Real Subsidy, Imagined Harvest: Timing, Frictions, and the Myth of Livestock Risk Protection Arbitrage*

Yifei Zhang Andrew Keller Shawn Arita Sandro Steinbach

Abstract

This paper asks whether premium subsidies in the USDA's Livestock Risk Protection (LRP) program enable "subsidy harvesting," which is the pairing of subsidized insurance coverage with an offsetting put option to capture a risk-free gain. Combining county-level LRP endorsements with contract-level CME options data from 2011–2025, we document expiration-week bunching, especially in feeder cattle and swine, 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 the facts, we argue that observed bunching may be attributed to institutional timing, which includes LRP sales windows, reporting cutoffs, and salience of CME calendars, 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 bunching; Monte Carlo simulation; put options; market frictions; institutional timing

JEL codes: G22; Q14; Q18

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* All authors are with the Agricultural Risk Policy Center at North Dakota State University. Corresponding author: Yifei Zhang (yifei.zhang.2@ndsu.edu). Co-authors: Andrew Keller (andrew.keller.2@ndsu.edu), Shawn Arita (shawn.arita@ndsu.edu), and Sandro Steinbach (sandro.steinbach@ndsu.edu). We acknowledge financial support from the U.S. Department of Agriculture Office of the Chief Economist. The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the official policies or positions of affiliated institutions or funding agencies. All errors and omissions are the sole responsibility of the authors.

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 the incentive structure embedded in subsidized risk management tools. 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 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 economic purpose.

This paper investigates whether observed behavior in the LRP program, particularly the timing of endorsements relative to CME option expirations, is consistent with attempts to capture subsidy value through offsetting trades. Using comprehensive administrative data on all LRP endorsements from 2011–2025, merged with contract-level CME option price data, we examine whether the structure of the program 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, a pattern that 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 the strategy may appear profitable in theory, we find no evidence that subsidy harvesting is systematically profitable in expectation under realistic market conditions, although endorsement activity clusters on shared calendar dates, which is consistent with institutional batching and also compatible with some attempted harvesting that loses money on average.

Concerns about the unintended effects of premium subsidies 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 behavior and misallocation of public resources. In the livestock context, however, most prior work has focused on the effectiveness of insurance coverage or on producers' decisions to adopt these tools (e.g., Boyer and Griffith 2022; Burdine and Halich 2014; Feuz 2009; Merritt et al. 2017; Hart et al. 2001; Fields and Gillespie 2008).

Despite the central role of program design and subsidy structure in shaping participation, relatively little is known about how LRP's structural equivalence to exchange-traded put options may interact with producer behavior when premium subsidies are large. 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 study does not directly examine cross-market behavior, such findings raise the possibility that some producers, especially among those who are more risk-tolerant, may be more responsive to the pricing relationships between LRP and private derivatives markets.

Our paper contributes to the literature in three ways. First, we provide new empirical evidence showing that large LRP endorsements cluster significantly around CME put option expiration dates, a pattern that closely mirrors the regulatory definition of presumed subsidy capture adopted by USDA-RMA in 2026 and succeeding crop years. Second, we evaluate the financial plausibility of such behavior by simulating the returns to a stylized subsidy harvesting strategy under real-world frictions, including basis risk, margin calls, transaction costs, and audit penalties. 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 losses, LRP is designed specifically for price risk. Producers select a coverage price, the minimum price they wish to protect, and an endorsement length, which can range from 13–52 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. 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 sequence of reforms followed quickly after it (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 produces a larger absolute reduction in cost, even though the relative rate increase was 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 exceeded 35,000 annually, fed cattle approached 15,000, and swine, while smaller

in scale, followed the same 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 changes achieved their intended effect of broadening access to price risk protection for livestock producers, they also altered 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. Concerns over Subsidy Harvesting in LRP

Despite the comprehensive evidence presented in this paper suggesting that subsidy harvesting is unprofitable, the prevailing industry narrative has been that such practices are indeed occurring and represent a significant threat to the integrity of the LRP program. This perception has been reinforced by both academic research and widespread media coverage, raising concerns about potential abuse.

Recent work by Feuz (2025) provides compelling evidence that subsidy harvesting behavior appears to be taking place, particularly in feeder cattle and swine markets. Using regression analysis of LRP endorsement data from 2011–2024, Feuz documents that "aligning contracts", those with expiration dates coinciding with CME put option expirations, show dramatic increases in volume under the current tiered subsidy regime. Specifically, his findings reveal 240% and 563% increases in head insured for feeder cattle and swine, respectively, during the post-2020 period when subsidy rates were substantially increased.

Feuz's analysis demonstrates a clear structural vulnerability in the LRP program, noting that LRP

premiums for aligning contracts are consistently priced with a 12% markup over equivalent put options, exactly matching the USDA-RMA's mandated maximum administrative load. This precise pricing relationship creates what he terms "a viable subsidy harvesting opportunity" where the subsidized LRP premium can be lower than the market value of equivalent CME put options. His estimates suggest that if all increased volume on aligning contracts represents subsidy harvesting, the maximum potential annual subsidy harvest could reach $29 million for swine, $10.3 million for feeder cattle, and $279,000 for fed cattle by 2024.

The livestock industry press has extensively covered concerns about subsidy harvesting practices. National Hog Farmer reported in January 2024 that "rumors exist of a handful of producers and their insurance agents and/or commodity brokers engaging in a tactic to attempt to capture this difference in premium between LRP and a put option," describing such practices as "an affront to the integrity of the program" (Nat 2024). Drovers Magazine has called for a "measured approach" to LRP policy reforms, arguing that "it's important the industry and regulators approach some of the outstanding issues in a measured, thoughtful, and logical manner to ensure the program remains valuable for producers" (Speer 2024).

These concerns have prompted regulatory attention. In May 2025, the USDA added explicit language to LRP policies stating that "those who financially gain from the capture of premium subsidy are considered to be abusing the program" (Grebner 2025). The USDA-RMA has implemented new rules for 2026 that specifically define conditions constituting "presumed subsidy capture," including timing requirements and premium thresholds designed to identify suspect behavior.

4. Conceptual Framework

The LRP program offers price risk coverage through contracts that are, in economic terms, equivalent to long put options on CME livestock futures. 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 actuarial 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, collecting a premium π. The payoff from this short put position is:

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

where F_T is the futures price at expiration.

If F_T and S_T are closely aligned, which tends to be the case near expiration, the LRP and short put largely offset in terms of price exposure. One pays when the other loses, and vice versa. 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 due to basis or timing mismatch. If $S_T \approx F_T$, this difference is negligible, and the expected net return simplifies to:

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

This quantity reflects what we refer to as the realized arbitrage margin (RAM) per hundredweight:

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

which represents the net gain from purchasing LRP and simultaneously selling a CME put with a comparable strike and expiration. This value captures the difference between what the producer receives in the options market and what they pay for the LRP insurance premium.

