their intended effect of broadening access to price risk protection for livestock producers, they also changed the composition of program participants. Survey evidence suggests that producers are more likely to adopt LRP when premium subsidies are higher and when expected price protection improves (Boyer et al. 2024). The structure of the reformed program, offering high-subsidy and short-duration endorsements, may appeal more to producers with the institutional capacity to coordinate insurance purchases with futures market activity. This shift raises the possibility that some portion of the recent growth reflects strategic behavior, such as subsidy capture, rather than pure risk management.

3. Conceptual Framework

A producer selects a coverage price K and an endorsement period that ends on date T. If the USDA-reported ending value S_T falls below the coverage price, the policy pays out the difference:

$$\text{Indemnity} = \max\{K - S_T, 0\}\,. \tag{1}$$

Let P denote the total premium charged for this contract, and let the subsidy rate be $s \in (0,1)$. The producer paid premium is $(1-s)P$. Suppose the same producer sells a CME put option on the corresponding futures contract, with a strike price K and expiration close to T, obtaining a premium π. The payoff from this short put position is:

$$\pi - \max\{K - F_T, 0\}\,, \tag{2}$$

where F_T denotes the terminal price of the CME futures contract at expiration.

When F_T and S_T are closely aligned, as is typically observed near expiration, the LRP and short put positions largely offset each other's price exposure. Combining the two positions yields:

$$\Pi_{\text{Combo}} = [\max\{K - S_T, 0\} - \max\{K - F_T, 0\}] + \pi - (1-s)P\,. \tag{3}$$

The first bracketed term captures any small difference resulting from a basis or time conventions between the cash index and the futures settlement. If $S_T \approx F_T$, this difference is negligible, and the net return simplifies to:

$$\Pi_{\text{Combo}} \approx \pi - (1 - s)P\,. \tag{4}$$

This quantity defines the subsidy spread, the price gap between the CME option premium and the producer-paid LRP premium:

$$\text{Subsidy Spread} = \pi - (1 - s)P\,, \tag{5}$$

The subsidy spread represents the potential gain from combining subsidized LRP coverage with an offsetting CME put under frictionless conditions.

For an endorsement covering W hundredweight (cwt), the total potential gain implied by the subsidy spread equals

$$\text{Total Subsidy Spread} = W \cdot (\pi - (1 - s)P)\,. \tag{6}$$

This spread can be positive even when the producer is not actively managing price risk. As long as the CME option premium π exceeds the producer-paid LRP premium, the combined position offers a net gain that is largely independent of the direction of market prices.

While this setup may appear low-risk, it does carry practical concerns. The short put is subject to daily margin requirements. If prices fall, the producer may face cash flow pressure, even if the overall strategy is profitable at expiration. Differences between the coverage and strike prices, or between the settlement conventions of LRP and CME contracts, can also introduce minor deviations in payoffs.

These features lead to two empirical implications. First, endorsement activity may cluster near CME put-option expiration dates, when the time value of the option is minimal and the market premium most directly reflects the insured price level, making coordination between the two instruments operationally straightforward. Second, the difference $\pi - (1 - s)P$ defines a measurable upper bound on the subsidy that could, in principle, be captured through offsetting trades.

4. Clustering Patterns and Financial Incentives for Subsidy Capture

The previous framework implies that if producers respond to the subsidy spread in practice, endorsement activity should display timing patterns consistent with opportunities for subsidy capture. This section investigates whether producers time LRP endorsements in ways consistent with subsidy capture, a strategy where the producer simultaneously purchases a subsidized LRP endorsement and sells an offsetting CME put option to extract the premium subsidy. We use the county-level summary of business records from the USDA-RMA covering all LRP endorsements sold between 2011 and 2025.[1] Each record includes the endorsement's sales date, coverage price, end date, total insured weight, and associated premium and subsidy amounts. Table 1 summarizes LRP endorsement characteristics by commodity, focusing on premium structure and subsidy rates. It is worth noting that across all three commodities, average subsidy rates fall between 33%–35%, indicating a relatively uniform selection of high coverage levels (95%–100%), where subsidies are lowest.

The behavior of subsidy capture can pose several risks to program integrity and market functioning. It can undermine the intended purpose of LRP by converting subsidized insurance into opportunities for financial arbitrage, distort price signals by inflating put option selling unrelated to genuine hedging needs, and expose producers to hidden financial risks, such as margin calls on uncovered positions. In response to these concerns, the USDA-RMA issued new rules in the LRP Insurance Policy for 2026 and succeeding crop years, which explicitly define such practices as "presumed violations" of program integrity. Section 25 of the revised LRP Basic Provisions outlines three key conditions that, if jointly satisfied, constitute presumed subsidy capture: (1) the CME option expiration is within four calendar days of the LRP endorsement end date; (2) the CME put is sold within two trading days before to five trading days after the LRP effective date; and (3) the CME put premium exceeds 80% of the LRP premium (USDA-RMA 2025b). These criteria establish a narrow regulatory definition of suspect activity. Our empirical approach uses them as the foundation for testing whether a subset of LRP endorsements exhibits timing patterns and financial incentives

[1] The sample begins in 2011, the first year for which CME options data consistently include contract-specific expiration dates.

consistent with those conditions.

To test for clustering of LRP endorsements around CME livestock option expiration dates, we construct two timing indicators: one for the end date and one for the sales effective date. The first equals 1 if the endorsement ends within four calendar days of a CME put-option expiration. The second equals 1 if the endorsement's sales-effective date falls between two trading days before and five trading days after expiration. Each LRP endorsement is matched to the nearest CME expiration for the same commodity and contract month to ensure alignment between the coverage period and the strike price of the underlying futures contract.

We implement both descriptive and formal empirical strategies. Figure 2 displays the distribution of insured weight relative to CME expiration, separately for endorsement end dates and sales effective dates. For small and medium-sized endorsements, the distributions are relatively flat. In contrast, clear spikes appear among large endorsements, those in the top quartile of total insured weight, particularly for feeder cattle and swine. Endorsement volumes for these commodities rise sharply in the days immediately surrounding option expirations, suggesting coordinated timing behavior.

To quantify these patterns, we estimate Poisson pseudo-maximum likelihood (PPML) regressions of daily insured weight on indicators for whether a date falls within the near-expiration windows. The unit of observation is a commodity-date, and we include month and year fixed effects, clustering standard errors at the year level. Table 3 reports estimates using endorsement end dates, showing that insured weight within the near-expiration window is approximately 20.1% for fed cattle, 128.0% for feeder cattle, and 417.0% for swine. Table 2 shows consistent but more muted effects for the sales effective date window, with insured weight increasing 19.5% for feeder cattle and 58.1% for swine, whereas fed cattle endorsements show no statistically significant change. These results confirm that large endorsements in feeder cattle and swine cluster systematically around CME option expirations.

Clustering alone does not establish intent or confirm the presence of arbitrage. To evaluate the potential economic incentive underlying this timing, we calculate the subsidy spread for each endorsement, defined in Equation 5. Because the LRP and short put roughly offset each other in price risk, this spread approximates the residual gain attributable to the premium subsidy under frictionless conditions.

We compute the subsidy spread for all matched LRP endorsements from 2011 through 2025. For each endorsement, we select the CME put option with the closest strike and contract month that expires on the same day as the LRP end date. The spread is aggregated to monthly and commodity-level averages. Figure 3 plots the average subsidy spread by commodity over time. Swine endorsements consistently show the highest values, sometimes exceeding $2.00 per cwt. For large policies, this translates to gross potential gains exceeding $50,000.

The most pronounced increases occur after 2020, following the expansion of LRP premium subsidies. Prior to that policy change, average spreads were near zero or negative; afterward, they frequently turned positive, indicating that the producer-paid LRP premium was below the market value of an equivalent CME put. Under frictionless conditions, such a positive spread would imply that a producer could hedge price risk completely and still retain part of the subsidy as profit. The coincidence of these high-spread periods with stronger clustering in endorsement timing suggests that financial incentives and observed behavior became more closely aligned after the 2020 reform.

While these correlations are suggestive, they are not direct evidence of arbitrage. Given that producers' trade in the derivative market is unobservable, we cannot determine whether offsetting positions were actually taken. Some of the observed timing may reflect administrative or marketing routines rather than strategic exploitation of the subsidy.[2] Nonetheless, the observed timing patterns closely match the conditions later codified by USDA–RMA in its 2025 definition of presumed subsidy capture, implying that some endorsements would likely have satisfied those criteria if evaluated under the current rules.

Whether such strategies would remain economically rational depends on their net profitability once real-world frictions are considered. The next section evaluates this question through a Monte Carlo simulation of the expected returns to representative offsetting strategies under realistic market conditions.

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[2] In response to COVID-19 disruptions, USDA-RMA temporarily allowed LRP producers to defer premium payments until the end of the endorsement period in 2020. While this change does not affect the calculation of the subsidy spread, it likely reduced liquidity constraints and may have made high-value arbitrage opportunities more accessible to producers, especially those operating at scale. The timing of this policy coincides with the sharp rise in subsidy spread estimates observed in late 2020.

5. Monte Carlo Simulation of Subsidy Capture Profitability

LRP indemnities are equivalent to the payoff from a long put option on livestock prices. In a frictionless market, a producer could pair an LRP endorsement with an offsetting short CME put and appear to arbitrage the federal premium subsidy, converting it into a risk-free cash gain. In practice, however, such conversion is costly. Transaction fees, bid–ask spreads, margin financing, and potential audit penalties all erode the apparent gain.

It is also important to note that insurance can have a negative expected cash value without implying irrational participation, since its purpose is risk reduction rather than profit. The relevant question for livestock producers is therefore whether combining subsidized LRP coverage with offsetting derivatives positions can, in expectation, improve welfare beyond what is already provided by LRP alone. We address this question through a Monte Carlo simulation calibrated to observed market conditions and realistic frictions. The simulation evaluates a set of nine strategies that capture the main ways producers could combine or substitute between subsidized LRP coverage and exchange-traded derivatives. Table 4 summarizes the construction and intent of each strategy. The baseline "LRP only" represents the federally subsidized insurance position. The remaining strategies fall into three broad categories:

- Offsetting tests, which pair LRP with short CME options to evaluate whether a positive subsidy spread can be monetized (e.g., Locked short call, Locked call spread);
- Private-market insurance, which replaces or supplements LRP with equivalent CME options to measure how efficiently market instruments replicate program coverage (e.g., Long put, Income offset, LRP + Long put, Income put spread);
- Linear hedges, which use futures contracts to assess whether simple price-offsetting positions yield comparable protection (e.g., Short futures, LRP + Futures).

These constructions collectively span the realistic range of producer behaviors and provide a basis for comparing expected value and welfare outcomes across market instruments.

5.1 Simulation Design

The Monte Carlo simulation evaluates the performance of LRP relative to alternative hedging strategies under a consistent stochastic price process and friction structure. Each simulation combines observed LRP endorsements with comparable positions in exchange-traded options or futures. We report results by commodity, coverage level, and producer tier. The objective is to compare expected value, risk reduction, and welfare outcomes from LRP coverage with those achievable through derivative-market strategies.

The analysis distinguishes two producer tiers. "Retail" producers represent smaller operations facing higher transaction costs and financing spreads, whereas "large" producers reflect participants with preferential execution and borrowing terms. Each endorsement in the dataset is treated as a distinct experiment defined by its purchase date, coverage level, and term. Risk-adjusted performance is summarized using certainty equivalents (CE) under constant absolute risk aversion (CARA). Because the model incorporates transaction costs, margin financing, and premium subsidies, all comparisons reflect realistic economic outcomes rather than frictionless arbitrage values.

Price paths follow a lognormal distribution consistent with the Black–Scholes framework. For each endorsement, the terminal futures price is simulated as

$$F_T = F_0 \exp\left[\left(r - \tfrac{1}{2}\sigma^2\right)\tau + \sigma\sqrt{\tau}\, Z\right], \qquad Z \sim N(0,1), \tag{7}$$

where F_0 is the current futures price, r is the continuously compounded risk-free rate, σ is the annualized implied volatility, τ is the remaining term in years, and $Z \sim N(0,1)$ follows a standard normal distribution. LRP indemnities are computed as defined in Equation 1. Producer premiums are then adjusted for the applicable federal subsidy.

Each strategy j generates a path-specific net present value (NPV) that incorporates premiums, transaction costs, and financing charges:

$$\text{NPV}_j = e^{-r\tau}\left[\text{Indemnity}_j - \text{Premium}_j - \text{Friction Costs}_j\right]. \tag{8}$$

All cash flows are discounted to present value using $e^{-r\tau}$. Expected values are calculated from the simulated distribution of NPVs. The incremental value of strategy j relative to the LRP baseline is

$$\Delta \mathrm{NPV}_j = \mathrm{NPV}_j - \mathrm{NPV}_{\mathrm{LRP}}. \tag{9}$$

Because profitability alone does not capture producer welfare, we also compute revenue-based CE under CARA. The CE translates the entire distribution of simulated revenues into a single risk-adjusted value, which is the guaranteed amount of gain a producer would consider equally desirable to facing the underlying risky outcome. In this sense, it summarizes both expected returns and downside risk, allowing welfare comparisons across strategies. Thus, a higher CE indicates a strategy that delivers greater expected utility for a producer with the assumed level of risk aversion.

Let R_j denote simulated revenue per head under strategy j, and let $A > 0$ be the coefficient of absolute risk aversion. The CE is given by

$$\mathrm{CE}_j \equiv -\frac{1}{A} \ln\left(\mathbb{E}\left[\exp(-AR_j)\right]\right), \tag{10}$$

We evaluate CEs for three coefficients of absolute risk aversion, $A \in \{0.1, 0.5, 1.0\}$, representing low, moderate, and high risk aversion, respectively. Smaller values of A approximate risk-neutral behavior, producing certainty equivalents close to expected revenues, while larger values reflect stronger aversion to downside risk and yield lower certainty equivalents for the same distribution.

Welfare differences relative to LRP are expressed as

$$\Delta \mathrm{CE}_j \equiv \mathrm{CE}_j - \mathrm{CE}_{\mathrm{LRP}}, \tag{11}$$

so that positive values of $\{\Delta \mathrm{NPV}_j, \Delta \mathrm{CE}_j\}$ indicate cash or welfare gains beyond the insured benchmark.

The model applies a consistent stochastic price process and discounting factor to both LRP and CME positions. Option values are calculated using the same volatility, strike, and maturity inputs as observed CME options, ensuring that LRP-only and other strategies are valued consistently.

5.2 Simulation Calibration and Procedure

Table 5 summarizes the baseline calibration parameters used throughout the analysis. We calibrate the simulation parameters using a combination of exchange data, broker fee schedules, and CME margin requirements. Commission rates are set at 1.5 cents per cwt for retail producers and 0.75 cents for large producers, reflecting typical differences between retail and institutional execution costs. Half-spreads are calibrated to 10 cents per cwt for live and feeder cattle and 25 cents for lean hogs under retail, with large producers accessing tighter spreads of 5 and 15 cents, respectively. Margin requirements follow CME's Standard Portfolio Analysis of Risk (SPAN) guidelines for at-the-money livestock options.

