# Modeling Corporate Bond Returns Using The IPCA Model

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# Outline

- Introduction to Corp Bonds
  - How market works
  - Microstructure
  - Business value(buy side/sell side)
  - Overview of Terms
- IPCA Paper Summary and Model explained
- Data Explained
- Long-short portfolio
  - Strategy Explained
  - Performance
- Next Steps and Expectation

# What Are Corporate Bonds?

Debt securities issued by companies to raise capital

Investors receive periodic interest payments (coupons) and principal repayment

Higher yields than government bonds but with greater risk

# How the Market Works

- **Primary Market:** Companies issue new bonds via investment banks
- **Secondary Market:** Bonds are traded among investors
- Price influenced by interest rates, credit ratings, and demand
- **Key participants:** Corporations, institutional investors, retail investors, market makers

# Microstructure of Corporate Bonds

- **Pricing Factors:** Interest rates, credit risk, market sentiment
- **Market Participants:** Traders, brokers, dealers facilitate transactions
- **Higher Inefficiency:** Traded at OTC

# Business Value

**Asset Allocation:**

- **Risk-Adjusted Portfolio Optimization**:
  - Identifies cross-asset risk factors (e.g., equity-bond integration), enabling better diversification.
  - Supports dynamic adjustments using time-varying factor sensitivities, improving tactical allocation.
- **Global Market Applications**:
  - Extends to emerging markets, where data quality and market structure differ from developed markets.

# Business Value

**Buy-Side:**

- **Alpha Generation**:
    - Enables factor-based strategies (e.g., exploiting mispriced bonds via IPCA-extracted factors).

**Sell-Side:**

- **Product Innovation**:
    - Improves pricing accuracy for structured products (e.g., credit derivatives).
    - Facilitates factor-based index design (e.g., bond ETFs targeting IPCA-identified risk premia).

# Corporate Bonds Terms/Variables

| | | | |
|---|---|---|---|
| OAS Spread | Maturity | Coupon Rate | Risk-free rate |
| Yield to Maturity(YTM) | Distance to Default(D2D) | Rating | Return |

# Summary of the Paper

The paper **"Modeling Corporate Bond Returns"** by Bryan Kelly, Diogo Palhares, and Seth Pruitt presents a conditional factor model for corporate bond returns using five factors and time-varying factor loadings. Their key contributions and findings include:

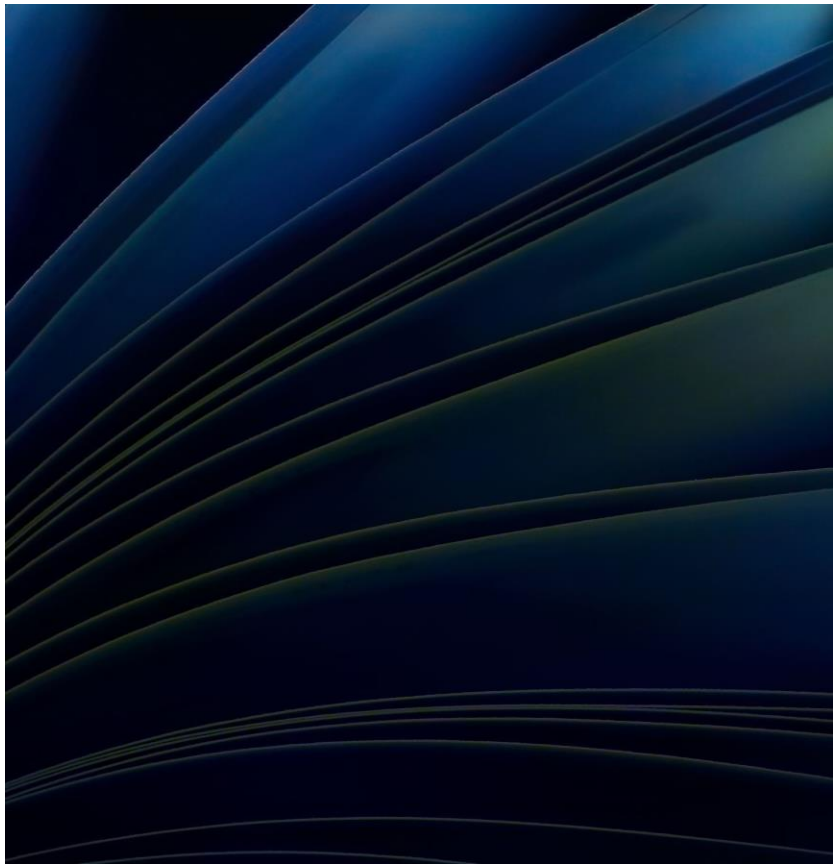
- **Improved Risk-Return Modeling**: Their model significantly outperforms previous factor models in explaining corporate bond risks and returns.
- **Higher Credit Risk Premium**: The model suggests a larger-than-expected credit risk premium, implying higher returns for taking on credit risk.
- **Stronger Debt-Equity Market Integration**: They find closer integration between bond and equity markets than previously documented.

# Paper: Methodology

USES **INSTRUMENTED PRINCIPAL COMPONENTS ANALYSIS (IPCA)**, WHICH ESTIMATES LATENT (HIDDEN) FACTORS RATHER THAN RELYING ON PRESELECTED OBSERVABLE ONES.

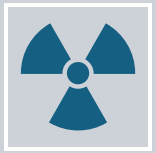
ALLOWS FACTOR BETAS TO VARY OVER TIME **BASED ON FIRM AND BOND CHARACTERISTICS**, IMPROVING EXPLANATORY POWER.

THEIR **FIVE-FACTOR MODEL** EXPLAINS **51% OF THE VARIATION IN INDIVIDUAL BOND RETURNS OUT-OF-SAMPLE**, OUTPERFORMING TRADITIONAL MODELS (E.G., FAMA-FRENCH FIVE-FACTOR MODEL AND BAI, BALI, AND WEN'S FOUR-FACTOR MODEL).

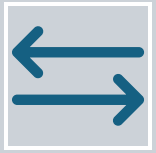


# Paper: Performance & Implications

Their model yields a **high out-of-sample Sharpe ratio**, suggesting superior portfolio performance.



It highlights key bond characteristics influencing risk exposure, including **bond spread, volatility, duration, and spread-to-default distance**.



They find that **systematic (factor-related) bond returns are much more integrated with equity markets** than idiosyncratic (individual bond-specific) returns.

# Paper: Conclusion

- **Redefines corporate bond pricing** by demonstrating the effectiveness of a **dynamic factor approach**.
- **Better captures bond risks and expected returns** compared to traditional models.
- **Offers valuable insights** for:
  - **Investors** seeking improved risk-return strategies.
  - **Portfolio managers** optimizing bond allocations.
  - **Researchers** studying corporate credit markets.