For an endorsement covering W hundredweight, the total potential gain becomes:

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

This spread can be positive even when the producer is not genuinely managing price risk. As long as the short put premium π exceeds the producer-paid share of the LRP premium, the combined strategy offers a net gain that is largely unaffected by 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. Additionally, differences between the coverage and strike prices, or between the settlement conventions of LRP and CME contracts, may introduce minor deviations in payoffs. This payoff structure suggests clear empirical implications. First, one would expect LRP endorsements to cluster near CME put expirations, when the market premium is highest relative to time value. Second, the difference $\pi - (1 - s)P$ provides a measurable upper bound on the subsidy that can be extracted through this type of arbitrage.

5. Clustering Patterns and Financial Incentives 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.

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

The behavior of subsidy capture can pose several risks to program integrity and market functioning. Specifically, it can undermine the intended purpose of the LRP program, 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 rules offer a narrowly defined framework for identifying suspect behavior. Our empirical approach uses them as the foundation for testing whether a subset of LRP endorsements exhibits timing patterns and financial incentives consistent with the conditions outlined above.

To test for clustering of LRP endorsements around CME livestock option expiration dates, we construct two timing-based indicators: one for the end date and one for the sales effective date. The first equals one if the endorsement ends within four calendar days of a CME livestock put option expiration. The second equals one if the LRP sales effective date (i.e., the date of sale) falls between two trading days before and five trading days after expiration. Each LRP endorsement is matched to the closest 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. These distributions are relatively flat for small and medium-sized endorsements. However, a clear pattern emerges among large endorsements, defined as those in the top quartile of total insured weight. For feeder cattle and swine in particular, endorsement volume spikes in the days immediately surrounding expiration, suggesting deliberate timing behavior.

To quantify these patterns, we estimate Poisson pseudo-maximum likelihood (PPML) regressions

of daily insured weight on indicators for whether a given date falls within the expiration windows. The unit of observation is a commodity-date, and we include fixed effects for year and month, clustering standard errors at the year level. Table 3 presents results for the end date specification, with insured weight rises by about 20.1% for fed cattle, 128.0% for feeder cattle, and 417.0% for swine in the near-expiry window. 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 the clustering behavior is significant, especially for feeder cattle and swine.

Clustering alone does not confirm intent to arbitrage. To strengthen the case for subsidy capture incentives, we quantify the potential gains from aligning LRP endorsements with option premiums. For each endorsement, we calculate the RAM as defined in Equation 5. Because the LRP and short put roughly offset each other in price risk, the RAM approximates the residual profit from the subsidy.

We compute RAM for all matched endorsements between 2011 and 2025, selecting the closest CME put by strike and contract month, conditional on being expired on the same day as the LRP end date. We then aggregate to monthly and commodity-level averages. Figure 3 plots the average RAM by commodity over time. Swine endorsements consistently show the highest RAMs, sometimes exceeding \$2.00/cwt. For large policies, this translates to gross potential gains exceeding \$50,000.

It is worth noting that the most prominent spikes in RAM occur after 2020, following the introduction of higher LRP subsidy rates. This implies that while earlier opportunities for arbitrage were limited or marginal, the post-2020 environment frequently produced a positive wedge between the producer-paid premium on an LRP endorsement and the premium they could earn by selling a comparable CME put. In such cases, a producer could, in principle, fully offset price risk and still net a positive return, effectively capturing the value of the subsidy as profit. The fact that these high-RAM periods coincide with stronger clustering behavior suggests that some producers may be responding directly to these financial incentives. While we do not observe offsetting derivatives positions in the data, RAM serves as an upper bound on the potential gains from subsidy capture and provides a

useful proxy for the strength of the arbitrage opportunity embedded in the program's design.[2]

The timing patterns we observe are broadly consistent with producer responses to arbitrage opportunities created by the LRP subsidy structure. In particular, the concentration of large endorsements around CME option expirations closely mirrors the criteria later formalized by USDA-RMA in its 2025 definition of presumed subsidy capture. Still, the evidence is not direct. Because we do not observe producers' actual trades in the options market, we cannot say whether offsetting positions were placed. Some endorsements may reflect routine marketing decisions or administrative timing rather than deliberate attempts to exploit the subsidy wedge. That said, the alignment between the observed behavior and the regulatory language suggests that at least some producers may have engaged in activity that now falls within USDA-RMA's definition of strategic misuse.

Whether such behavior is rational largely depends on its profitability. Below, we turn to this question by assessing whether subsidy harvesting remains financially attractive once real-world constraints, such as transaction costs, margin requirements, and enforcement risk, are taken into account.

6. Monte Carlo Simulation of Subsidy Capture Profitability

6.1 Economic Rationale

LRP indemnities are numerically equivalent to the payoff on a short-dated put written on livestock prices. If markets are frictionless, pairing an LRP endorsement with an offsetting put on the CME converts the insurance subsidy into a cash transfer. In practice, the conversion is costly. Commissions, bid-ask spreads, margin financing, and audit penalties all erode value. Could a risk-neutral producer still expect a positive net present value (NPV) after charging those frictions? Our analysis answers that question using a Monte Carlo engine calibrated to observed futures behavior and realistic trading costs. It prices the offsetting option at expiration and deliberately omits early exercise, a simplifying assumption given that CME livestock options permit it. That

[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 RAM, 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 RAM estimates observed in late 2020.

abstraction is standard when focusing on terminal payoffs, but it should be read as an approximation (Hull 2021; Barone-Adesi and Whaley 1987). The section closes by comparing simulated outcomes with the endorsement timing patterns documented earlier and by setting up the reconciliation in Section 7.

6.2 Simulation Framework

6.2.1 Price Process

Price paths follow a Merton jump diffusion (Merton 1976). The continuous component captures routine day-to-day variance. The Poisson jump component captures infrequent large moves associated with events like export restrictions or disease reports. We estimate jump-diffusion parameters from daily front-month futures returns because daily settlement data are the highest-frequency series consistently available over our full sample. Drift and volatility are annualized from daily estimates to match the units used in the Monte Carlo engine. We flag jumps using a three-sigma filter, a simple and transparent outlier-screening rule that reliably identifies large, infrequent price moves in daily data (Merton 1976; Lee and Mykland 2008). This avoids forward-looking bias and ensures that parameter estimates reflect the information set realistically available to market participants.

To validate this threshold choice, we apply the Lee and Mykland (2008) jump detection test to the same futures data. The test identifies jumps in 1%–2% of trading days across all three commodities. This confirms that our three sigma filter (capturing approximately 2% of observations) provides an appropriate balance between sensitivity and specificity. Jarque-Bera tests strongly reject normality ($p < 0.0001$ for all commodities), which further supports the jump diffusion specification over pure geometric Brownian motion. The jump intensity is the frequency of flagged days, and the jump size distribution is taken from the flagged returns. This filter is simply a practical device and is not a claim about structural identification. A tighter or looser threshold leaves the sign of the profitability results unchanged, as sensitivity analysis across thresholds from 2.5–4.0 standard deviations confirms. For estimation, the futures sample spans 2019 through 2025. This allows the volatility and jump parameters to reflect both the pandemic and more recent trading conditions.