Financing costs on margin are modeled as a constant rate above the Secured Overnight Financing Rate (SOFR), SOFR plus 250 basis points for retail producers and SOFR plus 150 basis points for large producers. These costs represent the carrying expense of maintaining short option or futures positions over the policy term. Table 6 details the calibration of market frictions applied in the simulation.

The simulation proceeds as follows:

1. **Initialization:** For each commodity, coverage level, and producer tier, the model imports observed LRP endorsements from the RMA Summary of Business dataset, including coverage price, term length, and producer-paid premium.

2. **Parameter Setup:** Volatility (σ), discount rate (r), and friction parameters are assigned according to the producer tier and commodity. Implied volatility and the discount rate are drawn from the CME option term structure and Treasury or SOFR yields corresponding to each policy's maturity.

3. **Stochastic Simulation:** The model simulates $N = 1{,}000$ price paths for each commodity–coverage–tier combination. LRP indemnities and CME option or futures payoffs are calculated for each simulated path.

4. **Frictions and Financing:** Transaction costs, bid–ask spreads, and margin interest are applied using the tier-specific rates described above. This step adjusts nominal payoffs to reflect realistic execution and carrying costs.

5. **Discounting and Aggregation:** All payoffs and costs are discounted to present value using the risk-free rate. For each strategy, the simulation outputs the mean and median of NPV and CE under CARA preferences. Results are stored by commodity, coverage, and producer tier for aggregation across scenarios.

5.3 Results and Welfare Implications

Table 7 through Table 9 report simulated welfare outcomes for all strategies at 100% coverage for feeder cattle, live cattle, and lean hogs. Each table summarizes mean and median NPVs per cwt, the share of positive outcomes, and CE under three levels of constant absolute risk aversion ($A = 0.10, 0.50, 1.00$). Corresponding results for all other coverage levels are provided in the Appendix.

Across commodities and producer tiers, the LRP-only benchmark yields the highest mean NPV and CE among implementable strategies. The simulated gains are modest in dollar terms but economically meaningful when scaled to herd size. In particular, mean NPVs average roughly $0.08–$0.09 per cwt, consistent with the expected net subsidy after trading frictions. These positive welfare effects persist across all risk-aversion levels, confirming that the subsidy compensates for typical commission, spread, and financing costs.

By contrast, combined strategies, such as the locked short call, long put, or spread-based constructs, yield lower expected value and welfare than the baseline. Adding exchange-traded positions to LRP systematically reduces both NPV and CE. For instance, the locked short call and locked call spread produce expected NPVs between –$0.13 and –$0.28 per cwt at full coverage, while the share of positive realizations rarely exceeds 40%. These patterns indicate that the apparent subsidy spread observed in static comparisons does not translate into profitable opportunities once transaction costs and financing charges are applied.

Among single-instrument positions, CME long puts and short futures provide modest downside protection but do not improve expected value relative to LRP. The income put spread, intended to lower the upfront cost, similarly yields negative welfare outcomes. It reduces margin exposure but sacrifices coverage in severe price declines, resulting in negative CE across all risk-aversion levels. Combinations such as LRP + put or LRP + futures also fail to enhance welfare, as they effectively double-insure or neutralize the subsidized protection embedded in LRP.

Comparing producer tiers, large-tier simulations consistently show smaller losses from combined positions than retail-tier counterparts, reflecting tighter bid–ask spreads and lower financing spreads (150 bp versus 250 bp over SOFR). However, the welfare ranking is invariant. LRP dominates across all commodities and producer scales. The welfare penalty ranges from \$0.05 to \$0.35 per cwt in mean NPV and from \$0.10 to \$0.90 in CE at A = 0.50, depending on the commodity and instrument.

Results are strongest for feeder cattle, where the LRP subsidy is largest in absolute terms, followed by live cattle and lean hogs. Lean hog contracts exhibit the lowest absolute NPVs and smallest CE gains, consistent with higher transaction costs and more volatile basis dynamics.

In addition, lean hog results show larger efficiency losses relative to cattle. Both large and retail producers face tighter margins, higher implied volatility, and wider bid–ask spreads, which jointly reduce expected value. Mean NPVs for most strategies remain negative, often exceeding a welfare penalty of \$0.30–\$0.45 per cwt relative to LRP alone. Certainty equivalents decline sharply with risk aversion, implying the high variance of hog price paths and the greater sensitivity of option payoffs to volatility shocks. The long put and income spread designs perform particularly poorly, while short futures come closest to break-even but still underperform the LRP baseline once financing is included.[3]

Figure 4 summarizes welfare outcomes across commodities and strategies. The left panels show results relative to LRP-only, and the right panels show absolute NPVs. In every case, the LRP benchmark dominates: combined strategies and exchange-based hedges reduce expected welfare

[3] The small positive NPVs occasionally observed in large-tier simulations represent statistical noise rather than systematic gains.

even when a substantial share of simulated paths produce positive payoffs. Figure 5 presents all distributions of simulated NPVs. It confirms that while a few paths yield small profits, the means are negative for all combined or exchange-based strategies. The dispersion of these distributions indicates that observed profits reflect random price-path variation rather than systematic arbitrage.

Overall, the Monte Carlo evidence demonstrates that LRP functions as a welfare-enhancing insurance product, not an exploitable arbitrage. Exchange-based positions, while theoretically capable of offsetting premium wedges, generate lower certainty equivalents once realistic frictions and financing costs are introduced.

5.4 Sensitivity Analysis

The baseline results demonstrate that LRP alone consistently dominates all combined or exchange-based strategies across commodities, producer tiers, and coverage levels. To assess whether these findings hold under alternative assumptions, we next evaluate the robustness of the Monte Carlo outcomes to changes in coverage, transaction costs, and volatility parameters.

All scenarios in the sensitivity analysis are implemented using the Monte Carlo framework described previously, with 1,000 simulated price paths per commodity and strategy at 100% coverage for retail-tier producers. The baseline scenario reflects standard market conditions, while subsequent scenarios vary transaction costs, financing rates, volatility parameters, and policy regimes to assess the stability of welfare rankings.

The sensitivity experiments fall into five categories:

1. **Transaction cost scenarios** halve or double commissions and bid-ask spreads to represent differences in execution quality between retail and institutional traders.

2. **Audit risk scenarios** introduce compliance uncertainty by setting audit probabilities of 0%, 5%, and 10%.

3. **Financing scenarios** vary the producer's funding cost between SOFR + 100 basis points and SOFR + 400 basis points.

4. **Market volatility and dynamics** alter the structure of price uncertainty, either by adding a

market jump process or by calibrating to historically observed volatility regimes. The market jump specification activates a jump component in the price process with intensity parameter $\lambda = 0.6$, implying that a discrete price shock occurs, on average, once every 20 months. Each jump represents a rare but sizable movement in prices, broadening the tails of the simulated return distribution and providing a stress test for discontinuous market events.

5. **Policy and friction-free regimes** either remove trading frictions entirely or replicate empirical market environments before and after the 2019 LRP subsidy reform. Regime-based scenarios use observed CME option data from 2019–2021 to calibrate volatility and pricing conditions, preserving the empirical structure of volatility, moneyness, and market spreads rather than applying artificial scaling factors.

Table 10 through Table 12 report mean NPV values for each strategy and scenario, with the change from the baseline shown in parentheses.

Across all commodities, the welfare ranking of strategies is unchanged. The LRP-only benchmark continues to dominate all other strategies and positions. Reducing transaction costs raises the mean NPV of combined strategies slightly but do not reverse their sign. Doubling spreads or widening commissions lowers expected NPVs by \$0.05–0.15 per cwt, with the largest effects for option-intensive strategies such as the locked call spread and income put spread.

Audit-risk scenarios have negligible quantitative impacts, suggesting that, at observed enforcement rates, audit-related penalties are too small to affect producer welfare. Financing assumptions matter modestly: lowering the financing spread from 250 to 100 basis points improves expected NPVs by roughly 0.02 per cwt, while tightening to 400 basis points has the opposite effect.

Market volatility and jump scenarios introduce greater dispersion in welfare outcomes. Introducing market jumps in prices slightly increases mean NPVs for LRP and other insurance-like strategies, reflecting the value of protection against rare but severe price shocks. In contrast, the high-volatility scenario based on 2020 market data reduces welfare for all strategies, consistent with higher option-implied variance and wider bid-ask spreads that raise hedging costs.

Policy-related scenarios confirm that the 2019-2021 subsidy reform improved producer welfare by increasing the effective value of LRP coverage. Simulations using the pre-subsidy window (2019) yield lower NPVs across all commodities, while the post-subsidy regime (2021) produces gains of $0.03-0.06 per cwt for LRP and smaller improvements for most positions. The zero-friction scenario, which removes all transaction costs and financing charges, establishes a theoretical upper bound. The results imply that, even under idealized conditions, all other strategies remain slightly below the LRP benchmark when comparing expected values.

The zero-friction scenario is particularly informative. Even when all transaction costs, margin financing, and execution frictions are removed, LRP continues to yield the highest expected returns across commodities and coverage levels. Other strategies converge toward—but do not exceed—the LRP benchmark, confirming that the apparent subsidy wedge observed in static comparisons does not translate into a true arbitrage opportunity. CME options trade at prices that exceed their expected value precisely because market participants demand compensation for risk. Since LRP premiums are set actuarially (to cover expected indemnities plus administrative costs), while CME options embed a market risk premium, the premium differential cannot be harvested even under ideal conditions. This explains why clustering persists despite negative expected profitability.

The sensitivity analysis confirms that the main findings are robust. The relative ranking of strategies is invariant to plausible changes in market frictions, financing conditions, volatility regimes, and policy environments. LRP remains the optimal strategy maximizing producer welfare, while single or combined strategies continue to yield negative or near-zero expected value once realistic costs are incorporated.

Three mechanisms that jointly determine the welfare effects of livestock price insurance. First, trading frictions remain the dominant source of welfare loss. Bid-ask spreads on at-the-money options absorb a large portion of the LRP subsidy, especially in lean hogs, where retail-tier half-spreads of roughly 25 cents per cwt are more than twice those observed in cattle markets. Commission fees and the opportunity cost of margin financing further erode returns. Even under the most favorable execution conditions with narrow spreads and low financing costs, no combined strategy yields a positive expected value once realistic frictions are imposed.

Second, the financing and volatility environment affects the magnitude but not the direction of welfare outcomes. Tightening the financing spread from SOFR + 250 to +400 basis points lowers expected NPV by $0.02 to $0.03 per cwt, while relaxing it to +100 basis points provides only modest increases. Similarly, calibrating to the 2020 high-volatility regime worsens performance across all overlays, reflecting higher option-implied variance and wider spreads that raise hedging costs. By contrast, introducing infrequent market jumps marginally increases the welfare value of LRP and other insurance-based positions. These results confirm that discontinuous shocks increase the demand for protection but do not reverse the relative ranking of strategies.

Third, policy design materially affects producer welfare. The transition from pre-reform conditions in early 2019 to the post-reform regime in 2021 increased the expected value of LRP coverage by roughly $0.04 to $0.06 per cwt, reflecting higher premium subsidies and broader eligibility. However, even with these policy improvements, overlays that combine LRP with exchange-traded positions remain inferior to holding LRP alone. The zero-friction benchmark, which removes all transaction and financing costs, provides an upper bound: once costs are reintroduced, the apparent arbitrage dissipates entirely.

Heterogeneity across commodities and producer scales helps reconcile simulated outcomes with observed participation patterns. Large producers, who benefit from tighter spreads, lower commissions, and cheaper financing, still do not achieve positive expected NPVs but face smaller welfare losses than retail-tier producers. This asymmetry helps explain the concentration of LRP activity among more sophisticated or larger market participants documented in the data. For them, the subsidy effectively offsets but does not exceed trading costs, making participation rational yet non-arbitrageable.

6. Reconciling Theory and Evidence

The Monte Carlo analysis establishes that combining LRP coverage with offsetting CME option positions yields lower expected welfare than holding LRP alone. This result indicates that producers cannot systematically improve upon the insured position through additional market trades. In expectation, LRP remains the welfare-maximizing choice once subsidies, financing, and trading costs are accounted for. Yet the endorsement data reveal distinct timing patterns. A disproportionate share of LRP endorsements—particularly high-volume contracts—occurs near CME option expiration dates. At first glance, this clustering appears consistent with the existence of positive subsidy spreads: the difference between the market premium for a comparable CME put and the producer-paid portion of the LRP premium, as defined in Equation 5.

This apparent tension between simulation results and observed behavior reflects a difference between ex post and ex ante perspectives. The subsidy spread captures realized market incentives derived from observed prices and issued policies; it measures what producers might perceive in hindsight. During periods of elevated volatility or high option premiums, these realized margins can appear large, creating the impression of exploitable opportunities. The Monte Carlo framework, by contrast, evaluates profitability ex ante under forward-looking market expectations. Because CME option prices embed risk premia, they exceed the actuarial value of expected indemnities under LRP. Even in a frictionless setting, the corresponding offsetting trade has negative expected value, and the inclusion of realistic trading and financing costs further widens this gap.

The remainder of this section tests whether the observed clustering arises from institutional or market-linked mechanisms. The evidence points toward routine program features, sales cutoffs, reporting deadlines, and industry calendars—rather than profit-motivated trading behavior.

6.1 Conceptual Reconciliation

One theory is that insurers systematically hedge their LRP exposure, thereby creating the observed clustering. When multiple short-term endorsements accumulate, insurers hold positions equivalent to long portfolios of put options on livestock prices. Standard risk management requires offsetting this exposure through futures or options markets, particularly when liquidity concentrates around expiration dates.

This hedging narrative, however, faces several limitations. Most significantly, the Livestock Price Reinsurance Agreement (LPRA) explicitly prohibits approved insurance providers (AIPs) from using "private market instruments to transfer or hedge any liability" for policies placed in the Commercial Fund or ceded to Federal Crop Insurance Corporation (FCIC) (USDA-RMA 2025a). Under the LPRA, AIPs may not use private market instruments to hedge any liability ceded to FCIC or in the Commercial Fund. This restriction applies to the substantial majority of LRP business, leaving only privately reinsured portions available for potential hedging. This prohibition makes systematic hedging programs legally untenable for most LRP exposure.

The settlement mechanisms further undermine any expiration-timing advantage. For example, Feeder Cattle indemnities reference the CME Feeder Cattle Index, a 7-day weighted-average USDA price series. This averaging process dilutes any price movement specific to option expiry. Live Cattle and Swine settlements rely on AMS price series rather than CME option prices and create even greater separation from exchange expiration dynamics. Lean Hog futures (and the Lean Hog Index used for LRP swine) use a two-day USDA-based index. These multi-day averaging mechanisms appear to eliminate the economic rationale for precise expiration-day timing.

An alternative explanation could be institutional coordination through shared temporal reference points. The LRP sales structure itself may generate clustering through operational constraints. The LRP sales period ends at 8:25 a.m. Central the following day. Coverage is unavailable on CME market holidays and on USDA report days (Cattle on Feed for cattle and Hogs and Pigs for swine). Weekly and monthly transaction cutoffs occur at 8 p.m. Central on Fridays and 8 p.m. Central on the Friday after the first Sunday, respectively. Accepted-late data can reduce the A&O subsidy by up to 3 percentage points. These restrictions compress transaction activity into narrow windows, potentially creating apparent clustering independent of any strategic timing.