# IPCA model vs PCA model

| Aspect | PCA | IPCA |
|---|---|---|
| Data Inputs | Only Returns Data | Uses returns data along with bond features |
| Factor Loadings | Estimates static (time-invariant) factor loadings | Allows factor to vary over time |
| Noise & Error | May capture noise because it does not differentiate between signal and noise in features | Aggregates features to isolate true risk signals and reduce measurement error |
| Estimation Efficiency | Identifies the latent factor space solely based on return covariation | Uses an instrumented estimation approach using observable instruments to improve the consistency and efficiency of estimates |

# Data Explained - Variables

- We're building a series of pre-defined features to apply the model
- Bond-Based Variables
  - Coupon
  - Par Value
  - Face Value
  - Duration
  - Rating
  - Spread
  - Distance to Default

# Data Explained - Variables

- Equity-Based Variables
  - Book-to-Price
  - Debt-to-EBITDA
  - Earnings-to-Price
  - Market Cap
  - Total Debt
  - Profitability

# Data Explained - Variables

- Moments-Based Variables
  - Turnover Volatility
  - Equity Volatility
  - Bond Volatility
  - Bond Skewness
  - Value-at-Risk
- Beta Variables
  - VIX
  - Bond Market Excess Return: LQD

# How to define return?

- Excess Return = Return of Bonds – Risk Free Rate (T-Bond)
  - We can understand this as the premium for investors take on more risks
  - By risks, we mean the possibility of a company defaulting
- Scaled Return = Excess Return / DtS
  - A risk-adjusted approach to standardize the return
  - This means that a bond earning a certain excess return with a lower DtS (i.e., lower risk exposure) is more attractive than one with a higher DtS yielding the same excess return.
  - DtS = Duration * option adjusted spread

# Building a Long-Short Portfolio

Why People Use LS Strategies?

- Hedging Market Risk: By going long on assets expected to outperform and short on those expected to underperform, an LS portfolio can neutralize broad market movements.
- Exploiting Relative Mispricings: LS strategies allow investors to capture gains from mispriced assets, regardless of overall market direction.
- Enhanced Risk-Adjusted Returns: Ideally, the strategy can improve Sharpe ratio by balancing risk exposures across long and short positions.

Common Approaches:

- **Equal Weight**
- Signal-Strength Weight
- Risk Weight
- Market Cap Weight

# Advantages and Weakness of a LS Portfolio

**Advantages:**

- Reduces sensitivity to systematic risk by offsetting long and short positions.
- Can be tailored using different weighting methods (equal weight, signal-strength, volatility-adjusted, etc.).
- Targets asset-specific mispricings that may be overlooked by strategies focusing solely on market beta.

**Weaknesses:**

- Frequent rebalancing may lead to more trading expenses.
- Potential for short squeezes and higher borrowing costs for short positions.
- Poor model signals can result in misallocation and loss

# Why LS to Examine IPCA?

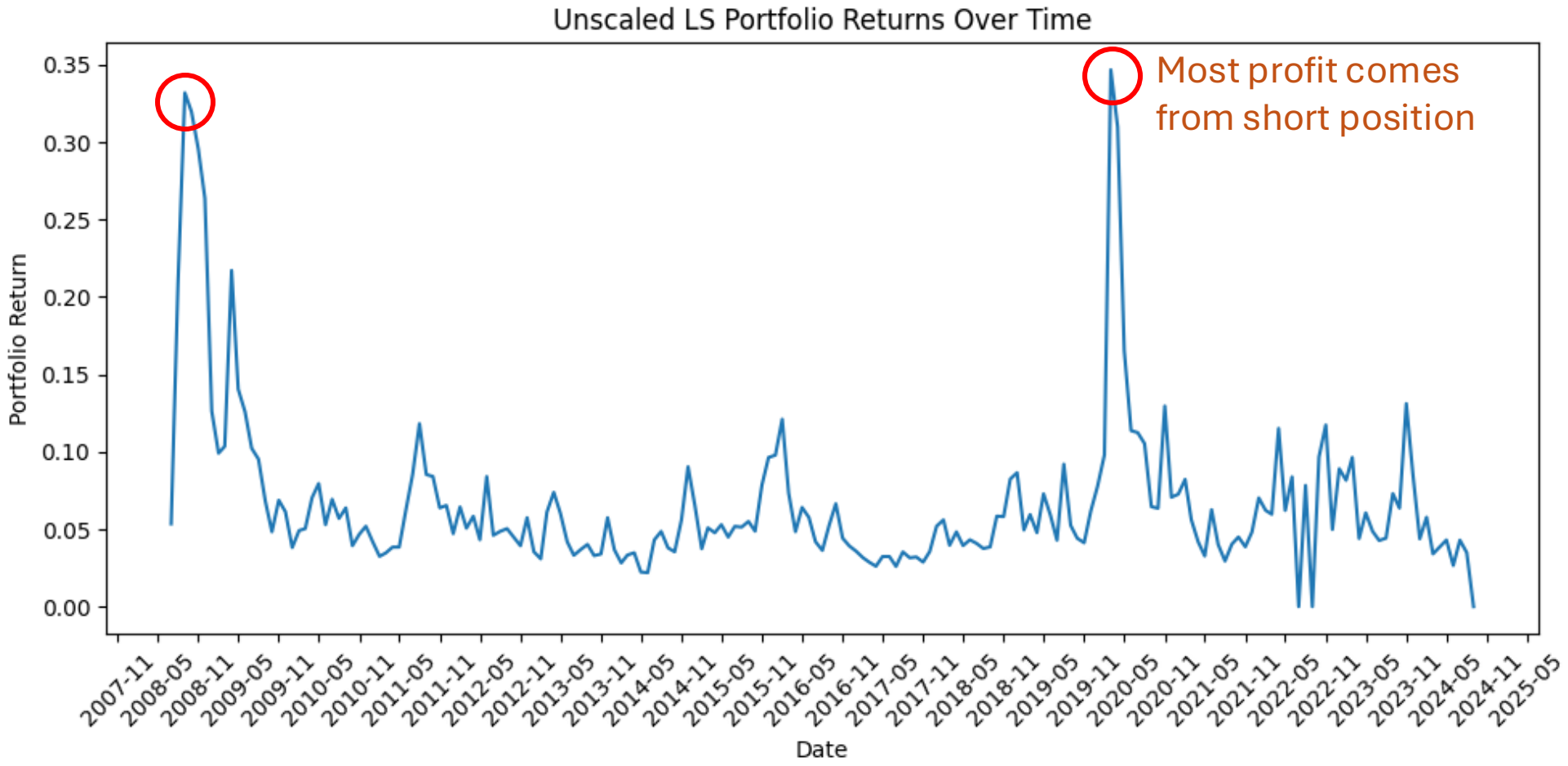
- It isolates the model's risk-return signal.
- The LS approach helps control for common market factors, enabling a clearer test of whether the model can explain cross-sectional differences in bond returns.
- Using a long-short framework allows assess the pricing error and risk premium captured by conditional factor model in a market-neutral setting, which might be obscured in a full-portfolio weighting scheme.