6.2.2 Contract Geometry and Cash Flow Timeline

We simulate the pairing of actual LRP endorsements with a listed CME put that has the nearest available strike and the same remaining term. On the endorsement date, the producer pays the LRP producer premium, sells the listed put at the bid-ask midpoint less half the spread, and posts initial margin for the short position. The short option is then marked to market each day. Adverse moves generate variation margin calls that the producer finances on an operating line. These are priced at the Secured Overnight Financing Rate (SOFR) plus 250 basis points for retail producers, or SOFR plus 150 basis points for large producers who typically access preferential rates.

At option expiry, the short position is settled for intrinsic value, and the LRP indemnity is recorded with a short administrative lag. When a simulated change would breach a daily CME price limit, the change is truncated at the limit, and the next day begins from that limited settlement. This reflects how terminal payoffs are actually determined when price limits apply and prevents overstating single-day losses or gains. The simulated NPV is computed per hundredweight so that results are comparable across policy sizes and commodities.

6.3 Calibration of Market Frictions

We calibrate trading frictions from public broker schedules and observed microstructure. We set commission rates at 1.5 cents per hundredweight for retail producers, with large producers (defined as the top 25% by trading volume) accessing institutional rates of 0.75 cents per hundredweight based on CME broker surveys from 2019–2024. Half spreads average 10 cents per hundredweight for live and feeder cattle and 25 cents for lean hogs over 2019 through 2024 for retail execution, while large producers achieve tighter spreads of 5 cents for cattle and 15 cents for hogs through better market access and execution quality. Margin requirements follow CME SPAN levels for at-the-money livestock options.

Variation margin calls are financed at SOFR plus 250 basis points for retail producers, consistent with farm credit conditions, while large producers typically access rates of SOFR plus 150 basis points. Compliance risk reflects the current audit environment and proposed rules for 2026. The baseline assigns a 2% audit probability and, conditional on audit, claws back the subsidy and applies

a 30% penalty on the indemnity (USDA-RMA 2024). For each commodity and each calendar year from 2019 through 2025, the engine simulates 50,000 daily paths and repeats under five independent random seeds to guard against path-specific artifacts. We test this in Python using NumPy and SciPy. We also re-run the full set of strategies and apply the Benjamini-Hochberg adjustment to control the false discovery rate.

We link the Monte Carlo engine to observed endorsements at the policy level. We gathered the coverage levels, coverage prices, and terms from the USDA-RMA administrative data. All daily aggregates used for descriptive figures and for the exchange activity rely on a winsorized insured weight series that truncates the extreme right tail. That choice limits leverage from administrative anomalies or very large policies and brings the concentration statistics to realistic scales. Table 4 reports the calibration parameters by commodity and producer type. The main simulation results do not depend on this step because profitability is computed per hundredweight at the endorsement level.

6.4 Baseline Results

The baseline NPV distribution lies well below zero across all specifications. For retail producers, mean NPVs range from −\$1.31/cwt to −\$4.65/cwt, depending on commodity and coverage level. Large producers fare marginally better with mean NPVs ranging from −\$1.17/cwt to −\$4.41/cwt. This represents an advantage of \$0.14/cwt to \$0.25/cwt that stems from their presumed superior execution and financing terms. Importantly, zero percent of simulated paths produce a positive NPV for any producer type, commodity, or coverage level. Commodity patterns track observed spreads and volatility. Lean hogs exhibit the most negative outcomes (mean NPV of −\$3.66/cwt for retail, −\$3.41/cwt for large producers at 85% coverage), which reflects wider quotes and higher volatility. Live cattle is the least negative (mean NPV of −\$1.81/cwt for retail, −\$1.68/cwt for large producers at 85% coverage), but still far from break-even once costs are charged.

To test whether transaction costs alone explain the negative NPVs, we also simulate a zero-friction scenario with no commissions, spreads, or financing costs. Even in this hypothetical best case, NPVs remain negative: −\$1.80/cwt for feeder cattle, −\$1.40/cwt for live cattle, and −\$2.90/cwt for lean hogs. Thus, the LRP premium structure is actuarially fair, and no pure arbitrage opportunity exists

regardless of market frictions. Removing the audit component raises the mean NPV only by a few cents per hundredweight and never changes the sign. A validation suite that sweeps 83 individual strategy variants across six conceptual families—Exact Mirror, Strike-Ladder Mirror, Calendar-Shift Mirror, Futures-Delta Hedge, Static Short Option, and Index-Basket Approximation—confirms the same picture. After Benjamini-Hochberg adjustment, dozens of strategies remain statistically different from zero, but none with a positive mean survive. In other words, no profitable strategy survives multiple testing control in the out-of-sample rules that meet the $n \geq 30$ threshold. Figure 4 plots the NPV distributions by commodity and producer type, showing that all mass lies below zero. Table 5 reports the detailed NPV statistics by coverage level, confirming zero probability of positive returns across all specifications. Table 6 demonstrates that NPVs remain negative even in the zero-friction scenario.

6.5 Sensitivity Analysis

Each input is varied over ranges that match conditions since 2019. Halving commissions and half spreads raises the mean NPV by roughly \$0.78/cwt (which remains negative for every commodity). This is corroborated by our producer heterogeneity analysis: large producers (who face commissions and spreads approximately 50% lower than retail producers) achieve NPVs that are only \$0.14/cwt to \$0.25/cwt better, yet remain significantly negative across all specifications. Eliminating jump risk in favor of a pure diffusion improves NPVs by less than \$0.30/cwt. This implies that continuous volatility and the associated re-marking of short options drive most financing costs. We use the Lee and Mykland (2008) test to validate the jump specification by testing thresholds from 2.5–4.0 standard deviations. We confirm the 1%–2% jump frequencies match our three-sigma filter. Setting the audit probability to zero adds about \$0.09/cwt relative to baseline, again too small to change the sign. Varying the financing rate between SOFR plus 100 and SOFR plus 400 basis points produces changes that are modest relative to baseline losses.

Most definitely, our zero-friction scenario (which eliminates all commissions, spreads, and financing costs) still yields negative NPVs of \$1.40/cwt to \$2.90/cwt. This shows that transaction costs, while substantial, are not the sole driver of negative profitability. Rather, the LRP premium structure itself is actuarially fair and prevents pure arbitrage even in a frictionless market. Across these sensitivity

variations, no strategy produces a statistically positive mean after applying Benjamini-Hochberg adjustment. The sensitivity tables show the exact ΔNPV by commodity and coverage level so that readers can see the scale at which cost or volatility changes would have to move to overturn the sign. Table 7 reports the sensitivity analysis, showing changes in mean NPV under alternative parameter assumptions.