CME expiration dates likely function as coordination devices rather than arbitrage opportunities. These dates are salient within the livestock industry. Live Cattle futures expire on the last business day of contract months, Lean Hog futures on the tenth business day, and Feeder Cattle futures on the last Thursday. Such widely recognized calendar markers may facilitate agent-client communication and operational planning without necessarily involving market positioning. The coordination could occur through shared awareness rather than financial optimization.

Notably, the clustering appears in both endorsement timing (when policies are purchased) and end dates (when coverage expires). This double-clustering pattern is consistent with institutional coordination combined with the program's fixed tenor structure. Policies purchased near CME expiration dates with standard 26-week or 52-week terms mechanically expire near future CME dates, creating self-reinforcing temporal patterns without requiring strategic calculation.

This framework does not suggest that all endorsement timing follows these institutional patterns.

Individual producers may attempt market timing despite negative expected values, while others may have entirely independent motivations. The main insight is that institutional rhythms appear sufficient to generate the observed aggregate clustering without requiring profitable arbitrage opportunities or systematic hedging programs. The pattern potentially reflects the intersection of regulatory constraints, operational procedures, and industry conventions rather than deliberate financial strategy.

6.2 Empirical Strategy for Detecting Market Linkages

To distinguish between market-driven and institutional explanations, we test whether endorsement clustering coincides with exchange trading activity. The analysis aligns daily insured weight from LRP endorsements with CME futures expiration dates: the last business day (Live Cattle), the last Thursday with the November-Thanksgiving exception (Feeder Cattle), and the 10th business day (Lean Hogs). The nearest-expiration contract serves as the baseline.

We match the daily insured weight at the endorsement date with exchange activity measures. The specification examines both volume patterns and changes in open interest. If systematic hedging were present, it would necessarily increase open interest through the establishment of new positions. All endorsement aggregates employ the winsorized weight series at the 95th percentile, with robustness checks at the 99th percentile, no winsorization, and using endorsement counts rather than weights.

The core specification estimates the expiration week effect while controlling for potential confounders. All regressions include day-of-week dummies, a month-end indicator, and year-month fixed effects. We compute cluster-robust standard errors by year-month. The placebo design replicates this exact specification.

The interpretation relies on specific predictions. Systematic hedging programs would generate strong positive correlations between endorsement weight and changes in open interest, as new positions are established to offset LRP exposure. The absence of such correlations, particularly given the LPRA's prohibition on hedging Commercial Fund exposure, would indicate that clustering reflects coordination rather than risk management.

6.3 Exchange Co-movement Results

Figure 6 shows the event study of within-month volume shares around CME expiration dates. The empirical patterns are consistent with coordination rather than systematic hedging activity. Volume correlations remain weak and consistent with shared attention rather than causal relationships. The lead-lag profiles show no anticipatory or reactive patterns that would characterize coordinated hedging programs.

Table 13 quantifies these effects. ExpWeek (± 3) coefficients imply changes of approximately 11% for Live Cattle ($\beta = 0.104$, not statistically significant), 18% for Feeder Cattle ($\beta = 0.163$), and 112% for Lean Hogs ($\beta = 0.750$), computed as $100 \times (e^{\beta} - 1)$. Only Lean Hogs is significant at conventional levels ($p < 0.001$), while Feeder Cattle shows a significant effect in the tighter ± 1-day window ($\beta = 0.302 \rightarrow \approx 35\%$, $p < 0.05$).

The expiration week effect persists after controlling for calendar structure. These effects remain stable across alternative specifications. The consistency across specifications suggests genuine temporal concentration, particularly pronounced in the hog market, where concentration and coordination may be strongest.

6.4 Falsification and Placebo Tests

Robustness checks further confirm the date-specific nature of the clustering. First, day-of-week matched placebos randomly assign fake expiration dates within each month that preserve the day-of-week structure of actual expirations. This test isolates whether the effect stems from generic weekday patterns versus specific dates. Figure 7 illustrates the resulting placebo distributions for each commodity. The actual expiration-week effect lies above the 81st percentile for Live Cattle, the 91st percentile for Feeder Cattle, and the 100th percentile for Lean Hogs, with the Lean Hogs effect highly significant ($p < 0.001$), confirming that the pattern is date-specific rather than weekday-driven. Table 14 reports the placebo test results, comparing actual coefficients to the simulated distribution.

Second, calendar-shift placebos move the entire expiration calendar forward or backward by 7 or 14 days while preserving monthly seasonality. These shifted calendars generate null effects, with the true coefficient exceeding 90% of placebo estimates. This test demonstrates that the precise alignment with CME dates matters, not just approximate monthly timing. Table 15 shows the calendar shift falsification test results.

Third, the holiday-shift falsification examines months where CME expiration dates move due to trading holidays. Following the corrected November rule for Feeder Cattle (where expiration shifts to the business day immediately preceding Thanksgiving week disruptions), endorsement peaks often remain anchored to regular institutional schedules rather than tracking the shifted market date. This decoupling provides evidence against pure market-timing explanations.

Fourth, reinsurance timing controls definitively rule out reinsurance mechanics as an explanation. When we control for the last business day (monthly settlement), the Friday after the first Sunday (monthly reporting cutoff), and all Fridays (weekly reporting), the CME expiration effects persist unchanged. Moreover, the effects survive AIP $\times$ Year-Month fixed effects that absorb any insurer-specific monthly patterns. Reinsurance operates on monthly cycles that do not align with commodity-specific CME dates. The 10th business day for Lean Hogs and last Thursday for Feeder Cattle cannot be explained by uniform month-end or Friday patterns. Table 16 demonstrates that CME expiration effects persist after controlling for reinsurance timing variables.

6.5 Institutional Mechanisms and Regulatory Constraints

The evidence points toward institutional coordination as the likely reason behind the timing clustering rather than hedging activity. The LPRA explicitly prohibits approved insurance providers from using “private market instruments to transfer or hedge any liability” for policies placed in the Commercial Fund or ceded to FCIC, which encompasses the substantial majority of LRP business. This prohibition alone eliminates hedging as a plausible explanation for market-wide clustering patterns.

Examination of insurer statutory filings provides additional confirmation. Schedule DB of NAIC annual statements, which requires detailed disclosure of derivatives positions, shows minimal futures or options exposure among major LRP writers relative to their insurance volumes (NAIC 2024). The absence of material derivatives positions in these regulatory filings corroborates that systematic hedging programs do not exist at scale.

Instead, the clustering appears to arise from multiple reinforcing institutional factors. The LRP sales window structure compresses transaction activity into narrow windows that naturally generate temporal concentration. Weekly reporting requirements under Appendix III of the Standard Reinsurance Agreement, with Friday evening deadlines and late-reporting penalties, create additional administrative rhythms that encourage batch processing. Analysis of the top 10 approved insurance providers by volume shows relatively consistent expiration week concentration across insurers, with a coefficient of variation below 0.5, suggesting industry-wide coordination rather than company-specific strategies. The absence of systematic heterogeneity across AIPs further rules out reinsurance-driven timing, as different reinsurance arrangements would produce different temporal patterns.

Figure 8 shows that these patterns are consistent across insurers. The top 20 AIPs exhibit an average expiration-week share of 14% with a coefficient of variation of 0.34, indicating moderate uniformity in timing behavior. The limited dispersion across firms suggests industry-wide rather than company-specific strategies. If reinsurance arrangements or proprietary hedging programs were important drivers, timing would vary substantially across AIPs; instead, the similarity in concentration supports an institutional rather than financial incentive.

6.6 Synthesis and Implications

The combined evidence demonstrates that endorsement clustering around CME expiration dates reflects institutional coordination mechanisms rather than hedging activity or profitable arbitrage. Legal prohibitions prevent systematic hedging, settlement mechanics eliminate timing advantages, and exchange data patterns are consistent with shared attention rather than coordinated position-taking. Instead, operational constraints, regulatory schedules, and industry conventions create common focal points that generate observed patterns.

This interpretation reconciles the negative expected values documented in Section 6 with pronounced temporal clustering. The pattern emerges from the intersection of narrow sales windows, reporting requirements, and shared calendar awareness rather than financial optimization. The persistence of clustering despite negative arbitrage values underscores that institutional factors, not market opportunities, drive timing decisions.

The results indicate that the observed clustering is unlikely to be driven by profitable arbitrage, suggesting that interventions designed specifically to address such activity may have limited impact on the timing patterns documented here. The forthcoming rule changes that increase penalties for intentional harvesting may reduce some gaming behavior at the margin, but the fundamental clustering pattern will likely persist given its institutional origins. Future modeling efforts should incorporate these operational realities rather than assuming purely financial motivations.

7. Conclusion

The design of the Livestock Risk Protection (LRP) program raises an important question for policy evaluation: Does offering a subsidized contract that closely parallels a private-market option create opportunities for subsidy capture? Because LRP indemnities are linked to CME futures prices, producers can, in principle, construct equivalent hedges using exchange-traded instruments. Using endorsement-level data, we document that LRP purchases are disproportionately concentrated around CME option expiration dates, a pattern that could, at first glance, suggest strategic timing to exploit differences between LRP and CME values. To assess whether such timing reflects real arbitrage, we simulate the returns from paired LRP–CME strategies under realistic assumptions about trading costs, financing, and basis risk. Across commodities and coverage levels, expected returns are uniformly negative. Even in a frictionless setting, the offsetting position yields no gain compared to having LRP alone, indicating that CME option prices already reflect the expected payouts from comparable LRP endorsements and that the subsidy spread may not translate into actual gains once priced by the market.

These findings contribute to a broader literature on policy-induced behavior in subsidized insurance markets (Goodwin and Smith 2013; Babcock 2015). While prior work has emphasized the potential for moral hazard or adverse selection under generous subsidy regimes, our results reveal a more nuanced mechanism that mimics arbitrage may emerge not from misaligned economic incentives but from the institutional structure and timing constraints of the program itself.

This interpretation has implications for regulatory design. The 2026 revisions to the LRP Basic Provisions classify timing-based endorsement practices as presumptive violations, reflecting regulatory concern about subsidy harvesting. Our results do not rule out isolated opportunistic behavior, but they indicate that, in aggregate, the incentive for systematic subsidy capture is weak. If clustering reflects structural features of program administration, enforcement efforts may have a limited effect on the observed patterns.

Several limitations remain in our analysis. Without transaction-level data, we cannot observe whether producers engage in offsetting trades in the options market, nor can we identify the precise role of agents, reinsurance agreements, or firm-level practices. More detailed data on CME positions and agent-level behavior would help clarify these dynamics. Future research might also explore how similar timing patterns manifest in other subsidized insurance products, such as Dairy Revenue Protection, compare uptake responses across programs with varying subsidy structures, or examine whether the institutional features we identify as coordination mechanisms operate similarly in other insurance products.

Overall, this study highlights the complexity of interpreting behavioral patterns in subsidized insurance programs. The presence of a subsidy, even a large one, does not guarantee profitable arbitrage. Instead, the observed behaviors may reflect the institutional structure of the program rather than attempts to game the system. As agricultural risk management programs expand in scope and generosity, careful attention to these margins will be essential to ensure the effectiveness and actuarial soundness of the program.

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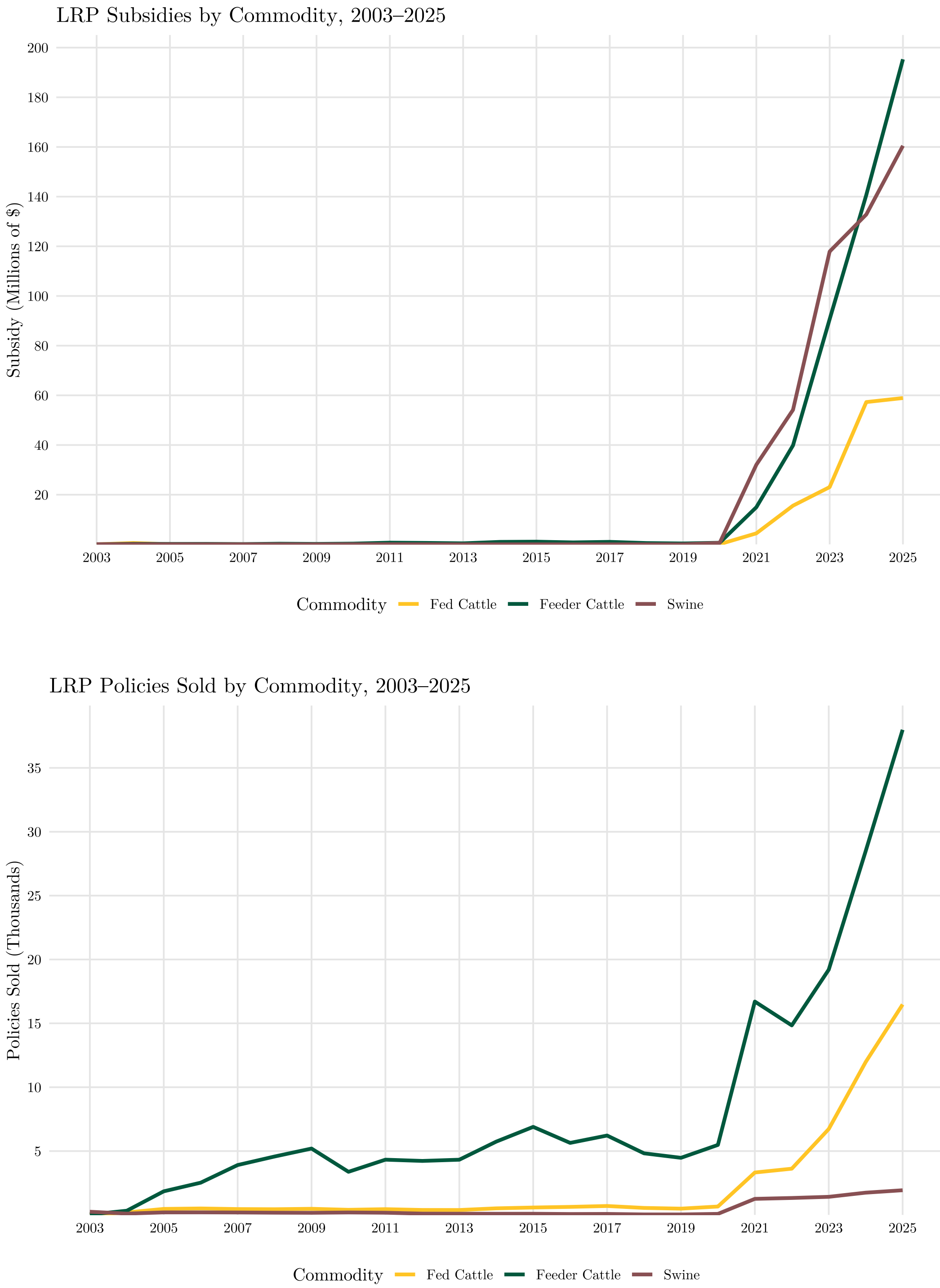
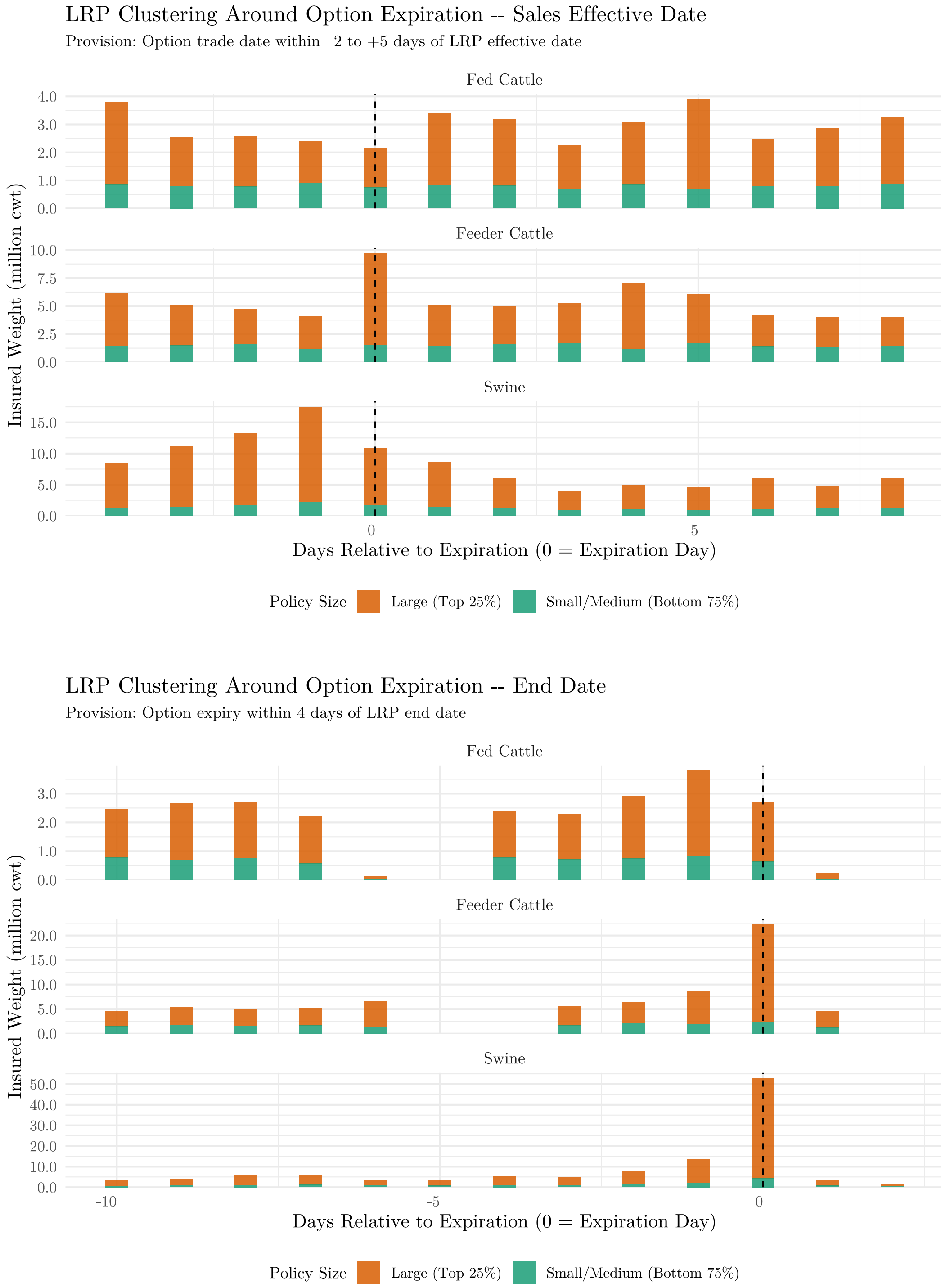
8. Figures and Tables