# Methodology

- Calculate the excess return
- Sort the value in descending order
- Select top and bottom 10% of the bonds to perform long/short
- The key question is: **How to avoid Look-Ahead Bias?**

**We'll compare the performance of unlagged and lagged versions to address this issue.**

# Performance of the LS Portfolio - Unscaled



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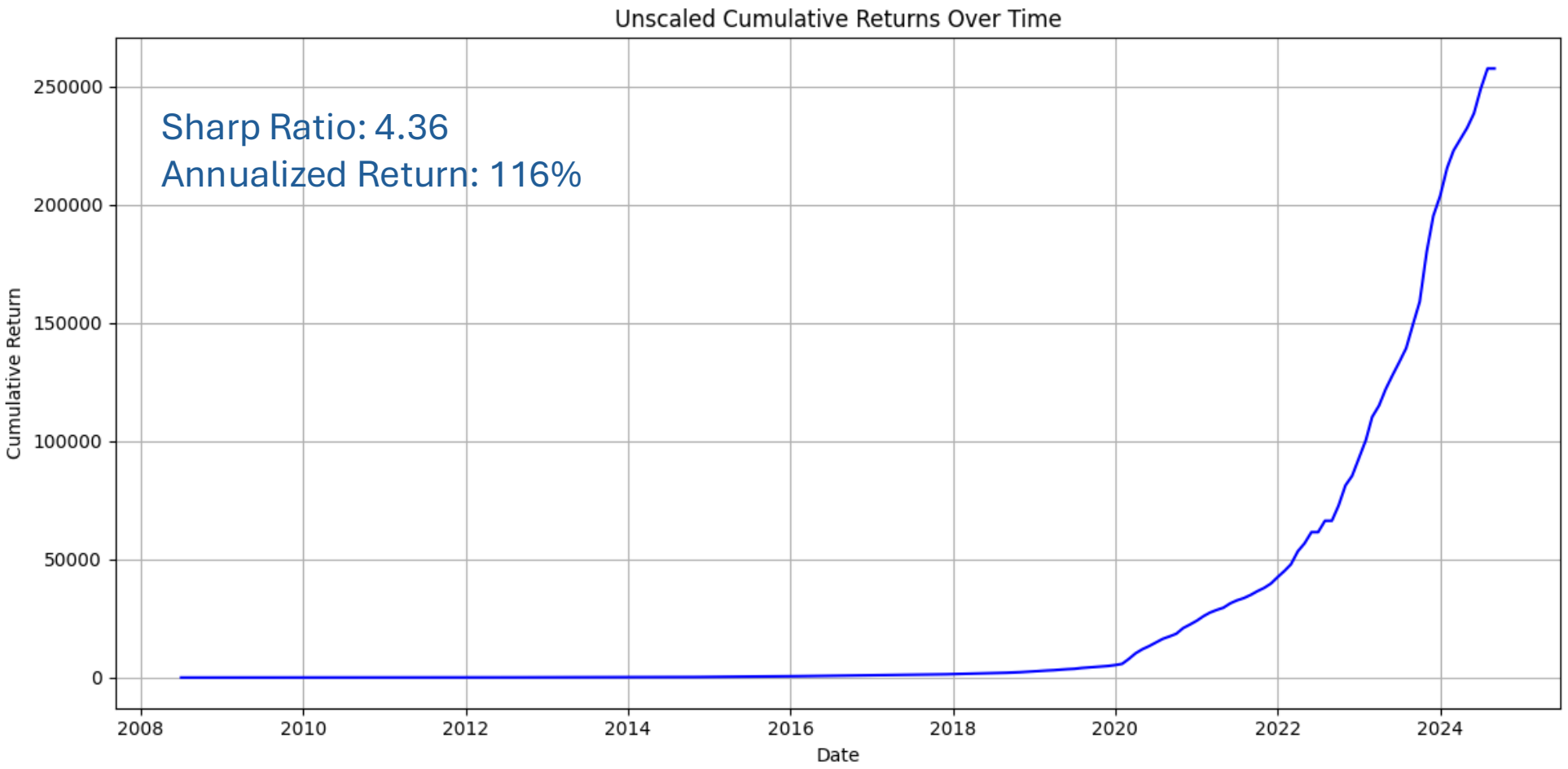
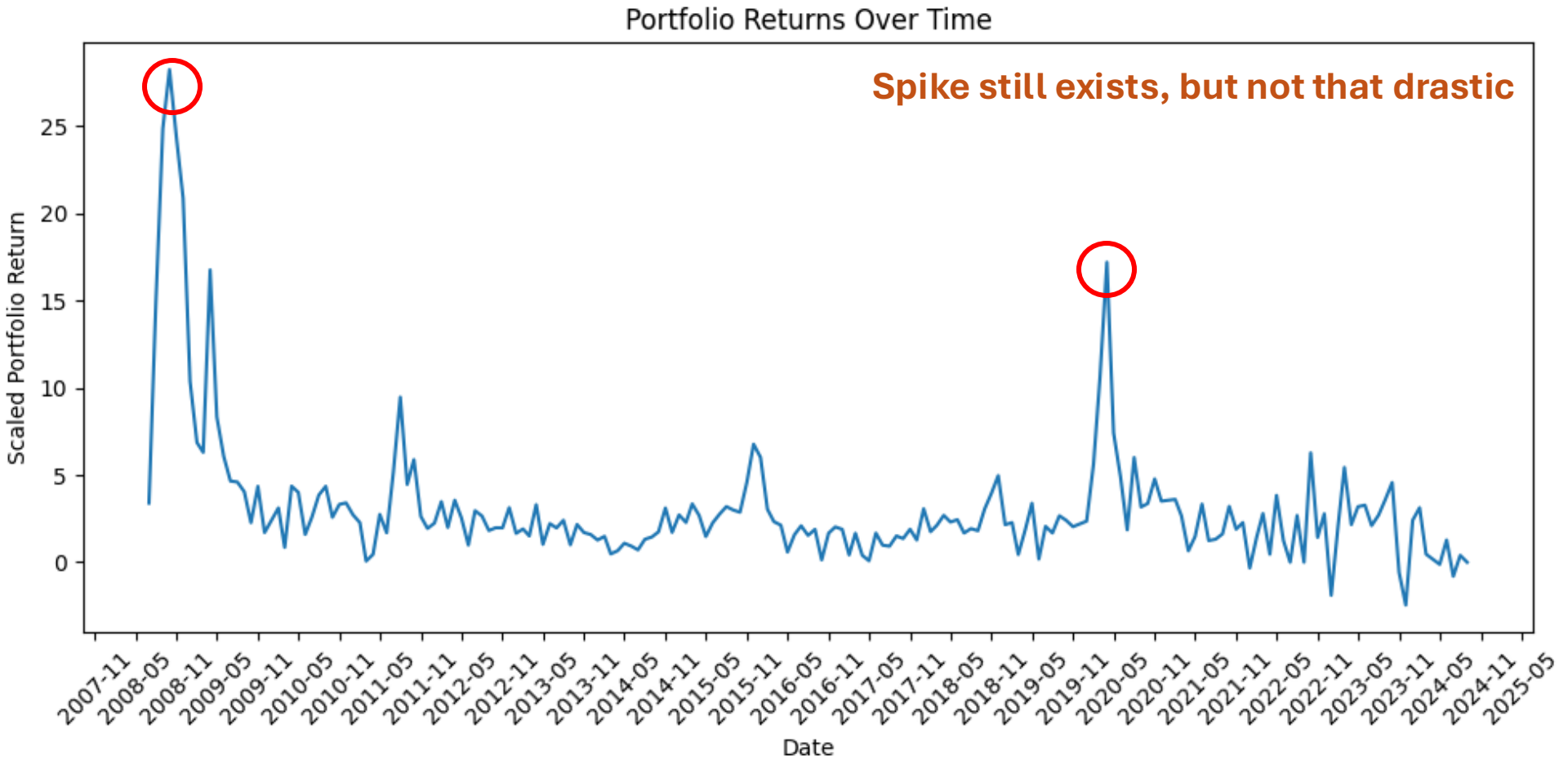