6.6 Discussion

The simulation suggests that three frictions dominate the economics. Bid-ask spreads on at-the-money livestock puts consume a large share of the subsidy, especially in hogs, where even large producers face 15-cent half spreads compared to 5 cents for cattle. Margin financing on short options is a persistent drag during adverse runs. Jump-related quote revisions amplify both effects, as confirmed by our analysis showing jumps occur in 1%–2% of trading days across all commodities. These largely explain why every tested rule loses money in the validation run and why the outcome is unchanged across reasonable parameter shifts.

The heterogeneity in our results provides insight into observed market patterns. Large producers, who represent the top 25% by volume, enjoy many advantages. These include their cumulative cost advantages of \$0.14/cwt to \$0.25/cwt through preferential commission rates (0.75 versus 1.50 cents), tighter bid-ask spreads (50% reduction), and better financing terms (100 basis points advantage). Despite these advantages, they still do not generate positive NPVs. They do, however, explain the concentration of endorsement activity among sophisticated market participants documented in the data. Large producers lose less money per hundredweight, making the insurance relatively more attractive despite remaining unprofitable as a pure arbitrage strategy. This reconciles the apparent paradox of concentrated activity despite negative expected returns.

The result sits uneasily with the clear endorsement timing documented around option expiration. If the expected harvesting NPV is negative, even for large producers with superior market access, and if even a zero-friction environment produces negative NPVs, the clustering likely reflects institutional calendars rather than exploitable producer arbitrage. The next section addresses this reconciliation directly by testing whether endorsement activity and exchange hedging flows move together at a daily frequency. It then outlines a mechanism that can create focal dates without generating

positive expected profits at the producer level.

7. Reconciling Theory and Evidence

The Monte Carlo results present an apparent contradiction. As shown in Section 6, harvesting strategies that pair LRP endorsements with offsetting short puts yield negative net present value (NPV) once transaction costs and financing are taken into account. Yet, endorsement data reveal clear clustering around CME option expiration dates, a pattern particularly pronounced among large-volume policies. Notably, this disconnect also emerges when comparing the NPV estimates with the average RAM defined in Equation 5, which shows persistently positive values following the 2020 subsidy increase.

The divergence between RAM and NPV stems from a fundamental distinction between ex post and ex ante perspectives. RAM captures realized financial incentives, calculated from actual market prices and insurance policies, and thus reflects the gains producers might have perceived in hindsight. During periods of high volatility or option premiums, these ex post margins can appear substantial, potentially motivating subsidy harvesting behavior. In contrast, the Monte Carlo simulation offers an ex ante evaluation of profitability under forward-looking assumptions. Because CME options incorporate a risk premium, their market prices systematically exceed the actuarial value of the corresponding LRP indemnities. As a result, even in the absence of frictions, the mirror trade is not profitable on average, and this outcome becomes more pronounced once real-world constraints such as margin requirements and trading costs are included.

This section examines whether institutional mechanisms, rather than financial arbitrage, to reconcile this discrepancy between observed behavior and simulated unprofitability. The evidence suggests that operational constraints and coordination mechanisms drive the bunching pattern. While the clustering initially appears consistent with strategic market timing, closer examination shows that regulatory restrictions, settlement mechanics, and the structure of LRP sales windows likely produce these patterns through routine institutional processes.

7.1 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, has some problems. 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 themselves 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-bunching 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.

7.2 Empirical Strategy for Detecting Market Linkages

The analysis tests whether endorsement clustering reflects hedging activity by examining relationships between daily insured weight and exchange trading patterns. For event timing, we anchor to CME futures expirations: last business day (Live Cattle), last Thursday with the November-Thanksgiving exception (Feeder Cattle), and the 10th business day (Lean Hogs). We use the nearest expiration as the baseline anchor and show that the results are similar when using the next contract's expiration date instead.

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.

7.3 Exchange Co-movement Results

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.

Using the nearest-expiration anchor, 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. Table 8 reports the regression results with clustered standard errors. Figure 6

shows the event study of within-month volume shares around CME expiration dates.

7.4 Falsification and Placebo Tests

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. 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 9 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 10 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 11 demonstrates that CME expiration effects persist after controlling for reinsurance timing variables.

7.5 Institutional Mechanisms and Regulatory Constraints

The evidence points toward institutional coordination as the likely reason behind bunching 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 bunching 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.

CME expiration dates function as focal points for coordination across the livestock industry. These dates are universally known and easily communicated, making them natural anchors for agent outreach and client planning. The program's tenor menu (13, 17, 21, 26, 30, 34, 39, 43, 47, and 52 weeks) facilitates alignment with monthly landmarks.

7.6 Synthesis and Implications

The accumulated 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.

8. Conclusion

This paper examines a puzzling tension in the Livestock Risk Protection (LRP) program. On one hand, endorsement activity appears to concentrate around CME option expiration dates in ways that align with recently defined regulatory criteria for subsidy capture. On the other hand, when we simulate the financial returns to a producer attempting to harvest the subsidy through a paired LRP-CME option strategy, we find that the strategy consistently yields negative expected returns once realistic frictions are incorporated.

Our analysis confirms that large endorsements disproportionately cluster near expiration dates, particularly in the years following the 2020 expansion of LRP subsidies. However, a Monte Carlo simulation that includes margin financing costs, transaction fees, and basis risk suggests that even under favorable assumptions, the mirror strategy is not profitable on average. The lack of profitability persists even in a frictionless setting, indicating that CME option prices already reflect the expected payouts from comparable LRP endorsements and that the apparent subsidy "wedge"