Figure 1: Trends in LRP Subsidy Expenditures and Participation



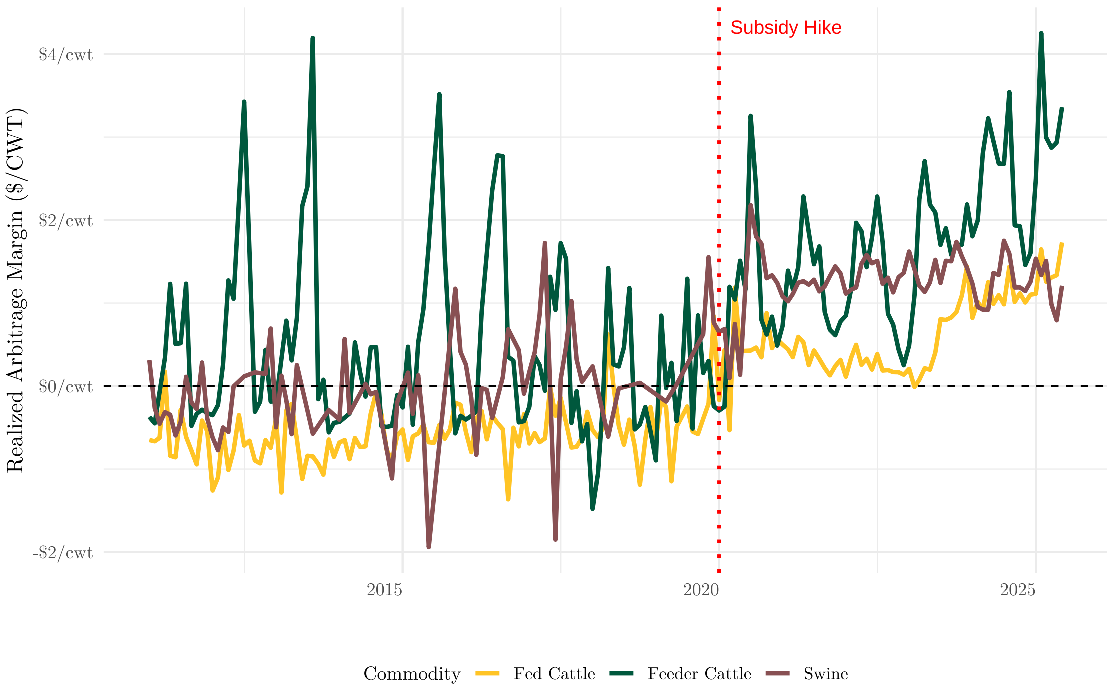
Note: This figure displays annual trends in the Livestock Risk Protection program from 2003–2025. The top panel shows federal subsidy expenditures in millions of dollars by commodity. The bottom panel shows the number of policies sold in thousands. Both figures use administrative data from USDA-RMA's Summary of Business (2003–2025). "Policies sold" refers to LRP endorsements earning a premium.

Figure 2: Insured Weight Clustered Around CME Option Expiration Dates



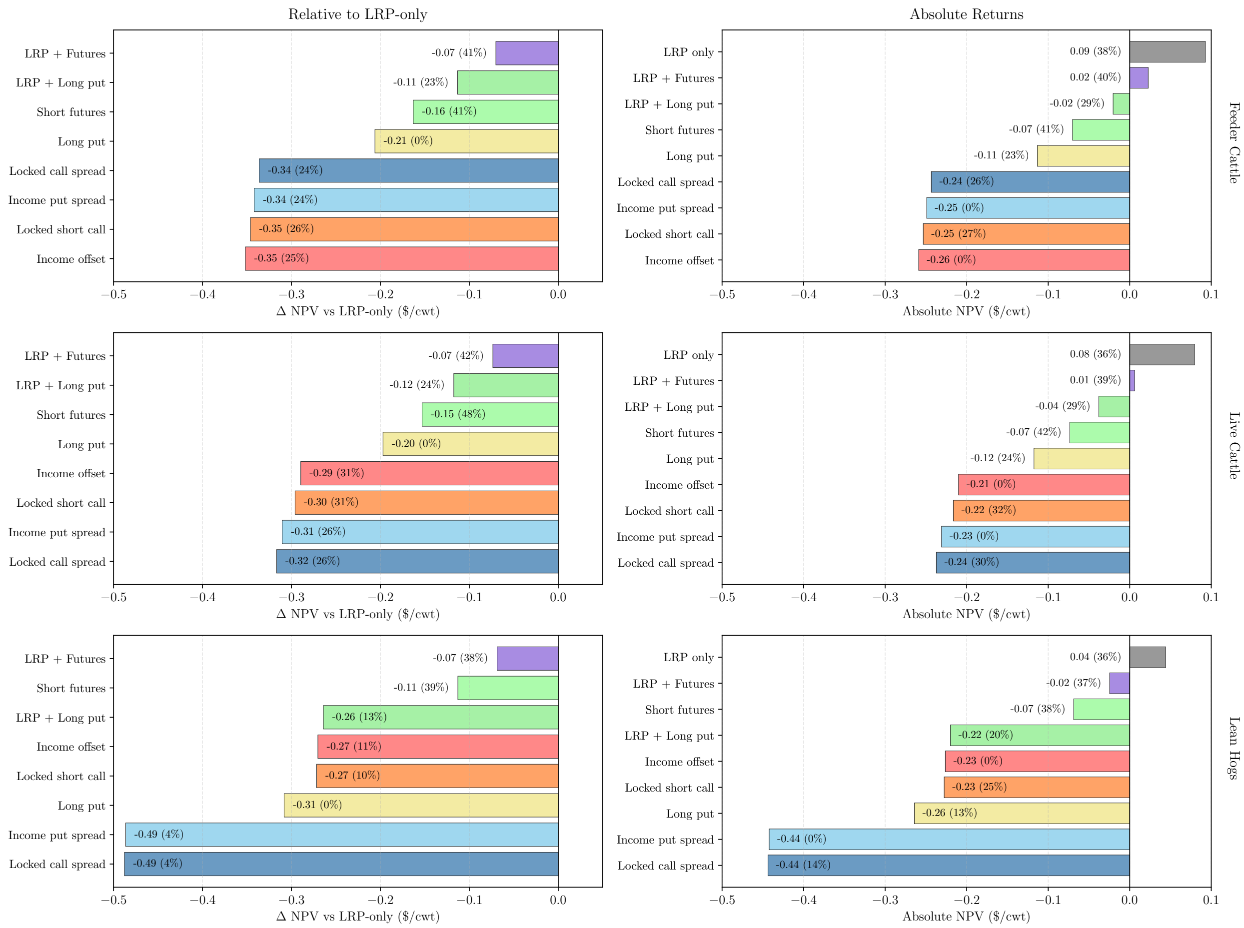
Note: This figure plots insured weight by days relative to option expiration. The top panel uses the date the option was traded and the LRP sales effective date. The bottom panel uses the LRP end date and option expiration. The vertical line at 0 indicates the CME expiration day. Policy size is divided into top 25% (orange) and bottom 75% (green) of insured CWT.

Figure 3: Average Realized Arbitrage Margin Over Time



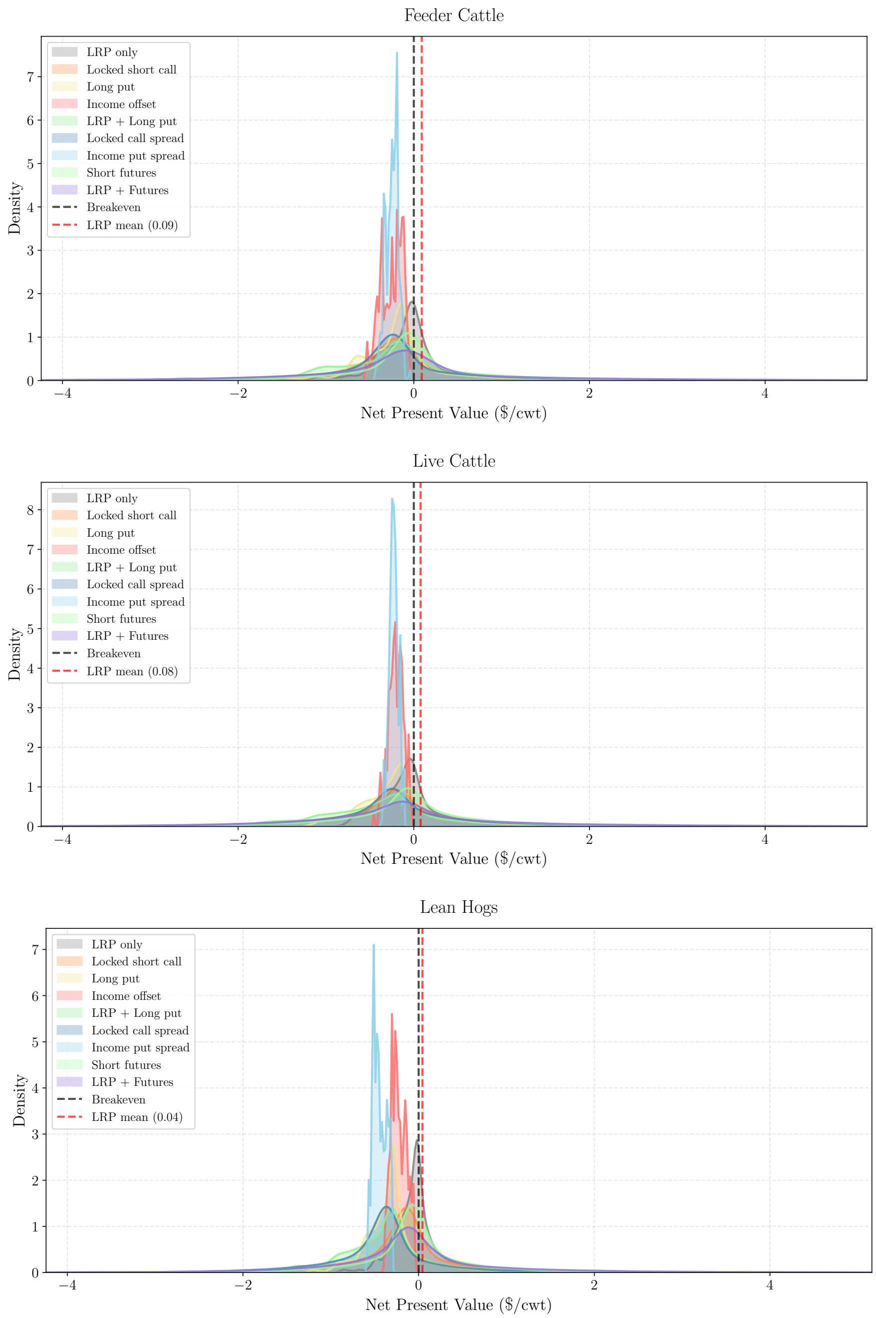
Note: The figure plots the estimated average subsidy spread per cwt by month of purchase. Values reflect the difference between the subsidized LRP premium and the exchange-traded value of the equivalent put option, assuming an identical strike. A positive value indicates potential for arbitrage profits. The vertical red line marks the 2020 increase in federal LRP premium subsidies.