# Performance of the LS Portfolio - Scaled

**Recall: Scaled Return = Excess Return / DtS**



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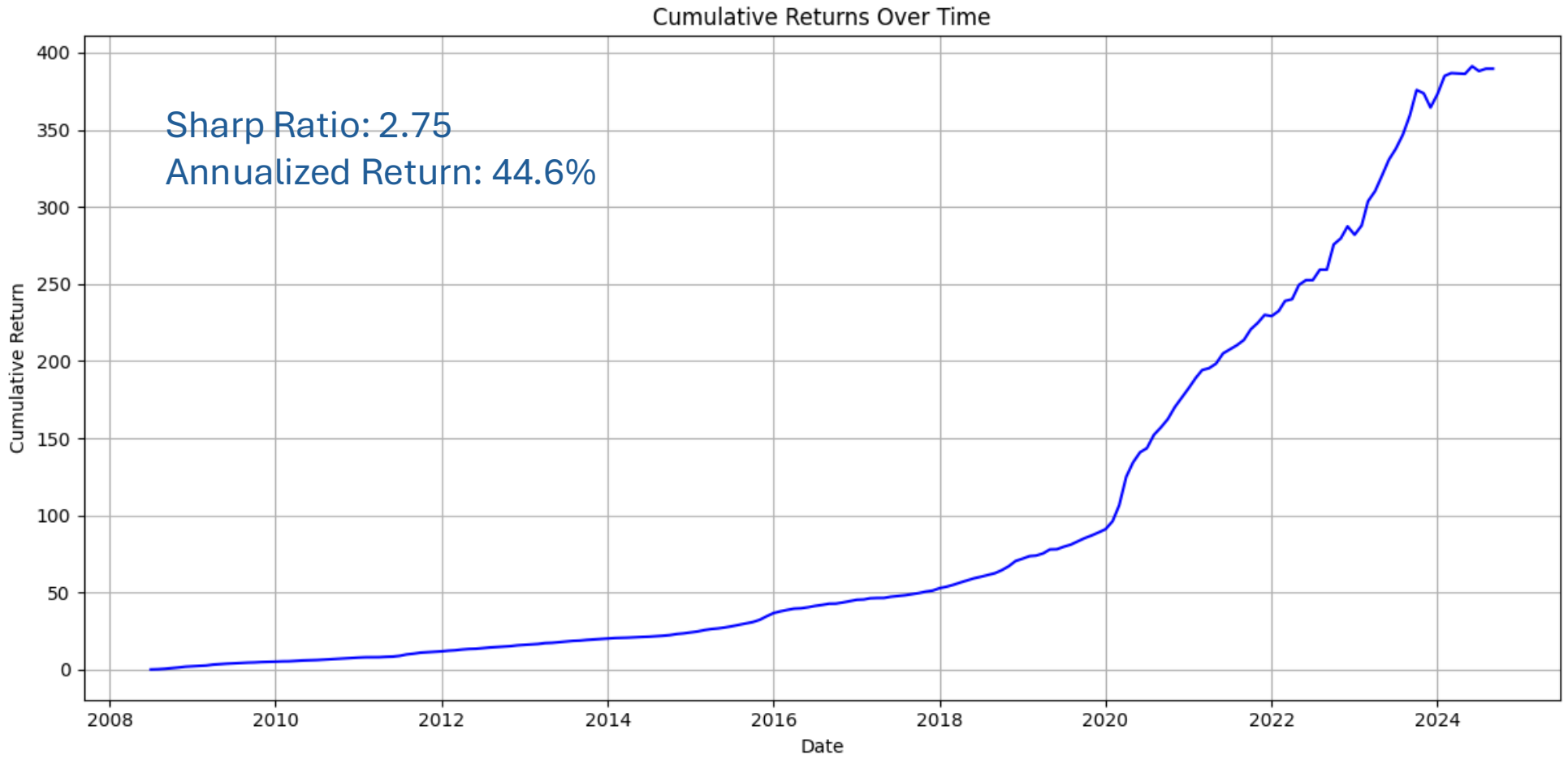
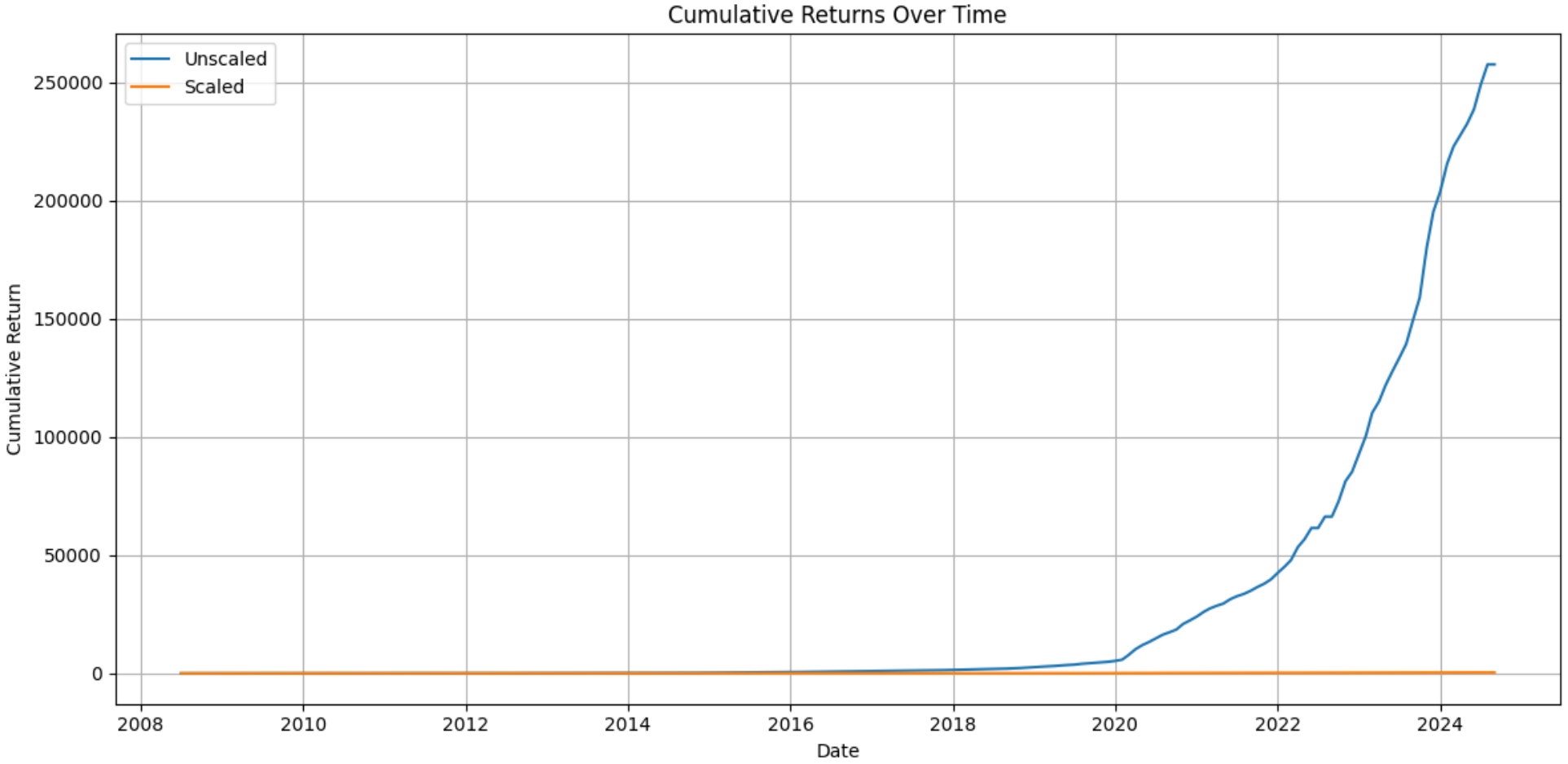