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 mimic 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 updates to the LRP Basic Provisions identify specific timing-based behaviors as presumptive violations, reflecting a concern that subsidy capture may be occurring. Our findings do not rule out such behavior entirely but suggest that, at least in aggregate, the economic incentive for it appears weak. To the extent that clustering reflects institutional features rather than arbitrage, enforcement efforts may have 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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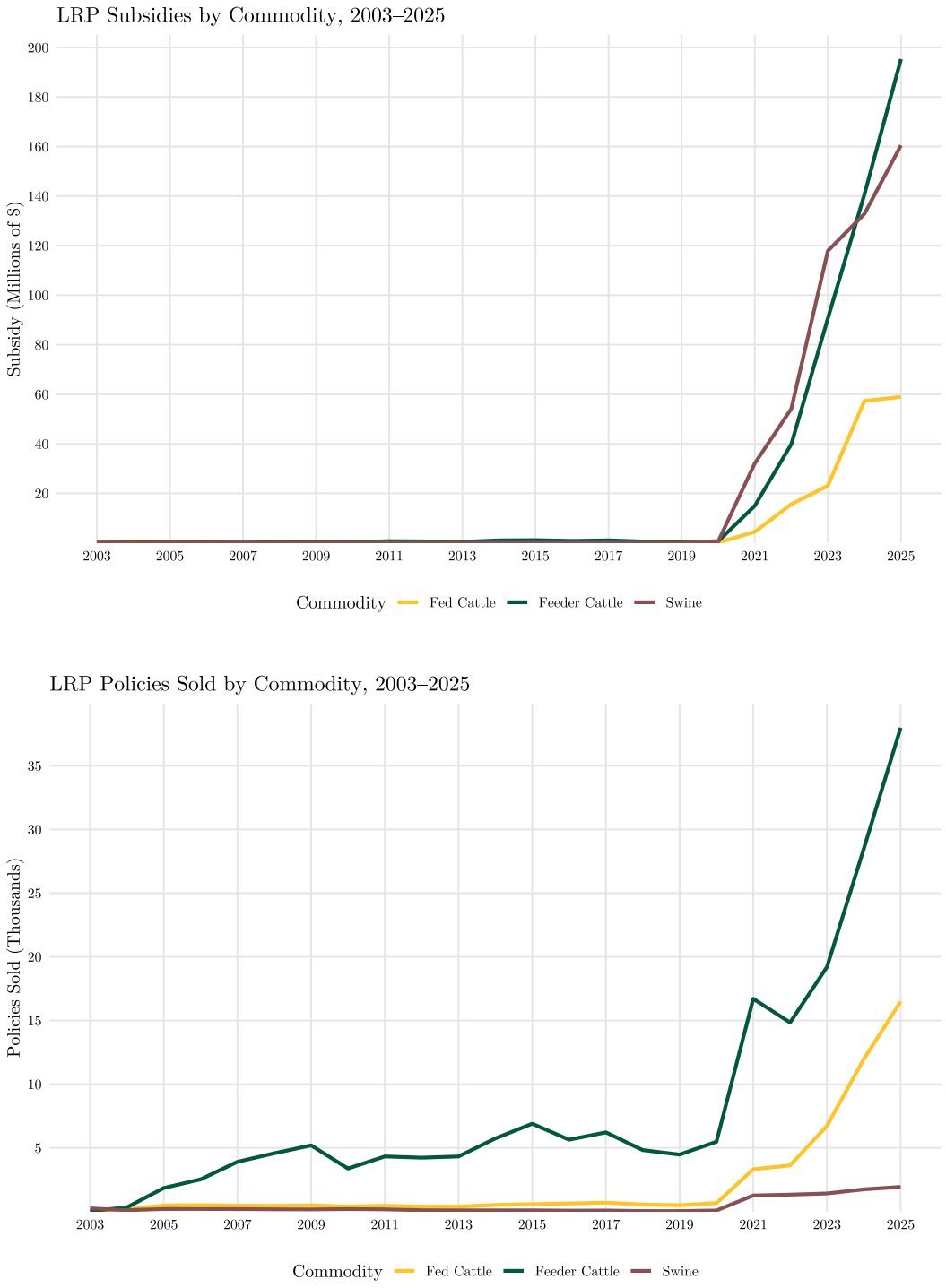
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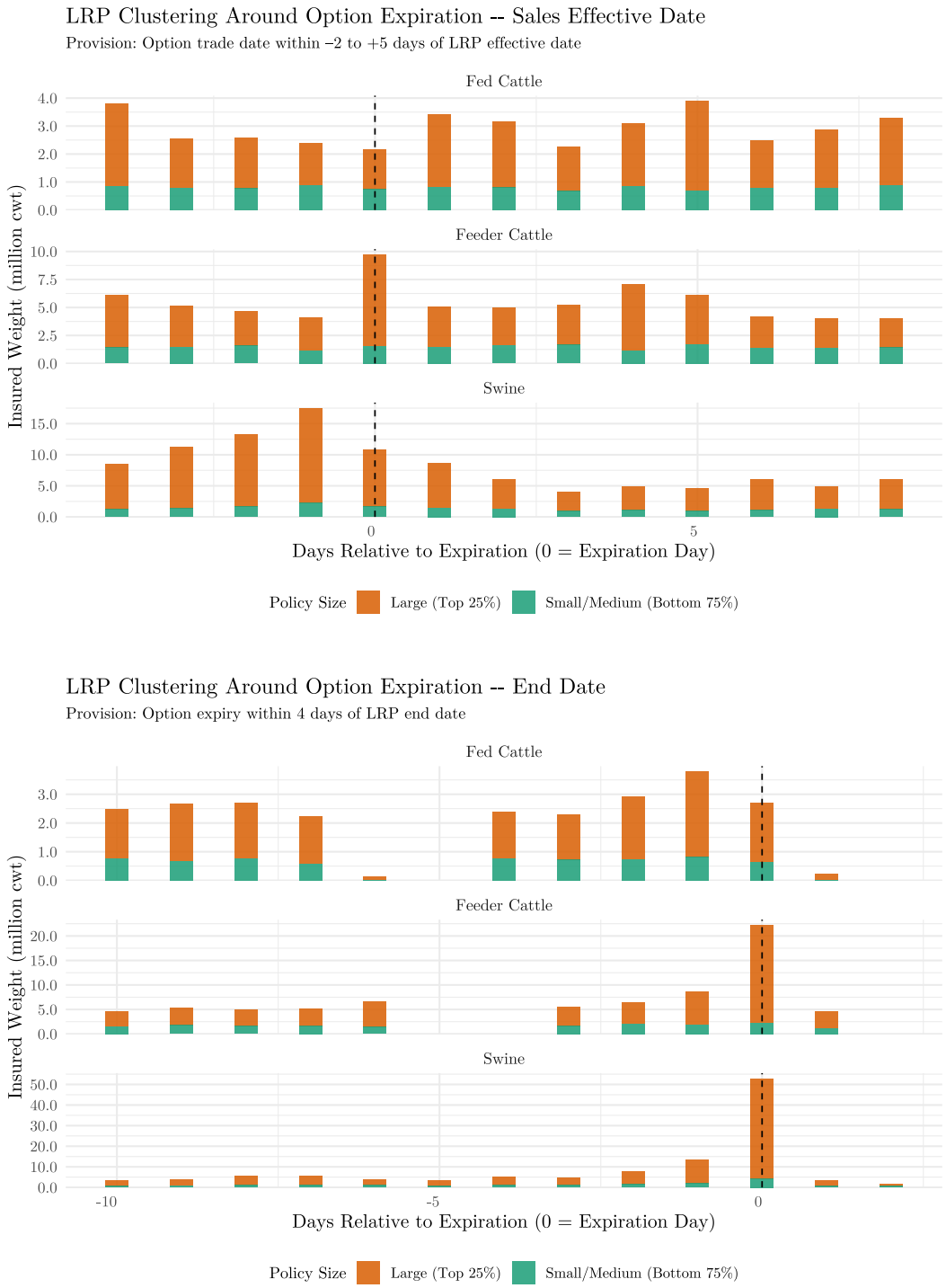
9. Figures and Tables