Figure 4: Simulated Welfare Outcomes Across Strategies and Commodities



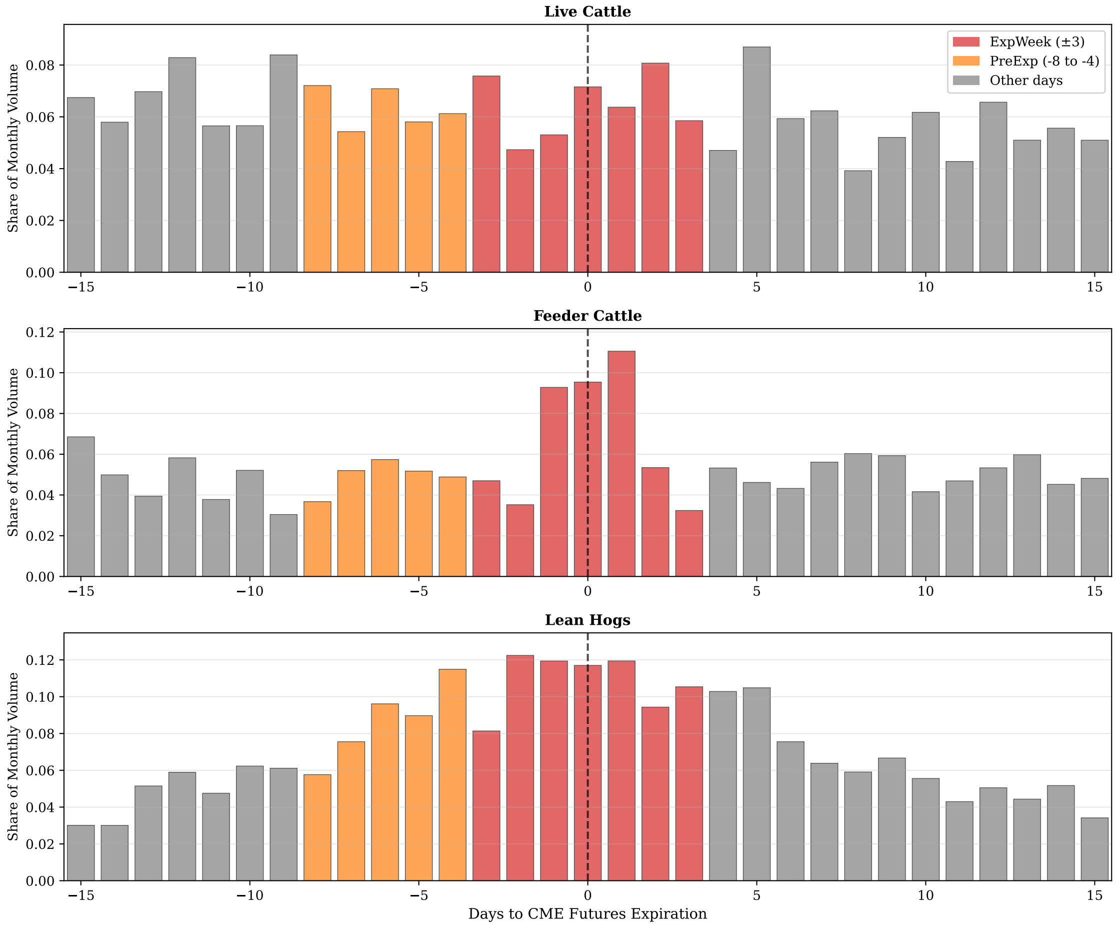
Note: Each panel reports mean NPVs in dollars per cwt from 1,000 Monte Carlo price paths at 100% coverage for retail producers. Left panels show ΔNPV relative to the LRP-only benchmark; right panels show absolute NPVs. Bars are labeled with the percentage of positive draws, $P(\text{NPV} > 0)$. Strategies are ordered by mean outcome.

Figure 5: Distribution of Simulated NPVs Across Strategies



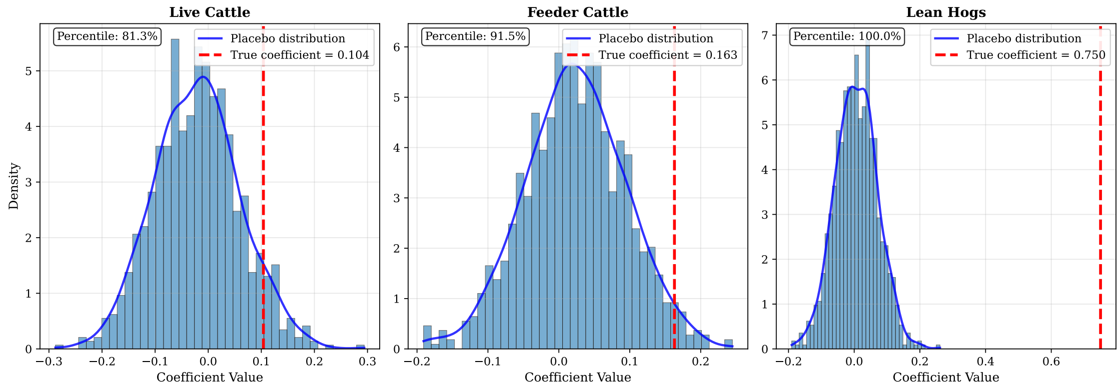
Note: Kernel density estimates of simulated NPVs based on 1,000 Monte Carlo price paths for feeder cattle, live cattle, and lean hogs at 100% coverage. Each curve corresponds to one strategy, and the vertical dashed line marks the LRP-only mean. The distributions illustrate the dispersion of simulated outcomes and the share of positive draws reported in Figure 4.

Figure 6: Event Study – LRP Volume Around CME Expiration



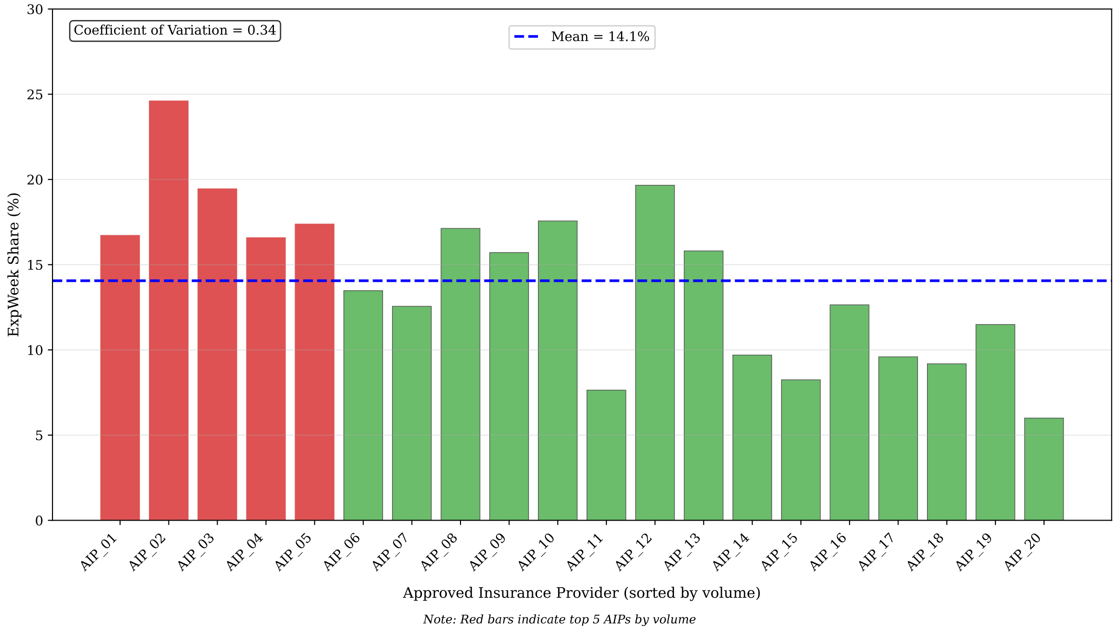
Note: This figure plots the event study of LRP endorsement volume around CME futures expiration dates. The vertical axis shows the share of monthly volume occurring on each day. Day 0 represents the CME expiration date. Red bars indicate the expiration week window (±3 days), orange bars show the pre-expiration window (−8 to −4 days), and gray bars represent all other days. Volume is calculated as the winsorized (95th percentile) sum of insured weight. Sample includes all LRP endorsements from USDA-RMA Summary of Business, 2019-2025. Expiration dates follow CME rules: last business day for Live Cattle, 10th business day for Lean Hogs, and last Thursday (with November adjustment) for Feeder Cattle.

Figure 7: Placebo Test – True Effects vs Random Assignment



Note: Placebo test comparing actual expiration week effects (red vertical line) against the distribution of effects from 1,000 randomly assigned fake expiration dates. Random dates preserve the day-of-week structure within each month-year. Blue histogram shows the placebo distribution. Percentiles indicate where the true coefficient falls in the placebo distribution. For Lean Hogs, the actual effect exceeds 100% of placebo estimates ($p < 0.001$), confirming that clustering is specific to CME dates rather than generic calendar patterns. All specifications include day-of-week dummies, month-end indicator, and year-month fixed effects with standard errors clustered by year-month.

Figure 8: Expiration Week Concentration by AIP



Note: This figure plots the share of insured volume occurring during CME expiration weeks (±3 days) by Approved Insurance Provider. Red bars indicate AIPs with above-mean concentration; green bars show below-mean concentration. The dashed line represents the mean concentration across all AIPs (14.1%). Coefficient of variation = 0.34 indicates relatively consistent patterns across insurers, suggesting industry-wide coordination rather than firm-specific strategies. Sample includes the top 20 AIPs by total volume, representing over 95% of LRP business 2019-2025. AIP codes are anonymized for confidentiality.

Table 1: Descriptive Statistics by Commodity

Variable	**Mean**	**SD**	**Min**	**Max**
Fed Cattle				
Total Weight (cwt)	2,491.56	6,298.76	11.00	212,000.00
Total Premium ($)	16,926.28	46,232.71	23.00	1,697,861.00
Producer Premium ($)	11,029.29	30,054.27	14.00	1,103,610.00
Subsidy Rate	0.34	0.06	0.00	0.55
Coverage Price ($/cwt)	171.87	24.81	79.45	219.05
Feeder Cattle				
Total Weight (cwt)	997.61	2,800.92	3.00	280,000.00
Total Premium ($)	9,015.11	24,070.49	5.00	1,990,696.00
Producer Premium ($)	5,921.73	15,663.68	2.00	1,293,952.00
Subsidy Rate	0.33	0.08	0.00	0.60
Coverage Price ($/cwt)	227.77	49.64	68.06	344.17
Swine				
Total Weight (cwt)	7,046.22	18,045.05	2.00	325,577.00
Total Premium ($)	46,355.86	121,234.43	15.00	2,009,685.00
Producer Premium ($)	30,113.21	79,012.95	10.00	1,306,296.00
Subsidy Rate	0.35	0.04	0.00	0.56
Coverage Price ($/cwt)	85.81	9.82	42.30	124.08

Note: This table reports the summary statistics for all LRP endorsements from USDA-RMA Summary of Business, 2011–2025. Total Weight measured in cwt. Premium amounts in U.S. dollars. Subsidy Rate calculated as Subsidy Amount divided by Total Premium Amount. Coverage Price represents the guaranteed minimum price per cwt selected by the producer at enrollment.

Table 2: Effect of Near-Expiry Window on Insured Weight (Sales Effective Date)

Commodity	Estimate	Std. Error	z-Stat	p-value	% Change
Fed Cattle	-0.058	0.104	-0.550	0.5820	-5.59
Feeder Cattle	0.178	0.089	2.010	0.0446	19.5
Swine	0.458	0.075	6.100	0.0000	58.1

Note: Estimates are from a Poisson Pseudo-Maximum Likelihood (PPML) regression. The dependent variable is the total insured CWT maturing on a given day for each commodity. Percentage change is calculated as $100 \times \exp(\beta) - 1$. The Near-Expiry Window is an indicator variable equal to one if the sales effective date falls within the 2 days to the nearest option expiration date. All models include month and year fixed effects and cluster standard errors by year.

Table 3: Effect of Near-Expiry Window on Insured Weight (End Date)

Commodity	Estimate	Std. Error	t-stat	p-value	% Change
Fed Cattle	0.183	0.077	2.38	0.0172	20.1
Feeder Cattle	0.826	0.095	8.74	0.0000	128.0
Swine	1.640	0.151	10.9	0.0000	417.0

Note: Estimates are from a Poisson Pseudo-Maximum Likelihood (PPML) regression. The dependent variable is the total insured CWT maturing on a given day for each commodity. Percentage change is calculated as $100 \times \exp(\beta) - 1$. The Near-Expiry Window is an indicator variable equal to one if the end date falls within the 2 days to the nearest option expiration date. All models include month and year fixed effects and cluster standard errors by year.

Table 4: Strategy Definitions and Economic Interpretation

Strategy label	Instruments and construction	Economic intent
LRP only	Purchase Livestock Risk Protection (LRP) at the selected coverage level with the premium subsidy.	Benchmark insured position, provides the value of federally subsidized price insurance.
Locked short call	Hold LRP and sell a CME call option sized to offset the insured upside.	Test whether subsidized insurance premiums create an arbitrage-like wedge relative to market option prices by selling offsetting CME calls.
Long put	Buy a CME put option with the same strike and term as the LRP endorsement, without purchasing LRP.	Provide a pure exchange-traded insurance benchmark for comparison.
Income offset	Buy a CME put option such that its cost approximates the producer paid LRP premium.	Replicate the LRP cash outlay to measures how much insurance the producer could privately purchase with the same expenditure as under LRP.
LRP + Long put	Hold the LRP policy and purchase an additional CME put option with a similar strike and maturity.	Double-insure the downside and test whether private market options can enhance downside protection beyond subsidized LRP.
Locked call spread	Sell a near-the-money CME call and buy a further out-of-the-money call on the same underlying, creating a limited-upside short position over an LRP policy.	Tests whether producers can capture the apparent subsidy wedge between LRP and CME option prices by writing exchange-traded calls.
Income put spread	Short a nearer-the-money CME put and long a further out-of-the-money put on the same underlying, creating a limited-downside short position over an LRP policy.	Reduces upfront cost while sacrificing protection in deep-loss scenarios, effectively trading insured downside to monetize subsidy.
Short futures	Take a short CME futures position sized to match the covered exposure.	Replicate LRP through direct futures hedging.
LRP + Futures	Hold LRP and add a short futures position proportional to the insured coverage.	Adding a linear hedge on the insured base to reduce basis and price volatility.

Table 5: Baseline Calibration Parameters

Parameter	**Symbol**	**Source / Notes**
Initial futures price	F_0	CME daily settlement
Coverage level	K/F_0	Observed in RMA endorsement data
Volatility	σ	CME implied volatility for matching term and strike
Risk-free rate	r	Short-term Treasury or SOFR rate consistent with term
Horizon	τ	Policy term measured in weeks
Premium subsidy	s	35–55% (RMA schedule by coverage)
Risk aversion	a	CARA coefficient
Simulations	—	1,000 price paths per coverage $\times$ tier

Table 6: Calibration of Market Frictions

Commodity	Producer Type	Commission (¢/cwt)	Half-Spread (¢/cwt)	SPAN (%)	Financing (bp over SOFR)	Audit Prob (%)	Penalty (%)
Feeder Cattle	Retail	1.50	10.0	7.00	250	2.00	30.0
	Large	0.75	5.00	7.00	150	2.00	30.0
Live Cattle	Retail	1.50	10.0	6.00	250	2.00	30.0
	Large	0.75	5.00	6.00	150	2.00	30.0
Lean Hogs	Retail	1.50	25.0	10.0	250	2.00	30.0
	Large	0.75	15.0	10.0	150	2.00	30.0

Note: This table reports the calibration parameters used in the Monte Carlo simulation of livestock risk protection strategies. Commission rates and bid–ask half–spreads are drawn from CME broker surveys and public execution cost schedules, representing retail and institutional trading tiers. SPAN margin percentages reflect CME margin requirements for at–the–money livestock options as of 2024. Financing rates are expressed as basis points over the Secured Overnight Financing Rate (SOFR) and capture typical operating credit spreads for farm borrowers. All parameters are applied consistently across 1,000 simulated price paths per commodity, coverage, and producer tier. The model assumes deterministic financing and margin costs, with no audit or penalty process.