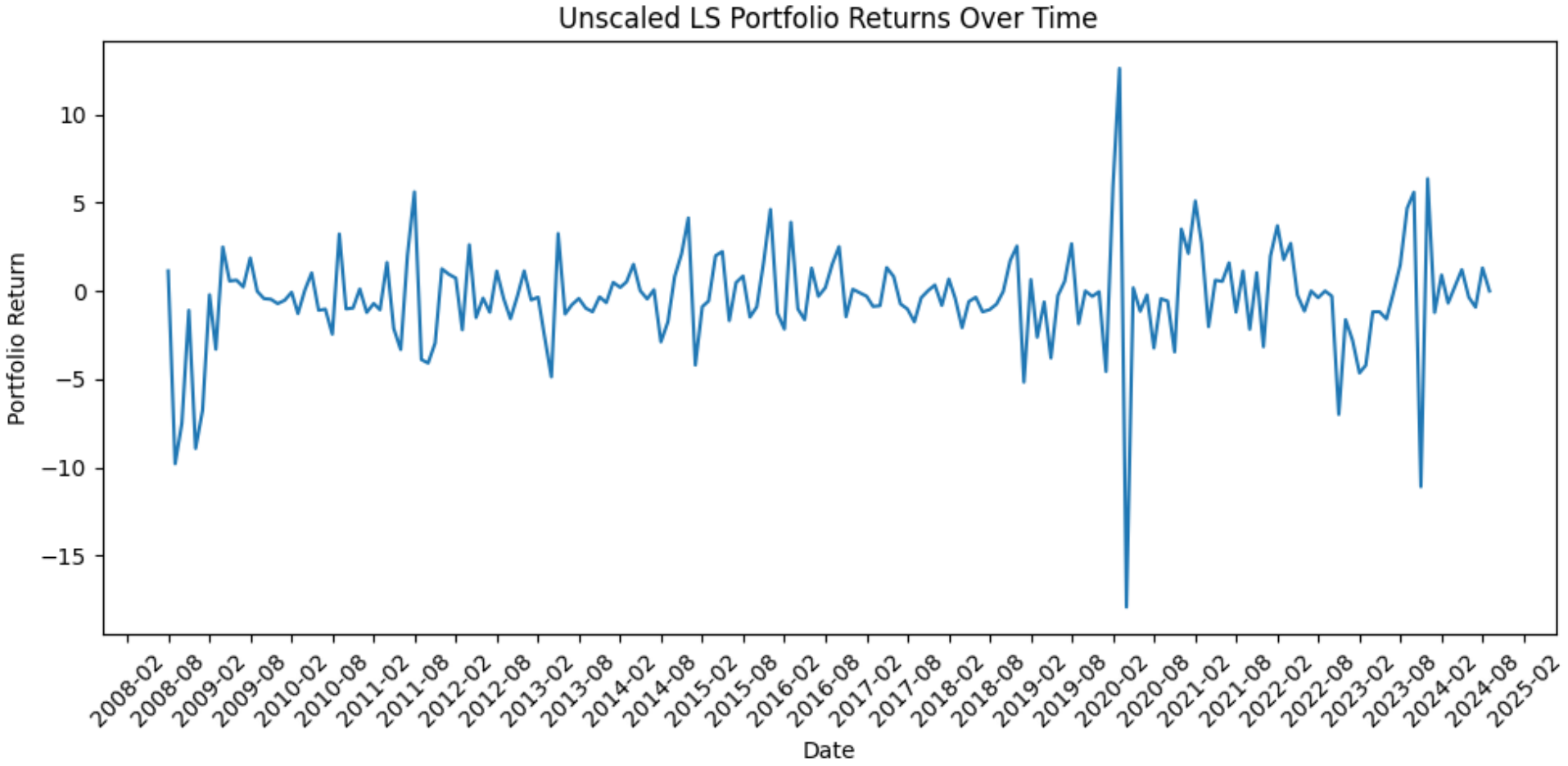
# Performance of the Unlagged LS Portfolio