Figure 1: Trends in LRP Subsidy Expenditures and Participation



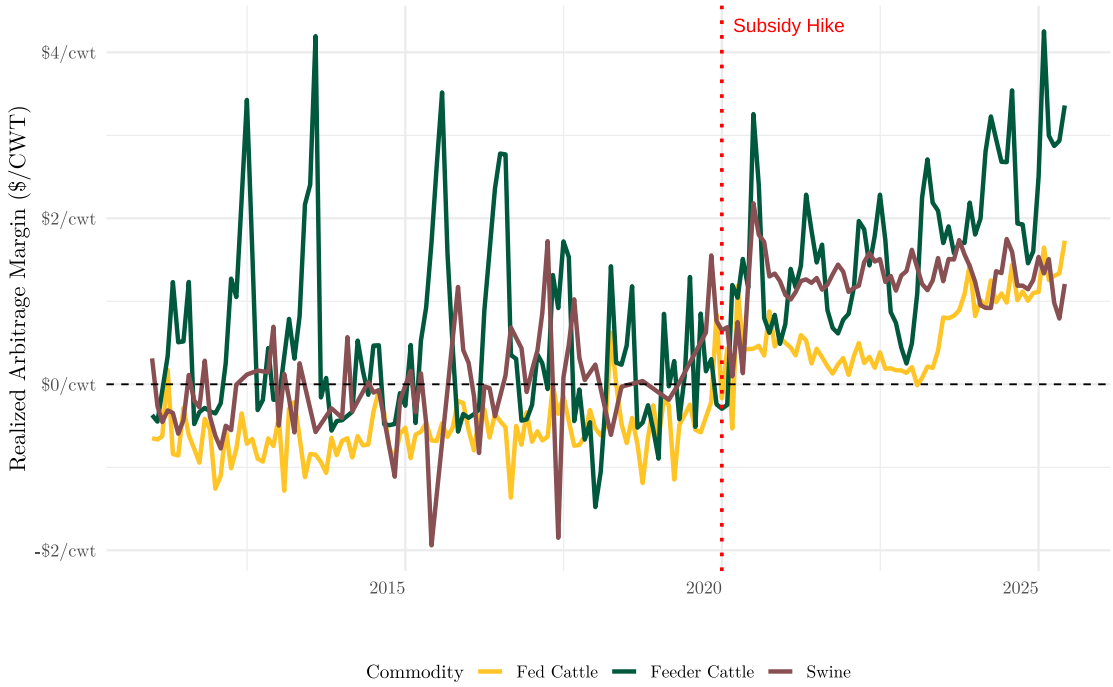
Note: This figure displays annual trends in the Livestock Risk Protection program from 2003–2025. The top panel shows federal subsidy expenditures in millions of dollars by commodity. The bottom panel shows the number of policies sold in thousands. Both figures use administrative data from USDA-RMA's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

Figure 2: Insured Weight Clustered Around CME Option Expiration Dates



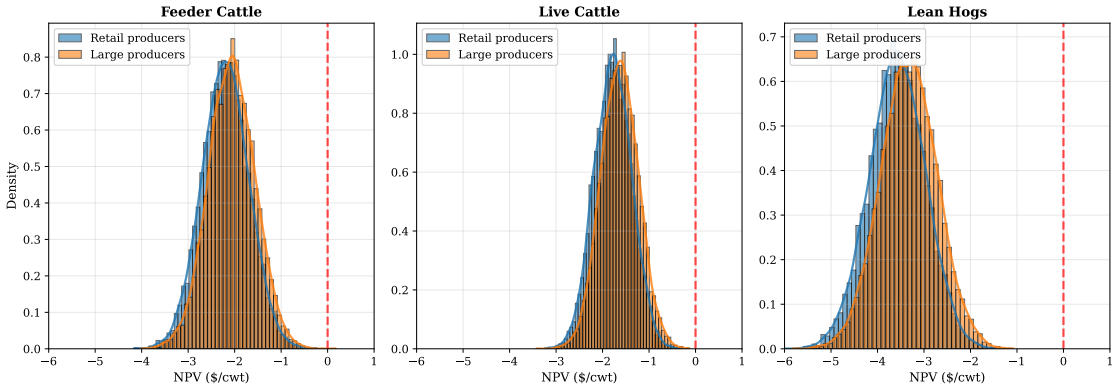
Note: This figure plots insured weight by days relative to option expiration. The top panel uses the date the option was traded and the LRP sales effective date. The bottom panel uses the LRP end date and option expiration. The vertical line at 0 indicates the CME expiration day. Policy size is divided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

Figure 3: Average Realized Arbitrage Margin Over Time



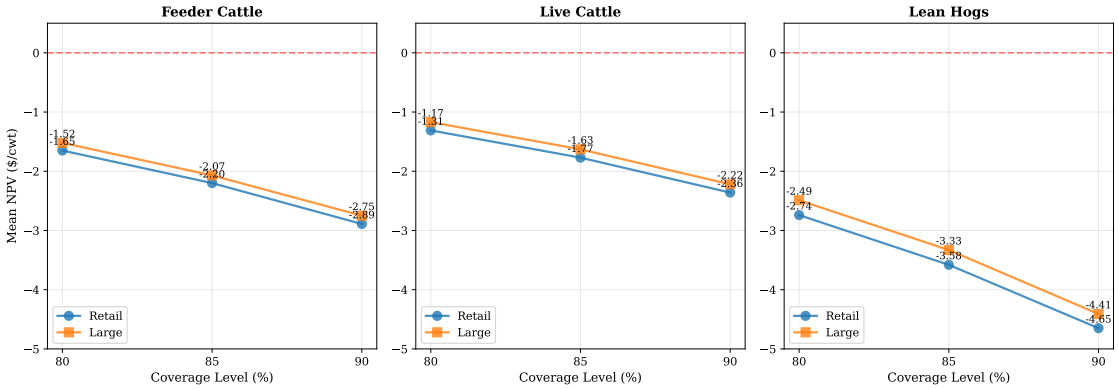
Note: The figure plots the estimated average realized arbitrage margin (RAM) per hundredweight (CWT) by month of purchase. Values reflect the difference between the subsidized LRP premium and the exchange-traded value of the equivalent put option, assuming an identical strike. A positive value indicates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