Table 7: Simulation Results for Feeder Cattle at 100% Coverage ($/cwt)

Strategy	**Mean NPV**	**P(NPV>0)(%)**	**ΔNPV vs LRP**	**CE(A=0.10)**	**CE(A=0.50)**	**CE(A=1.00)**
Producer Type: Large						
LRP only	0.09	38.47	0.00	0.06	0.03	-0.07
Locked short call	-0.17	32.21	-0.26	-0.23	-0.52	-1.02
Long put	-0.06	40.38	-0.15	-0.08	-0.16	-0.32
Income offset	-0.17	37.57	-0.27	-0.17	-0.37	-0.73
LRP + Long put	-0.04	33.03	-0.13	-0.07	-0.18	-0.39
Locked call spread	-0.13	35.57	-0.22	-0.19	-0.46	-0.91
Income put spread	-0.12	37.94	-0.21	-0.18	-0.47	-0.95
Short futures	-0.06	42.92	-0.15	-0.08	-0.20	-0.40
LRP + Futures	0.03	40.94	-0.06	-0.02	-0.10	-0.19
Producer Type: Retail						
LRP only	0.09	38.47	0.00	0.06	0.03	-0.07
Locked short call	-0.25	27.99	-0.34	-0.25	-0.56	-1.10
Long put	-0.11	35.07	-0.20	-0.13	-0.26	-0.51
Income offset	-0.26	29.79	-0.35	-0.23	-0.55	-1.09
LRP + Long put	-0.20	26.61	-0.28	-0.18	-0.45	-0.90
Locked call spread	-0.25	32.43	-0.34	-0.23	-0.51	-0.95
Income put spread	-0.24	30.13	-0.33	-0.21	-0.50	-0.93
Short futures	-0.07	41.45	-0.16	-0.10	-0.23	-0.42
LRP + Futures	0.02	40.07	-0.07	-0.07	-0.17	-0.33

Note: ΔNPVs are relative to the LRP-only baseline. CE values are computed under constant absolute risk aversion (CARA) at three coefficients of risk aversion ($A = 0.10$, 0.50, 1.00). Results are based on Monte Carlo simulations using 1,000 price paths per strategy.

Table 8: Simulation Results for Live Cattle at 100% Coverage ($/cwt)

Strategy	**Mean NPV**	**P(NPV>0)(%)**	**ΔNPV vs LRP**	**CE(A=0.10)**	**CE(A=0.50)**	**CE(A=1.00)**
Producer Type: Large						
LRP only	0.08	36.77	0.00	0.06	0.03	-0.05
Locked short call	-0.14	36.66	-0.21	-0.18	-0.36	-0.63
Long put	-0.06	28.28	-0.14	-0.13	-0.14	-0.19
Income offset	-0.13	5.00	-0.21	-0.13	-0.13	-0.13
LRP + Long put	0.02	32.30	-0.06	-0.02	-0.07	-0.25
Locked call spread	-0.11	36.79	-0.19	-0.16	-0.34	-0.60
Income put spread	-0.11	3.33	-0.19	-0.15	-0.33	-0.60
Short futures	-0.06	43.44	-0.14	-0.10	-0.29	-0.55
LRP + Futures	0.02	40.05	-0.06	-0.06	-0.18	-0.38
Producer Type: Retail						
LRP only	0.08	36.77	0.00	0.06	0.03	-0.05
Locked short call	-0.22	32.23	-0.30	-0.26	-0.44	-0.71
CME hedge only	-0.10	24.42	-0.18	-0.20	-0.16	-0.25
Income offset	-0.21	0.00	-0.29	-0.18	-0.18	-0.18
LRP + Long put	-0.04	29.78	-0.12	-0.08	-0.13	-0.30
Locked call spread	-0.23	30.34	-0.31	-0.24	-0.46	-0.72
Income put spread	-0.23	30.00	-0.31	-0.27	-0.45	-0.72
Short futures	-0.07	42.28	-0.15	-0.12	-0.30	-0.57
LRP + Futures	0.01	39.39	-0.07	-0.08	-0.20	-0.37

Note: ΔNPVs are relative to the LRP-only baseline. CE values are computed under constant absolute risk aversion (CARA) at three coefficients of risk aversion ($A = 0.10, 0.50, 1.00$). Results are based on Monte Carlo simulations using 1,000 price paths per strategy.

Table 9: Simulation Results for Lean Hogs at 100% Coverage ($/cwt)

Strategy	Mean NPV	P(NPV>0)(%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.50)	CE(A=1.00)
Producer Type: Large						
LRP only	0.04	36.77	0.00	0.03	0.00	-0.03
Locked short call	-0.16	30.23	-0.20	-0.18	-0.27	-0.40
Long put	-0.16	17.90	-0.20	-0.17	-0.20	-0.23
Income offset	-0.16	0.00	-0.20	-0.16	-0.16	-0.16
LRP + Long put	-0.13	25.08	-0.16	-0.13	-0.20	-0.25
Locked call spread	-0.28	21.24	-0.32	-0.30	-0.38	-0.52
Income put spread	-0.27	0.00	-0.32	-0.29	-0.38	-0.50
Short futures	-0.06	40.59	-0.10	-0.09	-0.17	-0.31
LRP + Futures	-0.01	38.89	-0.06	-0.05	-0.11	-0.40
Producer Type: Retail						
LRP only	0.04	36.77	0.00	0.03	0.00	-0.03
Locked short call	-0.23	25.97	-0.27	-0.25	-0.34	-0.47
Long put	-0.26	13.47	-0.31	-0.27	-0.30	-0.33
Income offset	-0.23	0.00	-0.27	-0.21	-0.27	-0.36
LRP + Long put	-0.24	20.47	-0.26	-0.24	-0.30	-0.36
Locked call spread	-0.44	14.93	-0.49	-0.46	-0.55	-0.69
Income put spread	-0.44	0.00	-0.49	-0.46	-0.55	-0.67
Short futures	-0.07	38.91	-0.12	-0.10	-0.18	-0.31
LRP + Futures	-0.02	37.85	-0.07	-0.06	-0.12	-0.41

Note: ΔNPVs are relative to the LRP-only baseline. CE values are computed under constant absolute risk aversion (CARA) at three coefficients of risk aversion ($A = 0.10$, 0.50, 1.00). Results are based on Monte Carlo simulations using 1,000 price paths per strategy.

Table 10: Sensitivity Analysis: Feeder Cattle at 100% Coverage (Mean NPV with ΔNPV in parentheses, \$/cwt)

Scenario	**LRP only**	**Locked short call**	**CME hedge only**	**Income offset**	**LRP + CME long put**	**Locked call spread**	**Income put spread**	**Short futures**	**LRP + Futures**
Baseline	0.10 (0.00)	-0.26 (0.00)	-0.12 (0.00)	-0.26 (0.00)	-0.02 (0.00)	-0.24 (0.00)	-0.24 (0.00)	-0.07 (0.00)	0.03 (0.00)
Transaction Costs									
Half costs	0.10 (0.00)	-0.21 (+0.04)	-0.06 (+0.06)	-0.21 (+0.04)	0.04 (+0.06)	-0.14 (+0.10)	-0.14 (+0.10)	-0.07 (0.00)	0.03 (0.00)
Double spreads	0.10 (0.00)	-0.32 (-0.07)	-0.22 (-0.10)	-0.32 (-0.07)	-0.12 (-0.10)	-0.41 (-0.17)	-0.41 (-0.17)	-0.07 (0.00)	0.03 (0.00)
Audit Risk									
No audit (0%)	0.10 (0.00)	-0.26 (0.00)	-0.12 (0.00)	-0.26 (0.00)	-0.02 (0.00)	-0.24 (0.00)	-0.24 (0.00)	-0.07 (0.00)	0.03 (0.00)
5% audit probability	0.09 (-0.01)	-0.26 (-0.01)	-0.12 (0.00)	-0.26 (-0.01)	-0.03 (-0.01)	-0.25 (-0.01)	-0.25 (-0.01)	-0.07 (0.00)	0.03 (0.00)
10% audit probability	0.08 (-0.01)	-0.27 (-0.01)	-0.12 (0.00)	-0.27 (-0.01)	-0.03 (-0.01)	-0.26 (-0.02)	-0.26 (-0.02)	-0.07 (0.00)	0.03 (0.00)
Financing									
SOFR +100bp	0.10 (0.00)	-0.19 (+0.06)	-0.12 (0.00)	-0.20 (+0.06)	-0.02 (0.00)	-0.21 (+0.03)	-0.21 (+0.03)	-0.05 (+0.02)	0.04 (+0.02)
SOFR +400bp	0.10 (0.00)	-0.32 (-0.06)	-0.12 (0.00)	-0.32 (-0.06)	-0.02 (0.00)	-0.27 (-0.03)	-0.27 (-0.03)	-0.09 (-0.02)	0.01 (-0.02)
Market Dynamics									
Market jumps	0.18 (+0.08)	-0.23 (+0.02)	-0.03 (+0.08)	-0.26 (0.00)	0.15 (+0.17)	-0.22 (+0.02)	-0.24 (+0.01)	-0.05 (+0.02)	0.13 (+0.11)
High volatility (2020)	0.04 (-0.06)	-0.14 (+0.12)	-0.11 (0.00)	-0.13 (+0.13)	-0.07 (-0.05)	-0.21 (+0.03)	-0.20 (+0.04)	-0.04 (+0.03)	0.00 (-0.02)
Policy Changes									
Pre-subsidy increase (2019)	0.01 (-0.09)	-0.24 (+0.02)	-0.11 (+0.01)	-0.25 (+0.01)	-0.10 (-0.09)	-0.28 (-0.04)	-0.29 (-0.05)	-0.06 (+0.01)	-0.05 (-0.08)
Post-subsidy increase (2021)	0.06 (-0.03)	-0.12 (+0.14)	-0.11 (0.00)	-0.10 (+0.15)	-0.05 (-0.03)	-0.19 (+0.05)	-0.18 (+0.06)	-0.04 (+0.04)	0.03 (0.00)
Zero friction	0.10 (0.00)	0.10 (+0.36)	0.00 (+0.12)	0.10 (+0.36)	0.10 (+0.12)	0.10 (+0.34)	0.10 (+0.34)	0.00 (+0.07)	0.10 (+0.07)

Note: This table examines the sensitivity of NPV results to alternative parameter assumptions. Baseline represents 100% coverage for retail producers with standard market frictions. Values in parentheses show the change from baseline NPV in dollars per cwt. "Half costs" reduces commissions and spreads by 50%. "No audit" sets audit probability to zero. Financing scenarios vary the spread over SOFR from 100 to 400 basis points. "Market jumps" introduce rare price shocks in the simulated price process, while the high-volatility scenario reflects sustained increases in daily market volatility and option-implied variance, as observed in 2020. Policy change scenarios are calibrated using observed CME option data, maintaining the empirical relationships among implied volatility, moneyness, and market spreads to replicate actual market conditions rather than synthetic volatility scaling. "Zero friction" eliminates all transaction costs, margin requirements, and audit risk to establish a theoretical upper bound. All scenarios maintain 1,000 simulated price paths.

Table 11: Sensitivity Analysis: Live Cattle at 100% Coverage (Mean NPV with ΔNPV in parentheses, $/cwt)

Scenario	**LRP only**	**Locked short call**	**CME hedge only**	**Income offset**	**LRP + CME long put**	**Locked call spread**	**Income put spread**	**Short futures**	**LRP + Futures**
Baseline	0.09 (0.00)	-0.19 (0.00)	-0.12 (0.00)	-0.18 (0.00)	-0.03 (0.00)	-0.22 (0.00)	-0.21 (0.00)	-0.07 (0.00)	0.02 (0.00)
Transaction Costs									
Half costs	0.09 (0.00)	-0.13 (+0.05)	-0.06 (+0.06)	-0.13 (+0.05)	0.03 (+0.06)	-0.10 (+0.11)	-0.10 (+0.11)	-0.07 (0.00)	0.02 (0.00)
Double spreads	0.09 (0.00)	-0.26 (-0.08)	-0.22 (-0.10)	-0.26 (-0.08)	-0.13 (-0.10)	-0.39 (-0.18)	-0.39 (-0.18)	-0.07 (0.00)	0.02 (0.00)
Audit Risk									
No audit (0%)	0.09 (0.00)	-0.19 (0.00)	-0.12 (0.00)	-0.18 (0.00)	-0.03 (0.00)	-0.22 (0.00)	-0.21 (0.00)	-0.07 (0.00)	0.02 (0.00)
5% audit probability	0.08 (-0.01)	-0.19 (-0.01)	-0.12 (0.00)	-0.19 (-0.01)	-0.04 (-0.01)	-0.22 (-0.01)	-0.22 (-0.01)	-0.07 (0.00)	0.02 (0.00)
10% audit probability	0.08 (-0.01)	-0.20 (-0.01)	-0.12 (0.00)	-0.20 (-0.01)	-0.04 (-0.01)	-0.23 (-0.01)	-0.23 (-0.01)	-0.07 (0.00)	0.02 (0.00)
Financing									
SOFR +100bp	0.09 (0.00)	-0.14 (+0.04)	-0.12 (0.00)	-0.14 (+0.04)	-0.03 (0.00)	-0.19 (+0.02)	-0.19 (+0.02)	-0.05 (+0.02)	0.04 (+0.02)
SOFR +400bp	0.09 (0.00)	-0.23 (-0.04)	-0.12 (0.00)	-0.23 (-0.04)	-0.03 (0.00)	-0.24 (-0.02)	-0.23 (-0.02)	-0.08 (-0.02)	0.01 (-0.02)
Market Dynamics									
Market jumps	0.14 (+0.05)	-0.19 (0.00)	-0.07 (+0.05)	-0.18 (0.00)	0.07 (+0.10)	-0.22 (0.00)	-0.21 (0.00)	-0.07 (0.00)	0.08 (+0.05)
High volatility (2020)	0.03 (-0.06)	-0.13 (+0.06)	-0.12 (0.00)	-0.12 (+0.07)	-0.09 (-0.06)	-0.21 (+0.00)	-0.20 (+0.01)	-0.04 (+0.02)	-0.01 (-0.04)
Policy Changes									
Pre-subsidy increase (2019)	0.00 (-0.09)	-0.21 (-0.03)	-0.12 (+0.01)	-0.21 (-0.03)	-0.11 (-0.09)	-0.27 (-0.06)	-0.27 (-0.06)	-0.06 (+0.01)	-0.06 (-0.08)
Post-subsidy increase (2021)	0.05 (-0.04)	-0.10 (+0.09)	-0.11 (+0.01)	-0.10 (+0.09)	-0.06 (-0.03)	-0.19 (+0.03)	-0.18 (+0.03)	-0.03 (+0.04)	0.02 (0.00)
Zero friction	0.09 (0.00)	0.09 (+0.28)	-0.01 (+0.12)	0.10 (+0.28)	0.09 (+0.12)	0.09 (+0.31)	0.10 (+0.31)	0.00 (+0.06)	0.09 (+0.06)

Note: This table examines the sensitivity of NPV results to alternative parameter assumptions. Baseline represents 100% coverage for retail producers with standard market frictions. Values in parentheses show the change from baseline NPV in dollars per cwt. Scenario definitions mirror those in Table 10. All scenarios maintain 1,000 simulated price paths.