# The Issue of Look-Ahead Bias

- Definition of Look-Ahead Bias:
  - When a trading strategy is backtested using data or information that would not have been available at the time of making trading decisions.
  - Essentially gives the strategy an "unfair" advantage by using future knowledge into past performance evaluations.
- Why It Matters:
  - Inflated Performance: Backtests shows exaggerated returns
  - Misleading Viability: A strategy that appears profitable in simulation may fail in live trading due to reliance on unavailable information.
  - Risk Underestimation: It may mask the actual risk and volatility, causing traders to underestimate potential losses.
- How To Fix It?
  - **Lag the data**

# Performance of the Lagged LS Portfolio - Unscaled



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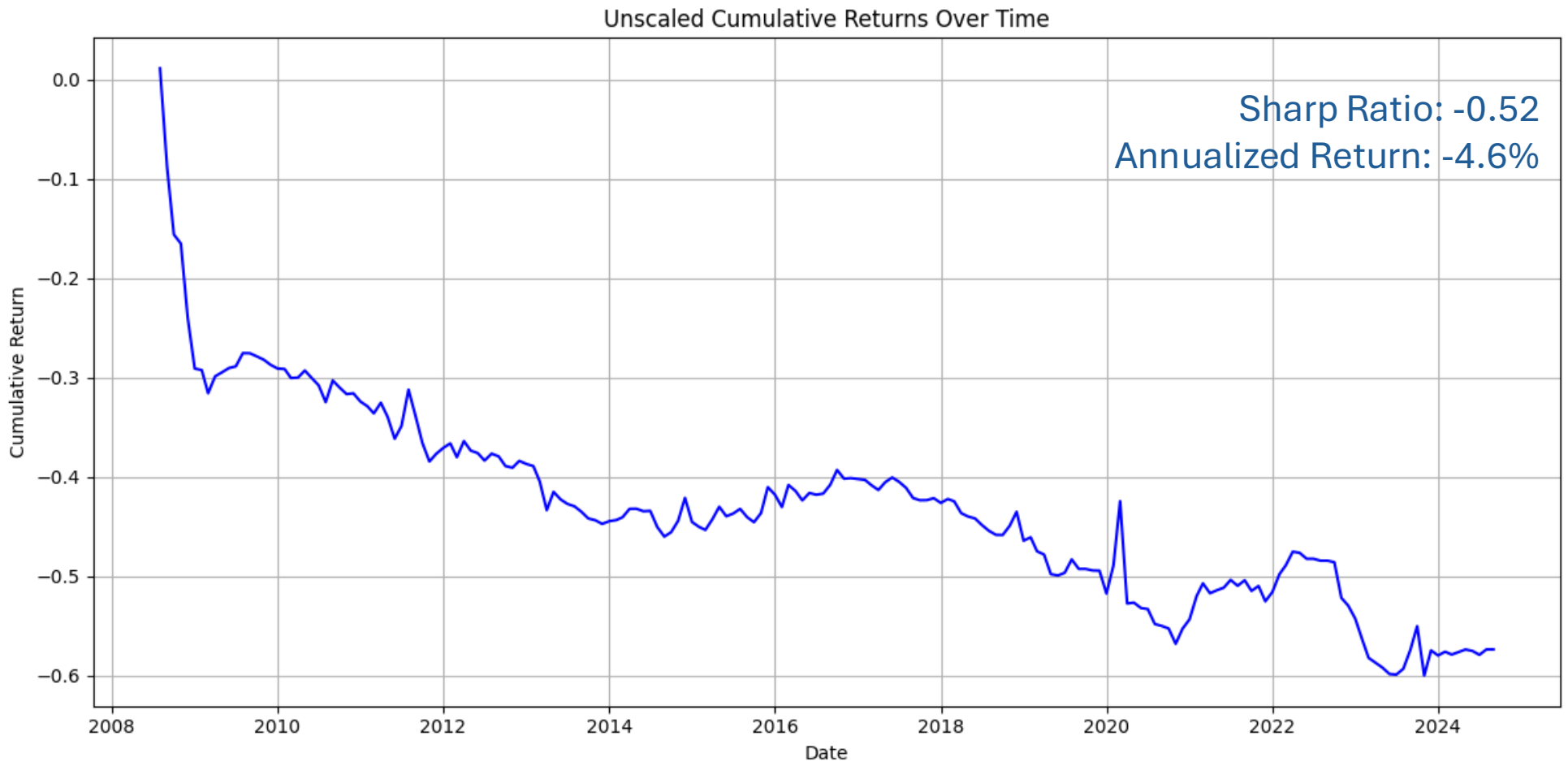
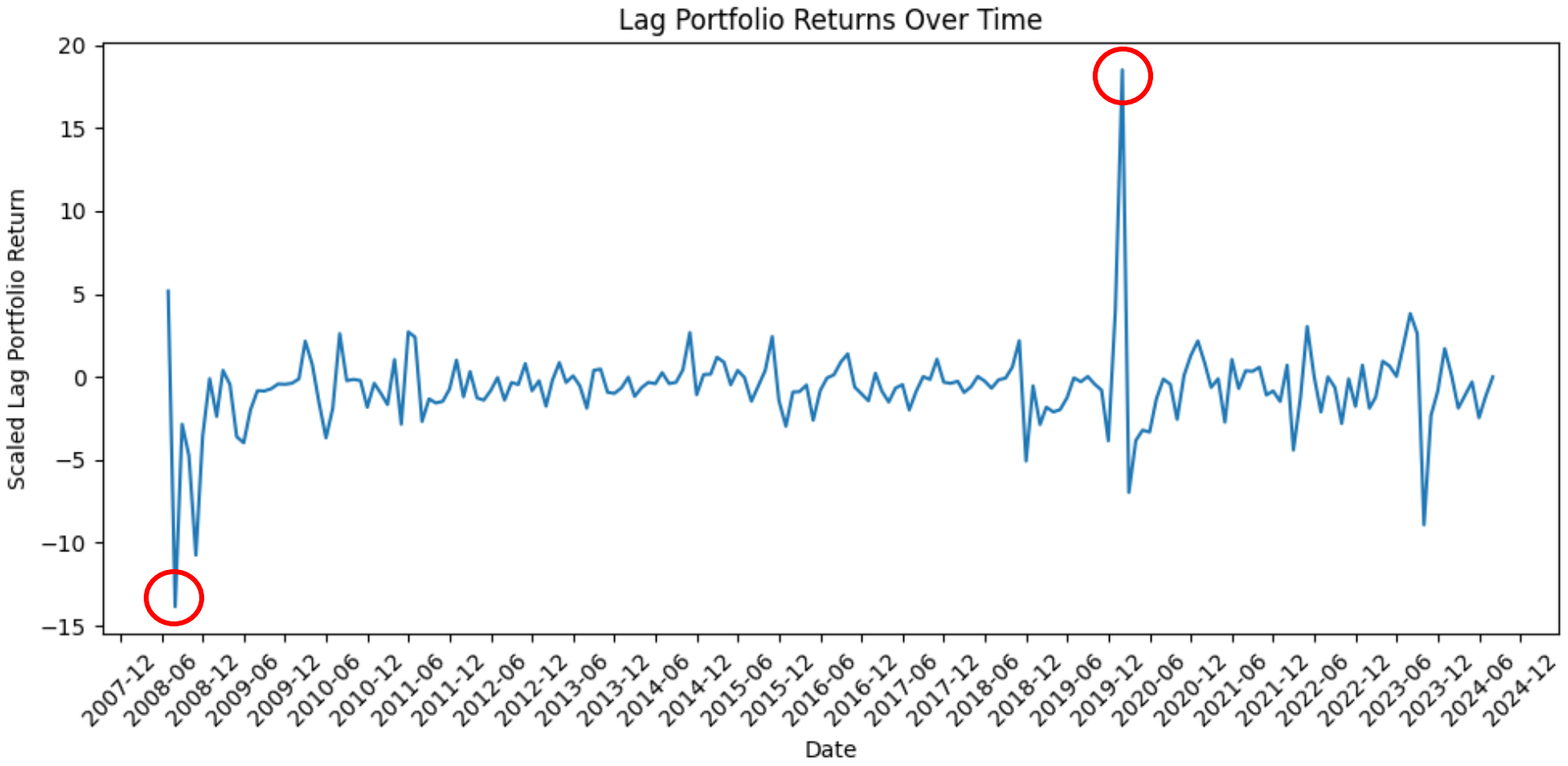