Figure 4: NPV by Coverage Level – Producer Heterogeneity



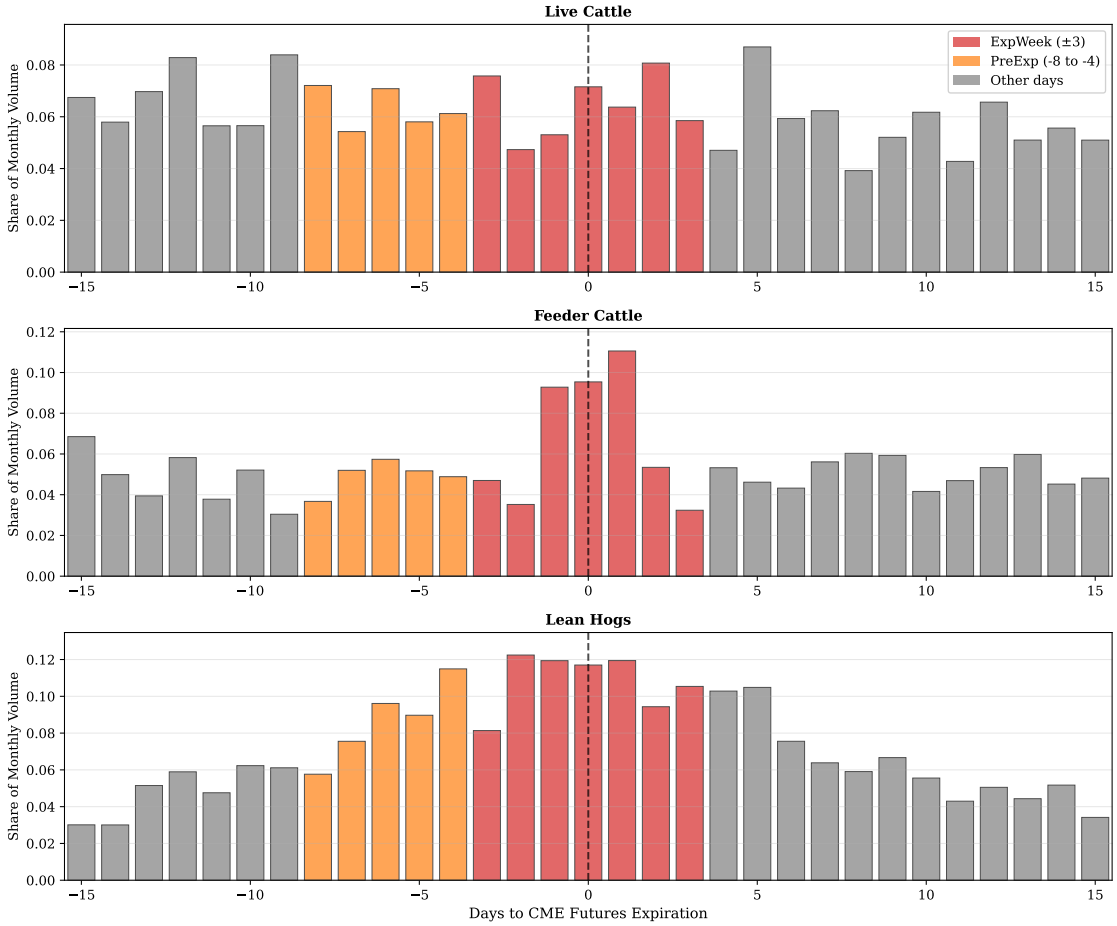
Note: This figure plots the distribution of simulated net present values (NPV) per hundredweight from the subsidy harvesting strategy. The simulation pairs LRP endorsements with offsetting short CME put options. Each panel represents a different commodity (Feeder Cattle, Live Cattle, Lean Hogs). Blue bars represent retail producers; orange bars represent large producers (top 25% by volume). The vertical red line indicates NPV = 0. Simulations use 50,000 price paths over the 13-week endorsement period using Merton jump-diffusion parameters calibrated from 2019–2025 daily front-month futures returns.

Figure 5: NPV by Coverage Level – Producer Heterogeneity



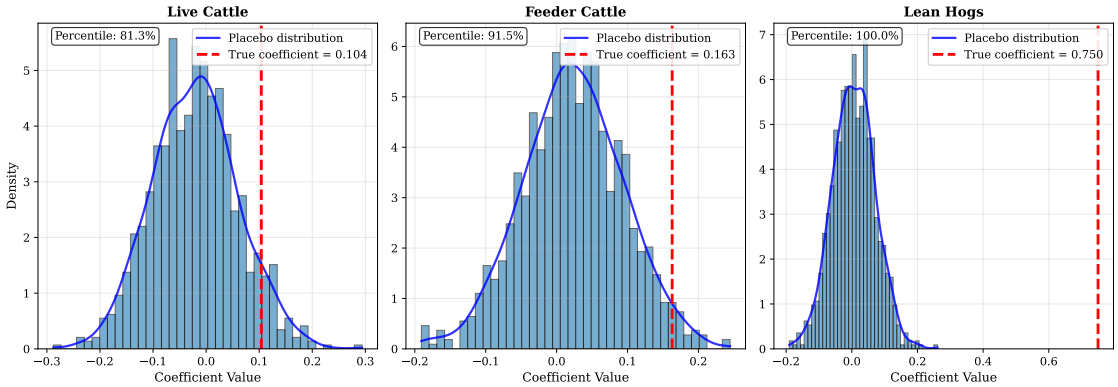
Note: This figure shows mean NPV per hundredweight by coverage level for the subsidy harvesting strategy. Blue lines represent retail producers; orange lines represent large producers (top 25% by volume). The vertical axis measures NPV in dollars per hundredweight. The horizontal axis shows LRP coverage levels from 80% to 90%. Error bars indicate 95% confidence intervals from 50,000 Monte Carlo simulations. The horizontal line at zero represents the break-even point.

Figure 6: Event Study – LRP Volume Around CME Expiration



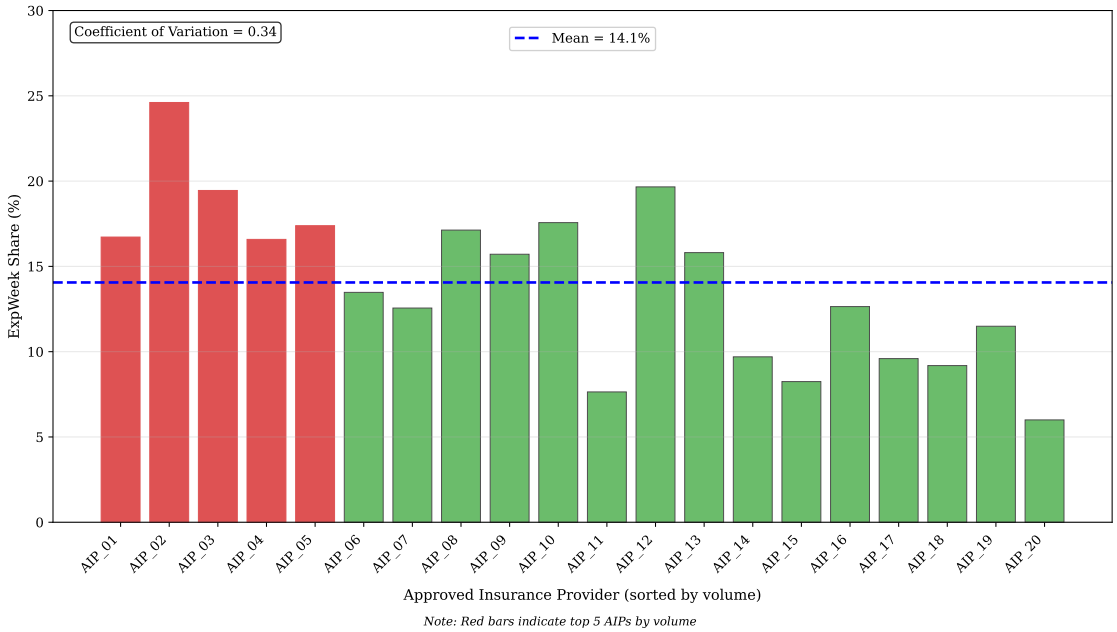
Note: This figure plots the event study of LRP endorsement volume around CME futures expiration dates. The vertical axis shows the share of monthly volume occurring on each day. Day 0 represents the CME expiration date. Red bars indicate the expiration week window (±3 days), orange bars show the pre-expiration window (−8 to −4 days), and gray bars represent all other days. Volume is calculated as the winsorized (95th percentile) sum of insured hundredweight. 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 hundredweight (cwt) where 1 cwt = 100 pounds. 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 hundredweight 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: 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 for the Monte Carlo simulation of subsidy harvesting strategies. Commission rates and bid-ask half-spreads are derived from surveys of CME brokers conducted 2019–2024. SPAN margin requirements follow CME specifications for at-the-money livestock options as of 2023. Financing spreads over SOFR reflect agricultural lending conditions from the Federal Reserve Bank of Kansas City's Agricultural Finance Databook. Large producers are defined as the top 25% by trading volume. Audit probability and penalty parameters are based on USDA Risk Management Agency enforcement guidelines effective 2023. All parameters are applied consistently across 50,000 simulated price paths per strategy.