Table 12: Sensitivity Analysis: Lean Hogs at 100% Coverage (Mean NPV with ΔNPV in parentheses, $/cwt)

Scenario	**LRP only**	**Locked short call**	**CME hedge only**	**Income offset**	**LRP + CME long put**	**Locked call spread**	**Income put spread**	**Short futures**	**LRP + Futures**
Baseline	0.04 (0.00)	-0.23 (0.00)	-0.27 (0.00)	-0.21 (0.00)	-0.22 (0.00)	-0.45 (0.00)	-0.43 (0.00)	-0.07 (0.00)	-0.03 (0.00)
Transaction Costs									
Half costs	0.04 (0.00)	-0.16 (+0.07)	-0.14 (+0.13)	-0.14 (+0.07)	-0.09 (+0.13)	-0.24 (+0.20)	-0.23 (+0.20)	-0.07 (0.00)	-0.03 (0.00)
Double spreads	0.04 (0.00)	-0.28 (-0.06)	-0.52 (-0.25)	-0.27 (-0.06)	-0.47 (-0.25)	-0.75 (-0.31)	-0.74 (-0.31)	-0.07 (0.00)	-0.03 (0.00)
Audit Risk									
No audit (0%)	0.04 (0.00)	-0.23 (0.00)	-0.27 (0.00)	-0.21 (0.00)	-0.22 (0.00)	-0.45 (0.00)	-0.43 (0.00)	-0.07 (0.00)	-0.03 (0.00)
5% audit probability	0.04 (0.00)	-0.23 (0.00)	-0.27 (0.00)	-0.22 (0.00)	-0.23 (0.00)	-0.45 (0.00)	-0.44 (0.00)	-0.07 (0.00)	-0.03 (0.00)
10% audit probability	0.04 (-0.01)	-0.23 (-0.01)	-0.27 (0.00)	-0.22 (-0.01)	-0.23 (-0.01)	-0.45 (-0.01)	-0.44 (-0.01)	-0.07 (0.00)	-0.03 (0.00)
Financing									
SOFR +100bp	0.04 (0.00)	-0.20 (+0.03)	-0.27 (0.00)	-0.19 (+0.03)	-0.22 (0.00)	-0.43 (+0.01)	-0.42 (+0.01)	-0.05 (+0.02)	-0.01 (+0.02)
SOFR +400bp	0.04 (0.00)	-0.25 (-0.03)	-0.27 (0.00)	-0.24 (-0.03)	-0.22 (0.00)	-0.46 (-0.01)	-0.45 (-0.01)	-0.09 (-0.02)	-0.04 (-0.02)
Market Dynamics									
Market jumps	0.07 (+0.03)	-0.22 (0.00)	-0.24 (+0.03)	-0.21 (0.00)	-0.17 (+0.05)	-0.44 (0.00)	-0.43 (0.00)	-0.07 (0.00)	0.00 (+0.03)
High volatility (2020)	0.03 (-0.01)	-0.18 (+0.04)	-0.27 (0.00)	-0.18 (+0.03)	-0.23 (-0.01)	-0.43 (+0.02)	-0.43 (+0.01)	-0.04 (+0.03)	-0.01 (+0.02)
Policy Changes									
Pre-subsidy increase (2019)	0.00 (-0.04)	-0.23 (-0.01)	-0.27 (0.00)	-0.24 (-0.02)	-0.26 (-0.04)	-0.46 (-0.02)	-0.46 (-0.03)	-0.06 (+0.01)	-0.06 (-0.04)
Post-subsidy increase (2021)	0.05 (+0.01)	-0.16 (+0.07)	-0.27 (0.00)	-0.15 (+0.06)	-0.22 (0.00)	-0.40 (+0.05)	-0.40 (+0.04)	-0.04 (+0.03)	0.01 (+0.04)
Zero friction	0.04 (0.00)	0.04 (+0.27)	-0.00 (+0.27)	0.05 (+0.26)	0.04 (+0.27)	0.04 (+0.48)	0.05 (+0.48)	-0.01 (+0.06)	0.04 (+0.06)

Note: This table examines the sensitivity of NPV results to alternative parameter assumptions for lean hogs. Baseline represents 100% coverage for retail producers with standard market frictions. Values in parentheses show the change from baseline NPV in dollars per cwt. Scenario definitions mirror those in Table 10. All scenarios maintain 1,000 simulated price paths.

Table 13: Expiration Week Effects on LRP Endorsement Volume

Commodity	ExpWeek (±3)	ExpDay (±1)	PreExp (-8,-4)
Live Cattle	0.104	0.391	0.094
	(0.154)	(0.292)	(0.206)
Feeder Cattle	0.163	0.302**	0.189
	(0.111)	(0.142)	(0.158)
Lean Hogs	0.750***	0.779***	-0.324**
	(0.117)	(0.153)	(0.148)

Note: Poisson pseudo-maximum likelihood (PPML) estimates of daily insured weight response to CME expiration windows. Dependent variable is $log(1 + CWT)$ aggregated to the commodity-date level. ExpWeek equals one if within ±3 days of expiration, ExpDay if within ±1 day, PreExp if -8 to -4 days before. All specifications include day-of-week dummies (excluding Sunday), month-end indicator, and year-month fixed effects. Standard errors clustered by year-month in parentheses. Sample covers 124,598 LRP endorsements from 2019–2024, winsorized at the 95th percentile of insured weight. Percentage effects computed as $100 \times (exp(\beta) - 1)$. *** p<0.01, ** p<0.05, * p<0.10.

Table 14: Placebo Test: Actual vs Simulated Expiration Effects

Commodity	True β	Placebo Mean	Placebo SD	Percentile (%)	P-value
Live Cattle	0.104	-0.022	0.082	81.3	0.472
Feeder Cattle	0.163	0.018	0.071	91.5	0.135
Lean Hogs	0.750	0.006	0.065	100.0	0.000

Note: Placebo test with 1,000 iterations of randomly assigned fake expiration dates within each month, preserving day-of-week structure. "True β" is the coefficient from Table 13. "Placebo Mean" and "Placebo SD" characterize the null distribution. "Percentile" indicates the position of the true effect in the placebo distribution. P-values from two-sided tests of the null hypothesis that the true effect could arise from random timing.

Table 15: Falsification Test: Effects Under Calendar Shifts

Commodity	Original β	Shifted +7 Days	P-value	Shifted +14 Days	P-value
Live Cattle	0.104	−0.003	0.986	0.021	0.892
Feeder Cattle	0.163	−0.161	0.344	−0.089	0.521
Lean Hogs	0.750***	0.046	0.755	0.033	0.812

Note: Falsification test shifting the entire CME expiration calendar forward by 7 or 14 days while preserving all other features. If clustering were driven by CME-specific timing, effects should persist under calendar shifts. If driven by generic monthly patterns, shifted effects should remain similar.

Table 16: CME Effects Persist After Controlling for Reinsurance Timing

Commodity	ExpWeek	LastBizDay	FridayAfterSun	Friday
Live Cattle	0.102	0.089	−0.045	0.078
	(0.156)	(0.212)	(0.198)	(0.145)
Feeder Cattle	0.158	0.134	0.067	0.091
	(0.113)	(0.187)	(0.176)	(0.132)
Lean Hogs	0.741***	0.156	0.102	0.123
	(0.119)	(0.201)	(0.189)	(0.156)

Note: Regression including controls for reinsurance-related timing that could potentially explain clustering. LastBizDay equals one for the last business day of the month (monthly settlement). FridayAfterSun indicates the Friday after the first Sunday (monthly reporting cutoff per LPRA Appendix III). Friday captures all Friday effects (weekly reporting). *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

Appendix A: Figures for Simulation by Commodity

Table A.1: Simulation Results for the LRP-Only Strategy (Mean and Certainty-Equivalent NPVs, $/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	P(NPV > 0) (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	0.11	-0.25	18.7	0.00	-0.05	-0.13	-0.17	-0.20
	90	Large	0.11	-0.25	18.7	0.00	-0.05	-0.13	-0.17	-0.20
	95	Retail	0.09	-0.27	20.5	0.00	-0.03	-0.11	-0.16	-0.21
	95	Large	0.09	-0.27	20.5	0.00	-0.03	-0.11	-0.16	-0.21
	100	Retail	0.09	-0.25	38.5	0.00	0.06	-0.01	-0.01	-0.07
	100	Large	0.09	-0.25	38.5	0.00	0.06	-0.01	-0.01	-0.07
Live Cattle	90	Retail	0.10	-0.25	10.4	0.00	-0.03	-0.10	-0.16	-0.20
	90	Large	0.10	-0.25	10.4	0.00	-0.03	-0.10	-0.16	-0.20
	95	Retail	0.08	-0.27	12.9	0.00	-0.01	-0.09	-0.15	-0.19
	95	Large	0.08	-0.27	12.9	0.00	-0.01	-0.09	-0.15	-0.19
	100	Retail	0.08	-0.26	36.8	0.00	0.06	0.00	0.00	-0.05
	100	Large	0.08	-0.26	36.8	0.00	0.06	0.00	0.00	-0.05
Lean Hogs	90	Retail	0.06	-0.16	18.5	0.00	0.00	-0.05	-0.08	-0.11
	90	Large	0.06	-0.16	18.5	0.00	0.00	-0.05	-0.08	-0.11
	95	Retail	0.05	-0.17	20.4	0.00	0.00	-0.03	-0.07	-0.11
	95	Large	0.05	-0.17	20.4	0.00	0.00	-0.03	-0.07	-0.11
	100	Retail	0.04	-0.17	36.8	0.00	0.03	0.02	0.00	-0.03
	100	Large	0.04	-0.17	36.8	0.00	0.03	0.02	0.00	-0.03

Note: Each row reports results for 1,000 Monte Carlo price paths per commodity, coverage level, and producer type. NPVs are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations yielding positive outcomes. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50$, and 1.00. ΔNPV values are measured relative to the LRP-only baseline.

Table A.2: Simulation Results for the Locked Short Call Strategy (Mean and Certainty-Equivalent NPVs, $/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	$P(\text{NPV} > 0)$ (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	-0.22	0.29	34.87	-0.33	-16.14	-30.14	-37.52	-41.64
	90	Large	-0.14	0.38	36.95	-0.25	-16.05	-30.05	-37.44	-41.55
	95	Retail	-0.25	-0.06	34.09	-0.34	-4.75	-11.19	-16.62	-20.35
	95	Large	-0.16	0.02	36.25	-0.25	-4.67	-11.11	-16.53	-20.27
	100	Retail	-0.25	-0.24	27.99	-0.35	-0.31	-0.41	-0.60	-1.01
	100	Large	-0.17	-0.16	32.21	-0.26	-0.23	-0.33	-0.52	-0.93
Live Cattle	90	Retail	-0.27	0.17	43.59	-0.37	-11.53	-25.64	-34.88	-40.33
	90	Large	-0.19	0.25	44.48	-0.29	-11.45	-25.56	-34.80	-40.25
	95	Retail	-0.26	-0.11	42.63	-0.34	-3.36	-8.48	-14.29	-18.97
	95	Large	-0.17	-0.03	43.69	-0.25	-3.28	-8.39	-14.21	-18.89
	100	Retail	-0.22	-0.21	32.23	-0.30	-0.26	-0.32	-0.44	-0.71
	100	Large	-0.14	-0.13	36.66	-0.21	-0.18	-0.24	-0.36	-0.63
Lean Hogs	90	Retail	-0.24	-0.04	35.93	-0.30	-3.58	-9.11	-14.36	-18.04
	90	Large	-0.16	0.05	37.80	-0.21	-3.49	-9.03	-14.27	-17.95
	95	Retail	-0.25	-0.19	34.73	-0.30	-1.20	-2.88	-5.42	-8.14
	95	Large	-0.16	-0.10	36.77	-0.21	-1.11	-2.79	-5.33	-8.06
	100	Retail	-0.23	-0.23	25.97	-0.27	-0.25	-0.27	-0.34	-0.47
	100	Large	-0.16	-0.16	30.23	-0.20	-0.18	-0.21	-0.27	-0.40

Note: Each row reports Monte Carlo results for the locked short call strategy, based on 1,000 simulated price paths per commodity, coverage level, and producer type. All values are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations with positive returns. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50$, and 1.00. ΔNPV values measure differences relative to the LRP-only benchmark.

Table A.3: Simulation Results for the Long Put Strategy (Mean and Certainty-Equivalent NPVs, $/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	P(NPV > 0) (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	-0.12	-0.48	7.83	-0.23	-0.27	-0.35	-0.40	-0.43
	90	Large	-0.06	-0.42	11.36	-0.17	-0.22	-0.30	-0.34	-0.37
	95	Retail	-0.12	-0.48	9.82	-0.21	-0.24	-0.31	-0.37	-0.41
	95	Large	-0.06	-0.42	13.40	-0.15	-0.18	-0.26	-0.31	-0.35
	100	Retail	-0.11	-0.46	23.24	-0.21	-0.14	-0.18	-0.22	-0.28
	100	Large	-0.06	-0.40	28.05	-0.15	-0.08	-0.12	-0.16	-0.22
Live Cattle	90	Retail	-0.12	-0.47	5.78	-0.22	-0.25	-0.32	-0.38	-0.41
	90	Large	-0.06	-0.41	7.14	-0.16	-0.19	-0.27	-0.32	-0.36
	95	Retail	-0.12	-0.47	8.28	-0.20	-0.21	-0.28	-0.34	-0.39
	95	Large	-0.06	-0.41	9.72	-0.14	-0.15	-0.23	-0.29	-0.33
	100	Retail	-0.12	-0.45	24.42	-0.20	-0.14	-0.16	-0.20	-0.25
	100	Large	-0.06	-0.40	28.28	-0.14	-0.08	-0.11	-0.14	-0.19
Lean Hogs	90	Retail	-0.26	-0.48	4.83	-0.32	-0.32	-0.37	-0.40	-0.43
	90	Large	-0.15	-0.38	6.36	-0.21	-0.21	-0.26	-0.29	-0.32
	95	Retail	-0.26	-0.48	6.66	-0.31	-0.30	-0.34	-0.38	-0.41
	95	Large	-0.16	-0.38	8.31	-0.20	-0.20	-0.27	-0.31	-0.35
	100	Retail	-0.26	-0.48	13.47	-0.31	-0.27	-0.29	-0.31	-0.33
	100	Large	-0.16	-0.37	17.90	-0.20	-0.17	-0.18	-0.20	-0.23

Note: Each row reports Monte Carlo results for the long put strategy (exchange-traded hedge only), based on 1,000 simulated price paths per commodity, coverage level, and producer type. All values are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations yielding positive net present values. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50$, and 1.00. ΔNPV values measure differences relative to the LRP-only benchmark.