# Performance of the Lagged LS Portfolio - Scaled



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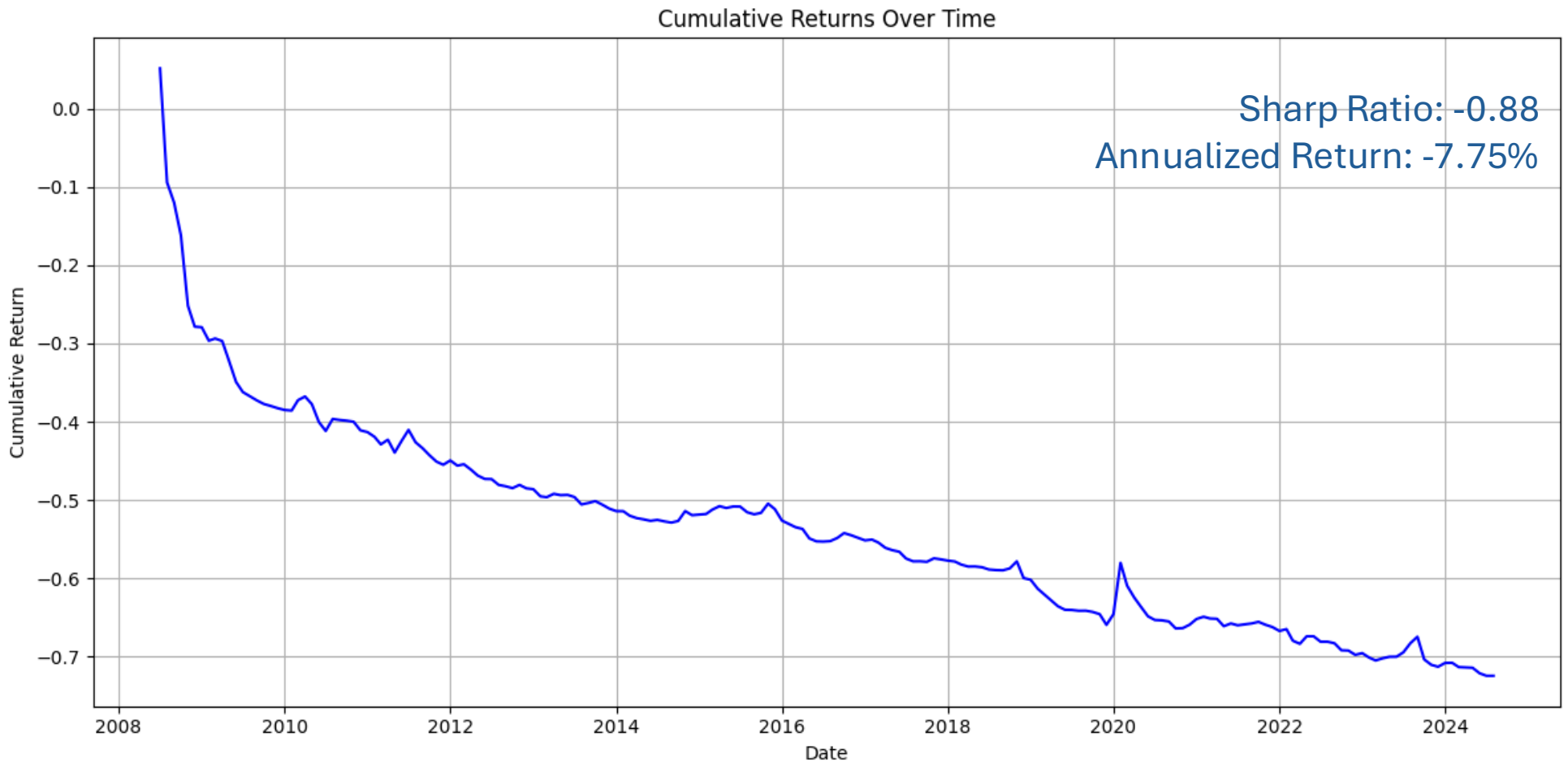