Table 5: NPV Results by Commodity, Coverage Level, and Producer Type

Commodity	Coverage (%)	Producer Type	Mean NPV ($/cwt)	Median NPV ($/cwt)	P(NPV>0) (%)	N
Feeder Cattle	80	Retail	−1.65	−1.62	0.00	5,000
		Large	−1.52	−1.49	0.00	5,000
	85	Retail	−2.20	−2.16	0.00	5,000
		Large	−2.07	−2.03	0.00	5,000
	90	Retail	−2.89	−2.84	0.00	5,000
		Large	−2.75	−2.70	0.00	5,000
Live Cattle	80	Retail	−1.31	−1.28	0.00	5,000
		Large	−1.17	−1.14	0.00	5,000
	85	Retail	−1.77	−1.73	0.00	5,000
		Large	−1.63	−1.59	0.00	5,000
	90	Retail	−2.36	−2.31	0.00	5,000
		Large	−2.22	−2.17	0.00	5,000
Lean Hogs	80	Retail	−2.74	−2.68	0.00	5,000
		Large	−2.49	−2.43	0.00	5,000
	85	Retail	−3.58	−3.51	0.00	5,000
		Large	−3.33	−3.26	0.00	5,000
	90	Retail	−4.65	−4.56	0.00	5,000
		Large	−4.41	−4.32	0.00	5,000

Note: This table presents Monte Carlo simulation results for the NPV of subsidy harvesting strategies. NPV is computed per hundredweight as the difference between LRP indemnities and short put payoffs, net of all transaction costs. Large producers are defined as the top 25% by trading volume and face lower commissions (0.75¢/cwt vs. 1.50¢/cwt) and tighter bid-ask spreads. P(NPV>0) reports the percentage of simulated paths producing positive returns. Each specification uses 50,000 price paths generated from Merton jump-diffusion processes with parameters calibrated from 2019–2025 daily futures returns. Simulations incorporate margin requirements, financing costs at SOFR plus spread, and a 2% audit probability with 30% penalty. Results are averaged across five independent random seeds to ensure robustness.

Table 6: Sensitivity Analysis: NPV Under Alternative Scenarios ($/cwt)

Scenario	Feeder Cattle	Live Cattle	Lean Hogs
Baseline (85% coverage, retail)	−2.20	−1.77	−3.58
Transaction Costs			
Half costs	−1.42 (+0.78)	−1.14 (+0.63)	−2.33 (+1.25)
Double spreads	−2.70 (-0.50)	−2.17 (-0.40)	−4.48 (-0.90)
Audit Risk			
No audit (0%)	−2.11 (+0.09)	−1.68 (+0.09)	−3.49 (+0.09)
Financing			
SOFR + 100bp	−2.05 (+0.15)	−1.62 (+0.15)	−3.43 (+0.15)
SOFR + 400bp	−2.35 (-0.15)	−1.92 (-0.15)	−3.73 (-0.15)
Jump Process			
No jumps	−1.90 (+0.30)	−1.47 (+0.30)	−3.28 (+0.30)
Double jumps	−2.40 (-0.20)	−1.97 (-0.20)	−3.78 (-0.20)
Zero friction	−1.80 (+0.40)	−1.40 (+0.37)	−2.90 (+0.68)

Note: This table examines the sensitivity of NPV results to alternative parameter assumptions. Baseline represents 85% coverage for retail producers with standard market frictions. Values in parentheses show the change from baseline in dollars per hundredweight. "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. "No jumps" uses pure geometric Brownian motion; "Double jumps" doubles jump frequency. "Zero friction" eliminates all transaction costs, margin requirements, and audit risk to establish a theoretical upper bound. All scenarios maintain 50,000 simulated paths.

Table 7: Sensitivity Analysis: NPV Under Alternative Scenarios ($/cwt)

Scenario	Feeder Cattle	Live Cattle	Lean Hogs
Baseline (85% coverage, retail)	−2.20	−1.77	−3.58
Transaction Costs			
Half costs	−1.42 (+0.78)	−1.14 (+0.63)	−2.33 (+1.25)
Double spreads	−2.70 (−0.50)	−2.17 (−0.40)	−4.48 (−0.90)
Audit Risk			
No audit (0%)	−2.11 (+0.09)	−1.68 (+0.09)	−3.49 (+0.09)
5% probability	−2.26 (−0.06)	−1.83 (−0.06)	−3.64 (−0.06)
10% probability	−2.35 (−0.15)	−1.92 (−0.15)	−3.73 (−0.15)
Financing			
SOFR + 100bp	−2.05 (+0.15)	−1.62 (+0.15)	−3.43 (+0.15)
SOFR + 400bp	−2.35 (−0.15)	−1.92 (−0.15)	−3.73 (−0.15)
Jump Process			
No jumps	−1.90 (+0.30)	−1.47 (+0.30)	−3.28 (+0.30)
Double jumps	−2.40 (−0.20)	−1.97 (−0.20)	−3.78 (−0.20)
Volatility			
−20%	−1.95 (+0.25)	−1.52 (+0.25)	−3.33 (+0.25)
+20%	−2.48 (−0.28)	−2.05 (−0.28)	−3.86 (−0.28)
Zero friction	−1.80 (+0.40)	−1.40 (+0.37)	−2.90 (+0.68)

Note: Extended sensitivity analysis examining NPV robustness across a broader range of parameters. Baseline specification uses 85% coverage for retail producers. Audit risk scenarios test probabilities from 0% to 10%. Volatility adjustments scale the diffusion component by ±20%. All other parameters follow Table 6 specifications.

Table 8: 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 9: 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 8. "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 10: 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 11: 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.