Table A.4: Simulation Results for the Income Offset Strategy (Mean and Certainty-Equivalent NPVs, \$/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	P(NPV > 0) (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	-0.24	-0.24	0.00	-0.35	-0.23	-0.23	-0.24	-0.24
	90	Large	-0.15	-0.15	7.14	-0.26	-0.15	-0.15	-0.15	-0.16
	95	Retail	-0.26	-0.26	0.00	-0.35	-0.24	-0.24	-0.25	-0.25
	95	Large	-0.17	-0.17	3.57	-0.26	-0.17	-0.17	-0.17	-0.18
	100	Retail	-0.26	-0.26	0.00	-0.35	-0.25	-0.25	-0.25	-0.26
	100	Large	-0.17	-0.17	3.57	-0.27	-0.17	-0.17	-0.17	-0.18
Live Cattle	90	Retail	-0.19	-0.19	83.33	-0.29	-0.19	-0.19	-0.19	-0.19
	90	Large	-0.11	-0.11	7.49	-0.21	-0.11	-0.11	-0.11	-0.11
	95	Retail	-0.21	-0.21	0.00	-0.29	-0.19	-0.19	-0.20	-0.20
	95	Large	-0.13	-0.13	5.00	-0.21	-0.13	-0.13	-0.13	-0.13
	100	Retail	-0.21	-0.21	0.00	-0.29	-0.18	-0.18	-0.18	-0.18
	100	Large	-0.13	-0.13	5.00	-0.21	-0.13	-0.13	-0.13	-0.13
Lean Hogs	90	Retail	-0.21	-0.21	0.00	-0.27	-0.21	-0.21	-0.22	-0.22
	90	Large	-0.14	-0.14	0.00	-0.20	-0.14	-0.14	-0.14	-0.14
	95	Retail	-0.23	-0.23	0.00	-0.27	-0.22	-0.22	-0.22	-0.22
	95	Large	-0.16	-0.16	0.00	-0.20	-0.16	-0.16	-0.16	-0.16
	100	Retail	-0.23	-0.23	0.00	-0.27	-0.21	-0.21	-0.21	-0.21
	100	Large	-0.16	-0.16	0.00	-0.20	-0.16	-0.16	-0.16	-0.16

Note: Each row reports Monte Carlo results for the income offset (CME put hedge with premium equal to the LRP premium) strategy, based on 1,000 simulated price paths per commodity, coverage level, and producer type. All values are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations yielding positive net present values. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50,$ and 1.00. ΔNPV values measure differences relative to the LRP-only benchmark.

Table A.5: Simulation Results for the LRP + Long Put Strategy (Mean and Certainty-Equivalent NPVs, \$/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	$P(\text{NPV} > 0)$ (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	-0.01	-0.73	12.22	-0.12	-0.32	-0.48	-0.57	-0.64
	90	Large	0.05	-0.68	14.78	-0.06	-0.26	-0.42	-0.51	-0.58
	95	Retail	-0.03	-0.75	14.12	-0.12	-0.27	-0.42	-0.53	-0.62
	95	Large	0.03	-0.70	16.69	-0.06	-0.21	-0.36	-0.48	-0.56
	100	Retail	-0.02	-0.71	29.79	-0.11	-0.08	-0.15	-0.23	-0.35
	100	Large	0.04	-0.65	33.03	-0.06	-0.02	-0.09	-0.18	-0.29
Live Cattle	90	Retail	-0.02	-0.72	7.37	-0.12	-0.28	-0.43	-0.54	-0.61
	90	Large	0.04	-0.66	8.51	-0.06	-0.22	-0.37	-0.49	-0.56
	95	Retail	-0.04	-0.74	9.93	-0.12	-0.23	-0.37	-0.49	-0.59
	95	Large	0.02	-0.68	11.11	-0.06	-0.17	-0.31	-0.43	-0.53
	100	Retail	-0.04	-0.71	29.78	-0.12	-0.08	-0.13	-0.20	-0.30
	100	Large	0.02	-0.65	32.30	-0.06	-0.02	-0.07	-0.14	-0.25
Lean Hogs	90	Retail	-0.20	-0.64	7.50	-0.26	-0.32	-0.41	-0.48	-0.54
	90	Large	-0.10	-0.54	10.43	-0.15	-0.21	-0.30	-0.38	-0.44
	95	Retail	-0.22	-0.66	9.44	-0.26	-0.30	-0.38	-0.45	-0.52
	95	Large	-0.11	-0.55	12.39	-0.16	-0.19	-0.27	-0.34	-0.41
	100	Retail	-0.22	-0.64	20.47	-0.26	-0.24	-0.27	-0.30	-0.36
	100	Large	-0.11	-0.54	25.08	-0.16	-0.13	-0.20	-0.20	-0.25

Note: Each row reports Monte Carlo results for the combined LRP and CME long put (stacked insurance) strategy, based on 1,000 simulated price paths per commodity, coverage level, and producer type. All values are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations yielding positive net present values. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50,$ and 1.00. ΔNPV values measure differences relative to the LRP-only benchmark.

Table A.6: Simulation Results for the Locked Call Spread Strategy (Mean and Certainty-Equivalent NPVs, \$/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	P(NPV > 0) (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	-0.21	-4.33	21.79	-0.32	-2.06	-3.04	-3.59	-3.94
	90	Large	-0.09	-4.21	25.13	-0.20	-1.94	-2.92	-3.47	-3.82
	95	Retail	-0.23	-0.57	31.10	-0.32	-2.64	-4.68	-6.14	-7.16
	95	Large	-0.11	-0.45	34.45	-0.20	-2.52	-4.56	-6.02	-7.04
	100	Retail	-0.24	-0.23	26.61	-0.34	-0.30	-0.40	-0.59	-1.00
	100	Large	-0.12	-0.11	32.94	-0.21	-0.18	-0.28	-0.47	-0.88
Live Cattle	90	Retail	-0.26	-4.34	27.16	-0.35	-1.76	-2.77	-3.41	-3.83
	90	Large	-0.13	-4.22	28.20	-0.23	-1.64	-2.64	-3.28	-3.70
	95	Retail	-0.27	-0.65	39.67	-0.35	-2.13	-4.03	-5.64	-6.88
	95	Large	-0.15	-0.52	41.06	-0.23	-2.00	-3.91	-5.51	-6.76
	100	Retail	-0.24	-0.23	30.34	-0.32	-0.28	-0.34	-0.46	-0.73
	100	Large	-0.11	-0.11	36.79	-0.19	-0.16	-0.22	-0.34	-0.61
Lean Hogs	90	Retail	-0.44	-2.44	19.32	-0.50	-0.96	-1.42	-1.79	-2.07
	90	Large	-0.26	-2.26	20.98	-0.32	-0.77	-1.23	-1.60	-1.88
	95	Retail	-0.46	-0.70	27.06	-0.51	-1.03	-1.72	-2.45	-3.14
	95	Large	-0.28	-0.51	29.13	-0.32	-0.84	-1.53	-2.27	-2.95
	100	Retail	-0.44	-0.44	14.93	-0.49	-0.46	-0.50	-0.55	-0.69
	100	Large	-0.28	-0.28	21.24	-0.32	-0.30	-0.33	-0.38	-0.52

Note: Each row reports Monte Carlo results for the locked call spread strategy (offsetting short call replaced with a call spread), based on 1,000 simulated price paths per commodity, coverage level, and producer type. All values are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations yielding positive net present values. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50$, and 1.00. ΔNPV values measure differences relative to the LRP-only benchmark.

Table A.7: Simulation Results for the Income Put Spread Strategy (Mean and Certainty-Equivalent NPVs, \$/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	P(NPV > 0) (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	-0.23	-0.23	9.73	-0.34	-0.97	-3.80	-8.16	-11.69
	90	Large	-0.10	-0.11	14.31	-0.21	-0.84	-3.68	-8.04	-11.56
	95	Retail	-0.25	-0.25	0.98	-0.34	-0.69	-2.30	-5.47	-8.74
	95	Large	-0.13	-0.13	3.58	-0.21	-0.56	-2.17	-5.35	-8.62
	100	Retail	-0.25	-0.25	0.00	-0.34	-0.31	-0.41	-0.58	-0.95
	100	Large	-0.13	-0.13	3.57	-0.22	-0.19	-0.28	-0.46	-0.83
Live Cattle	90	Retail	-0.21	-0.22	14.25	-0.31	-0.66	-2.28	-6.12	-10.29
	90	Large	-0.09	-0.10	9.27	-0.19	-0.53	-2.16	-5.99	-10.17
	95	Retail	-0.23	-0.23	1.25	-0.31	-0.51	-1.35	-3.75	-7.20
	95	Large	-0.11	-0.11	3.34	-0.19	-0.39	-1.22	-3.63	-7.08
	100	Retail	-0.23	-0.23	0.00	-0.31	-0.27	-0.34	-0.45	-0.72
	100	Large	-0.11	-0.11	3.33	-0.19	-0.15	-0.22	-0.33	-0.60
Lean Hogs	90	Retail	-0.43	-0.44	16.53	-0.49	-0.58	-0.93	-2.00	-4.03
	90	Large	-0.26	-0.27	17.50	-0.32	-0.41	-0.76	-1.83	-3.86
	95	Retail	-0.44	-0.44	2.85	-0.49	-0.55	-0.75	-1.39	-2.90
	95	Large	-0.27	-0.27	3.06	-0.32	-0.38	-0.59	-1.22	-2.73
	100	Retail	-0.44	-0.44	0.00	-0.49	-0.46	-0.49	-0.55	-0.67
	100	Large	-0.27	-0.27	0.00	-0.32	-0.29	-0.32	-0.38	-0.50

Note: Each row reports Monte Carlo results for the income put spread strategy (CME put spread mirroring the LRP structure), based on 1,000 simulated price paths per commodity, coverage level, and producer type. All values are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations yielding positive net present values. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50$, and 1.00. ΔNPV values measure differences relative to the LRP-only benchmark.

Table A.8: Simulation Results for the Futures Only Strategy (Mean and Certainty-Equivalent NPVs, $/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	P(NPV > 0) (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	-0.05	0.46	43.91	-0.16	-15.97	-29.97	-37.35	-41.47
	90	Large	-0.04	0.47	45.06	-0.15	-15.96	-29.96	-37.34	-41.46
	95	Retail	-0.06	0.12	43.48	-0.15	-4.57	-11.01	-16.43	-20.17
	95	Large	-0.05	0.14	44.65	-0.14	-4.55	-11.00	-16.42	-20.15
	100	Retail	-0.07	-0.06	41.45	-0.16	-0.13	-0.23	-0.42	-0.83
	100	Large	-0.06	-0.05	42.92	-0.15	-0.12	-0.22	-0.41	-0.82
Live Cattle	90	Retail	-0.14	0.30	46.67	-0.24	-11.40	-25.51	-34.75	-40.20
	90	Large	-0.13	0.31	47.28	-0.23	-11.39	-25.50	-34.74	-40.19
	95	Retail	-0.11	0.04	46.03	-0.19	-3.22	-8.33	-14.15	-18.83
	95	Large	-0.10	0.05	46.67	-0.18	-3.20	-8.32	-14.14	-18.82
	100	Retail	-0.07	-0.07	42.28	-0.15	-0.12	-0.18	-0.30	-0.57
	100	Large	-0.06	-0.06	43.44	-0.14	-0.10	-0.17	-0.29	-0.55
Lean Hogs	90	Retail	-0.08	0.13	42.22	-0.13	-3.41	-8.94	-14.19	-17.87
	90	Large	-0.06	0.14	43.50	-0.12	-3.40	-8.93	-14.18	-17.86
	95	Retail	-0.07	-0.01	41.70	-0.12	-1.02	-2.70	-5.24	-7.96
	95	Large	-0.06	0.01	43.00	-0.11	-1.00	-2.69	-5.22	-7.95
	100	Retail	-0.07	-0.07	38.91	-0.11	-0.09	-0.12	-0.18	-0.31
	100	Large	-0.06	-0.06	40.59	-0.10	-0.08	-0.11	-0.17	-0.30

Note: Each row reports Monte Carlo results for the short futures strategy (direct hedge via CME futures), based on 1,000 simulated price paths per commodity, coverage level, and producer type. All values are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations yielding positive net present values. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50,$ and 1.00. ΔNPV values measure differences relative to the LRP-only benchmark.

Table A.9: Simulation Results for the LRP + Futures Strategy (Mean and Certainty-Equivalent NPVs, $/cwt)

Commodity	Coverage (%)	Producer Type	Mean NPV	Median NPV	P(NPV > 0) (%)	ΔNPV vs LRP	CE(A=0.10)	CE(A=0.25)	CE(A=0.50)	CE(A=1.00)
Feeder Cattle	90	Retail	0.05	0.21	45.29	-0.05	-16.21	-30.21	-37.60	-41.71
	90	Large	0.07	0.22	46.03	-0.04	-16.20	-30.20	-37.59	-41.70
	95	Retail	0.03	-0.15	44.19	-0.06	-4.80	-11.27	-16.70	-20.43
	95	Large	0.04	-0.14	44.95	-0.05	-4.79	-11.26	-16.68	-20.42
	100	Retail	0.02	-0.31	40.07	-0.07	-0.10	-0.27	-0.54	-1.03
	100	Large	0.03	-0.30	40.94	-0.06	-0.08	-0.25	-0.53	-1.02
Live Cattle	90	Retail	-0.05	0.05	46.83	-0.14	-11.64	-25.76	-35.00	-40.45
	90	Large	-0.03	0.06	47.20	-0.13	-11.63	-25.75	-34.99	-40.44
	95	Retail	-0.03	-0.24	45.61	-0.11	-3.43	-8.59	-14.42	-19.10
	95	Large	-0.02	-0.22	46.01	-0.10	-3.42	-8.58	-14.40	-19.08
	100	Retail	0.01	-0.33	39.39	-0.07	-0.08	-0.20	-0.39	-0.75
	100	Large	0.02	-0.32	40.05	-0.06	-0.06	-0.18	-0.38	-0.74
Lean Hogs	90	Retail	-0.02	-0.03	43.19	-0.08	-3.54	-9.09	-14.34	-18.02
	90	Large	0.00	-0.02	44.08	-0.06	-3.53	-9.09	-14.33	-18.01
	95	Retail	-0.03	-0.18	42.03	-0.07	-1.11	-2.85	-5.40	-8.13
	95	Large	-0.01	-0.17	42.93	-0.06	-1.10	-2.84	-5.39	-8.12
	100	Retail	-0.02	-0.24	37.85	-0.07	-0.06	-0.12	-0.22	-0.41
	100	Large	-0.01	-0.22	38.89	-0.06	-0.05	-0.11	-0.21	-0.40

Note: Each row reports Monte Carlo results for the combined LRP + Futures strategy, where LRP coverage is supplemented with a short futures hedge. All simulations use 1,000 price paths per commodity, coverage level, and producer type. All values are in dollars per cwt. $P(\text{NPV} > 0)$ indicates the share of simulations yielding positive net present values. Certainty-equivalent (CE) values are computed under constant absolute risk aversion (CARA) with coefficients $A = 0.10, 0.25, 0.50$, and 1.00. ΔNPV values measure differences relative to the LRP-only benchmark.