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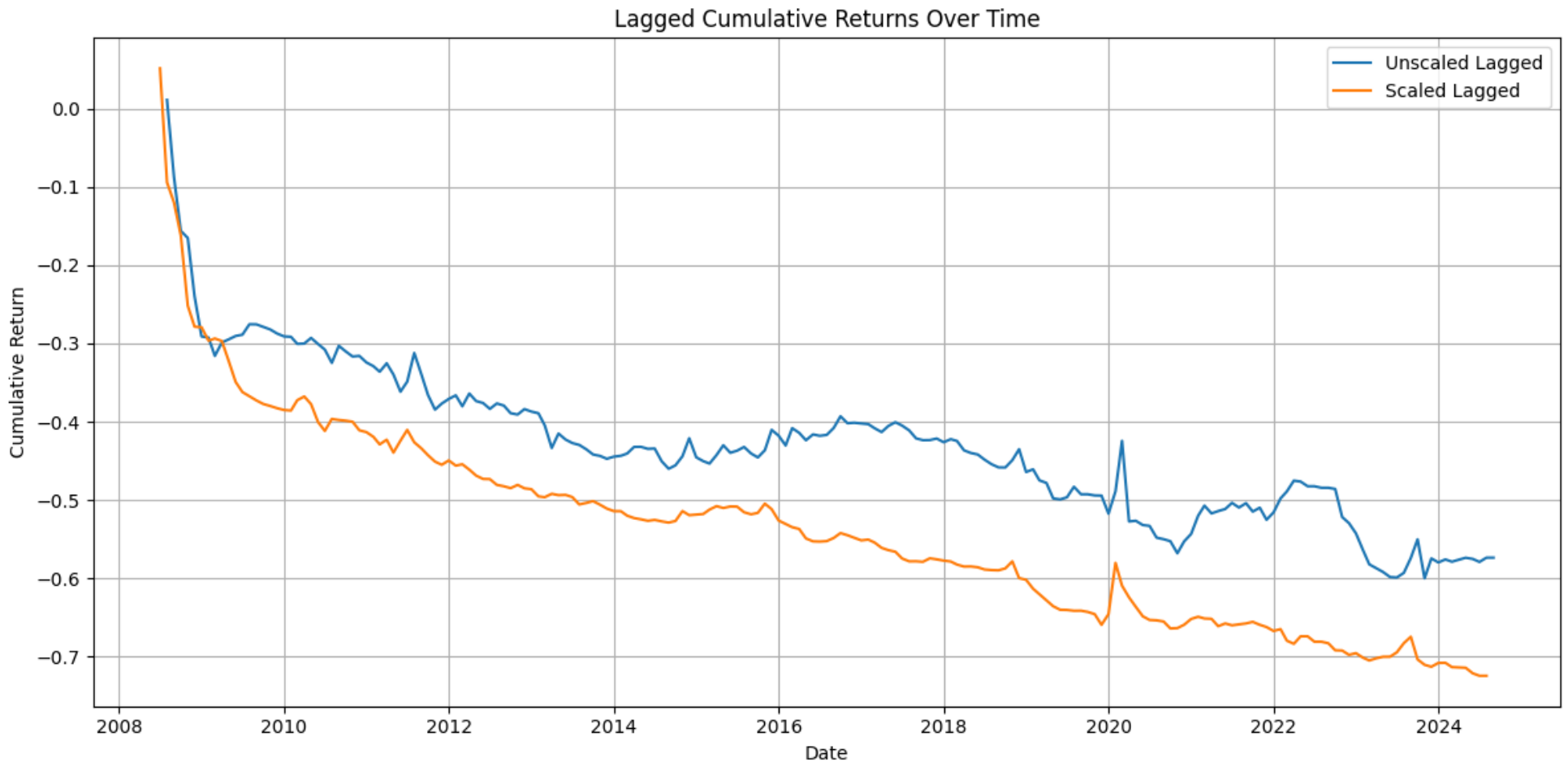
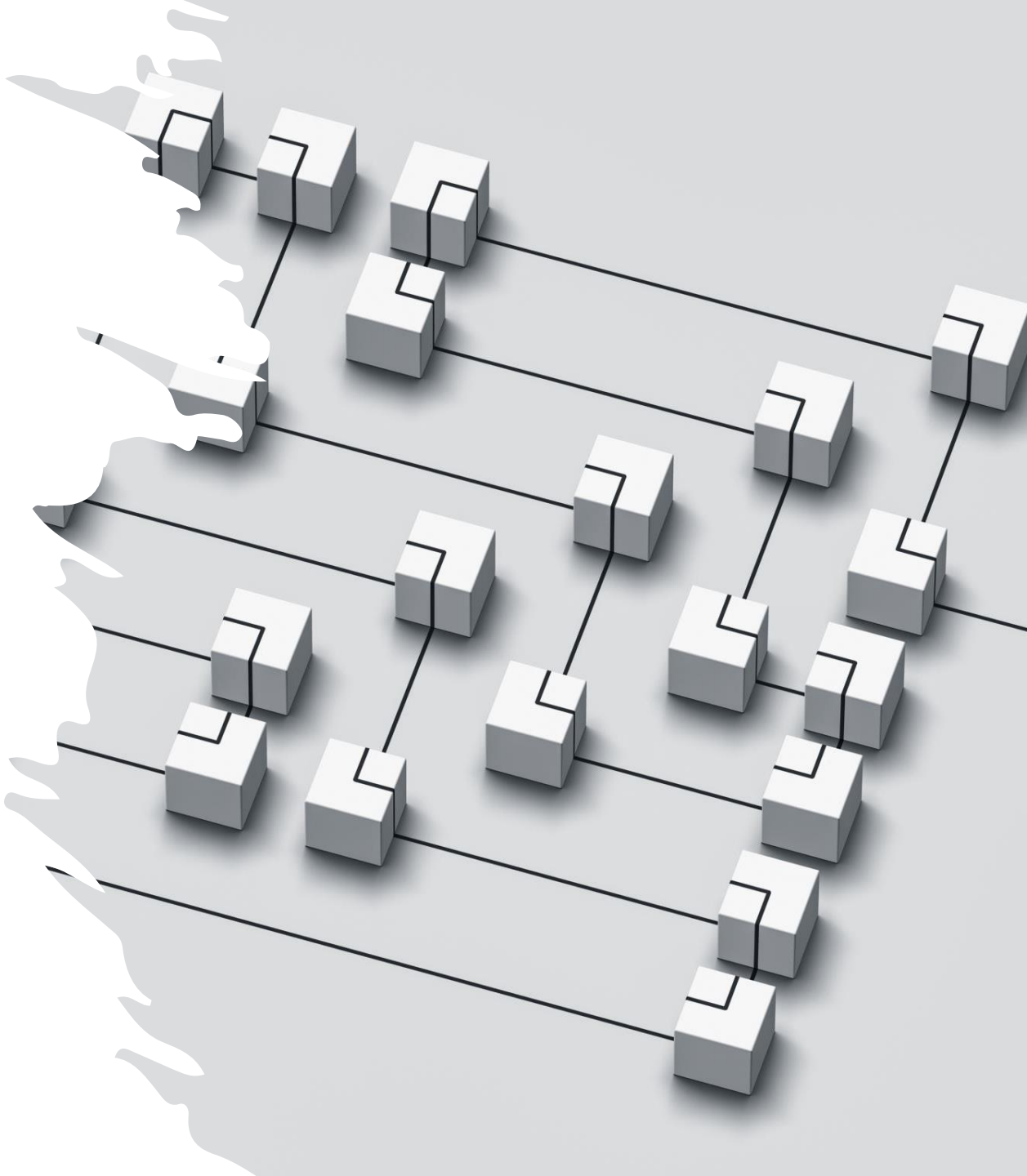


# Next Steps

- Identify the factors causing extreme returns
- Implement the IPCA Model
- Benchmarking our Model
  - Did it outperform LQD?
- Benchmarking our Return with Kelly's Outcome
  - Target: Out-of-sample gross Sharpe ratio of 6.2
  - 2.5 net of trading costs



# Thank You

Any Questions?