# RESEARCH NOTE: Structural Seasonal Alpha in Physical Commodities

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**Subject:** Systematic Seasonal Outperformance in Illiquid Commodity Markets

**Key Findings:** +8.82% Annualized Alpha (Lumber); Significant efficiency in Equity Benchmarks.

## 1. Executive Summary

This research identifies a clear bifurcation in market efficiency between physical commodities and financialized assets. Using a **Recursive Expanding-Window model**, we demonstrate that seasonal alpha persists in markets with rigid physical supply constraints (Lumber, Grains), while benchmark equities (Dow Jones) remain seasonally efficient. The strategy in Lumber produced an **8.82% annualized alpha** with a Sharpe Ratio of **0.70** (vs. 0.24 for Buy-and-Hold).

## 2. Systematic Performance Overview

The following chart illustrates the annualized excess returns (Alpha) generated by the recursive model. Results are filtered by statistical significance ($p < 0.05$), with the Dow Jones included as a control to represent market efficiency.

| Asset | Ann. Alpha | Sharpe (WF) | P-Value | Result |
|---|---|---|---|---|
| **LUMBER** | **+8.82%** | **0.70** | **0.000** | Significant Alpha |
| **WHEAT** | **+4.44%** | 0.47 | **0.000** | Significant Alpha |
| **CORN** | **+2.76%** | 0.48 | **0.000** | Significant Alpha |
| **COTTON** | **+0.57%** | 0.09 | **0.017** | Significant Alpha |
| **DOW JONES** | **-4.71%** | 0.17 | 0.749 | Efficient (Control) |

## 3. Methodology & Robustness

To eliminate "Backtest Overfitting," the model utilizes a **Recursive Walk-Forward Engine**:

- **No Look-Ahead Bias:** The model selects the "optimal" seasonal quarter based only on expanding historical data available at the time of the trade.
- **Out-of-Sample Simulation:** Strategies are re-optimized annually, simulating a real-world systematic trading environment.
- **Statistical Validation:** A 2,000-iteration Permutation Test was conducted. The "Big Three" (Lumber, Wheat, Corn) achieved $p = 0.000$, indicating structural patterns rather than stochastic noise.

## 4. Strategic Thesis

The persistence of alpha in physical commodities is driven by **non-arbitrable constraints**:

1. **Biological/Harvest Cycles:** Fixed production timelines in Grains and Timber cannot respond instantly to price signals.
2. **Storage & Logistics:** High carry costs and physical decay prevent financial arbitrageurs from fully smoothing out seasonal price curves.
3. **Commercial Hedging Pressure:** Producers and consumers prioritize price certainty over speculative alpha, leaving a "seasonal premium" available for systematic liquidity providers.

## 5. Conclusion

Systematic seasonal rotation is a viable strategy for enhancing risk-adjusted returns in physical commodity portfolios. By avoiding the noise of highly efficient financial markets and focusing on supply-constrained physicals, investors can capture structural premiums that are uncorrelated with broader equity markets.

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**Technical Stack:** R (tidyverse, lubridate, ggplot2)

**Data Sources:** FRED, Macrotrends

**Portfolio Repository:** https://github.com/aklaudano47/Commodity_Alpha_Engine