Quant/Risk Report

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CHARLOTTE

SPY vs SMIF Portfolio VaR

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=== PORTFOLIO vs SPY COMPARISON ===
                Metric      Portfolio            SPY    Difference
            Obs (days)     358.000000     358.000000      0.000000
  VaR 95% Hist (1d, $)  -8,142.376059 -12,461.241583  4,318.865524
  VaR 99% Hist (1d, $) -16,075.662398 -22,274.589126  6,198.926728
 VaR 95% Param (1d, $)  -9,868.310306 -13,645.278291  3,776.967985
 VaR 99% Param (1d, $) -14,166.479325 -19,492.189218  5,325.709894
  VaR 95% Hist (1w, $) -18,206.906366 -27,864.183264  9,657.276898
  VaR 99% Hist (1w, $) -35,946.273905 -49,807.495456 13,861.221551
 VaR 95% Param (1w, $) -22,066.212668 -30,511.769832  8,445.557164
 VaR 99% Param (1w, $) -31,677.210772 -43,585.860123 11,908.649351
          Beta vs SPY       0.691514       1.000000     -0.308486
   Alpha (daily est.)       0.000246       0.000000      0.000246
   R^2 (market explain)       0.884887       1.000000     -0.115113
   HHI (position-level)       0.090693       1.000000     -0.909307
Equity-only Beta vs SPY       0.817899            NaN           NaN
       Equity-only R^2       0.895103            NaN           NaN
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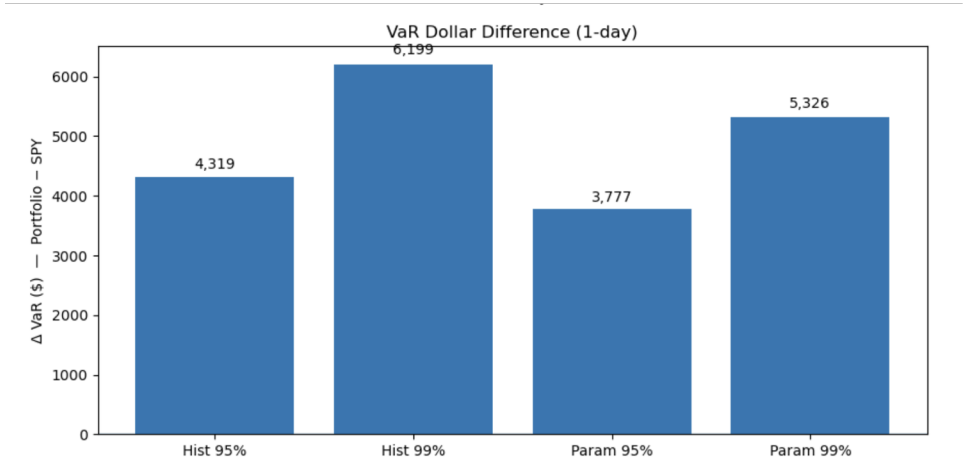
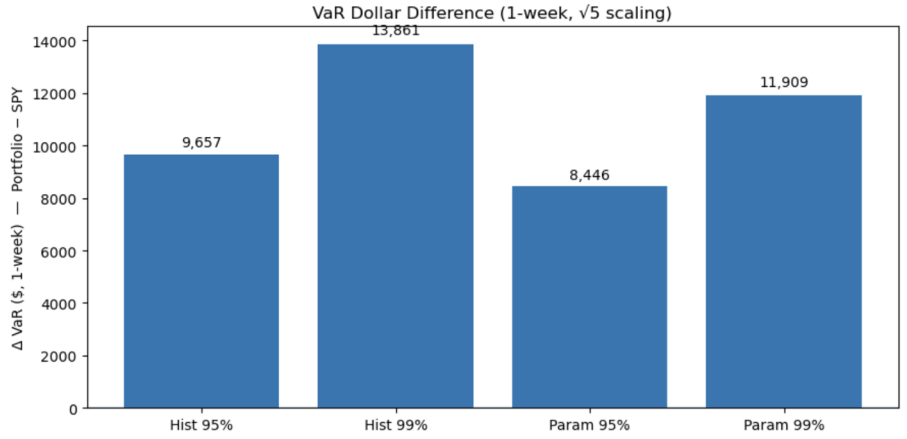
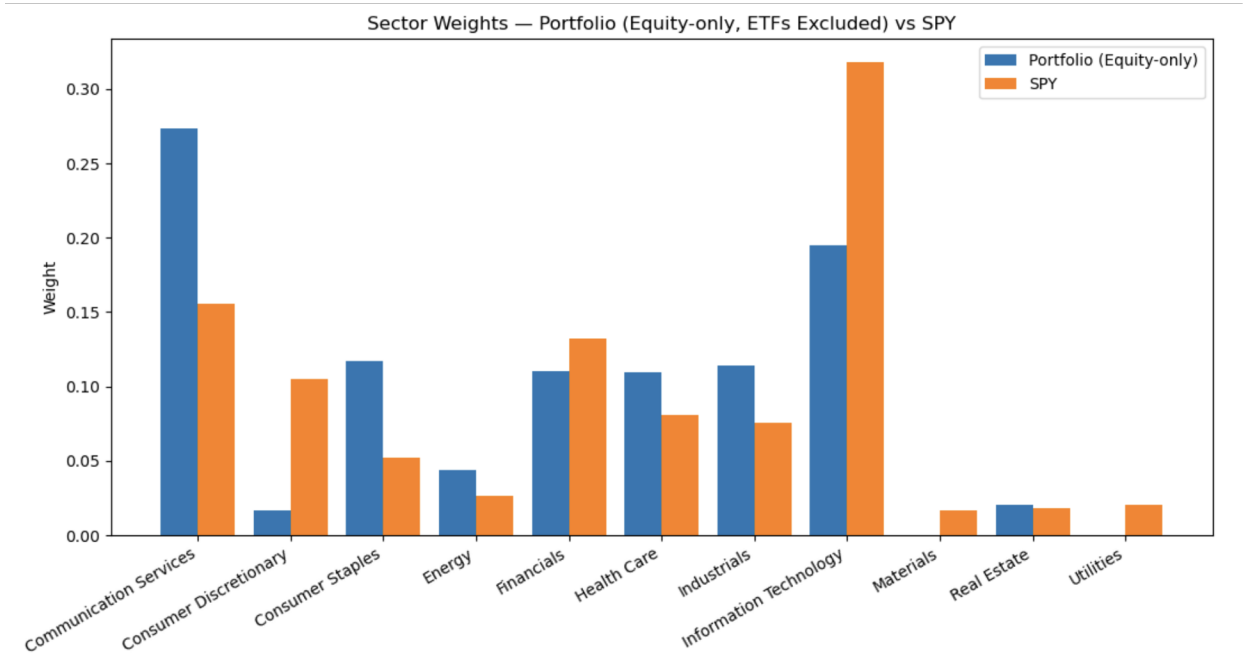
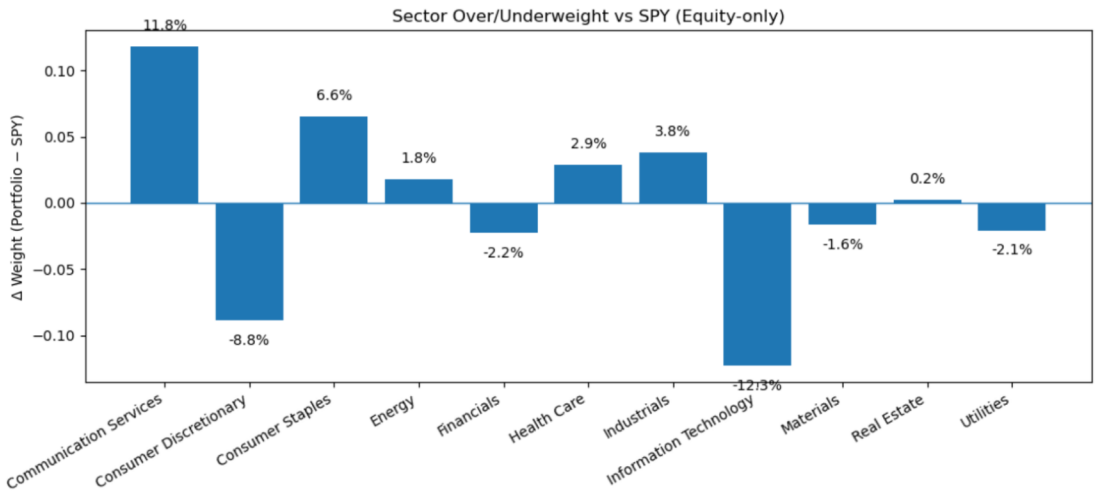




SPY vs SMIF Sector Breakdown





Why Risk & Alpha Matter

- Core question: Are our returns driven by skill (true alpha) or just by systematic exposures?
- Why it matters: Misattributed alpha = overconfidence in strategies, hidden risks to the fund.
- Today's agenda:
  - Risk metrics: Beta, R^2, Value-at-Risk (VaR), concentration, and sector tilts.
  - Alpha frameworks: CAPM → Fama–French 3-factor → Fama–French 5-factor →
- Goal for SMIF: Build a disciplined process to separate intentional bets from unintended risk exposures.

Risk Metrics - Beta

Equity-only Beta vs SPY	0.817899

$$\beta_p = \frac{Cov(r_p, r_b)}{Var(r_b)} \qquad R^2 = 1 - \frac{\sum_{i=1}^{n}(\hat{y}_i - y_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y}_i)^2}$$

- Interpretation:
  - $\beta > 1 \rightarrow$ portfolio more volatile than market
  - $\beta < 1 \rightarrow$ portfolio less volatile (defensive)
- Our Result: $\beta \approx 0.82 \rightarrow$ we're less volatile than SPY
- Implication: Even when market swings, our portfolio moves less.

Risk Metrics - R^2

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Equity-only R^2        0.895103
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$$R^2 = 1 - \frac{\sum_{i=1}^{n}(\hat{y}_i - y_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y}_i)^2}$$

- SSE = unexplained variation
- SST = total variation
- Interpretation: Proportion of portfolio returns explained by the model (market, factors, etc.).
- Our Result: $R^2 \approx 0.895 \rightarrow$ 89.5% of our portfolio's movement is explained by SPY.
- Implication: Only ~12% could be due to stock-picking skill or unique bets.

Value at Risk

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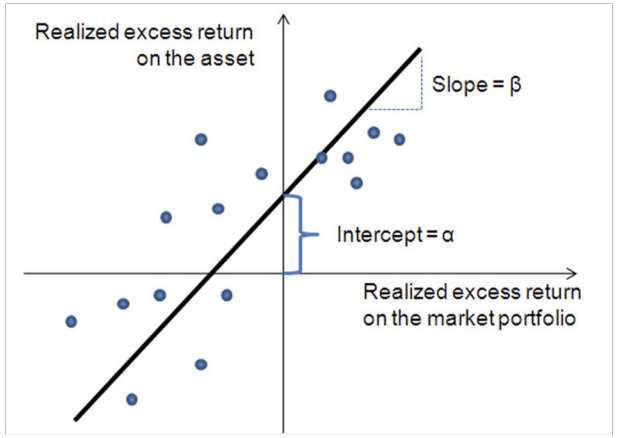
=== VaR (Portfolio) ===
VaR95_hist_1d     -8,032.439770
VaR99_hist_1d    -15,789.653209
VaR95_param_1d    -9,589.558115
VaR99_param_1d   -13,780.516413
VaR95_hist_1w    -17,961.081351
VaR99_hist_1w    -35,306.737917
VaR95_param_1w   -21,442.903819
VaR99_param_1w   -30,814.171465
```

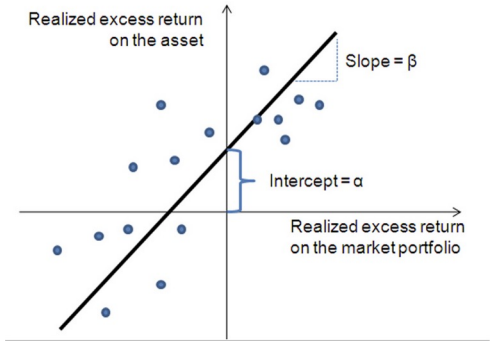
- Concept: “What’s the most we might lose, with X% confidence, in 1 day/week?”
- Methods:
  - Historical (percentiles of actual returns)
  - Parametric (assuming normal distribution)
- Our Result:
  - 95% 1-day VaR ≈ –$8K
  - 99% 1-day VaR ≈ –$16K
- Implication: Tail losses are meaningful, especially in high-volatility regimes.

Alpha - Why Alpha Matters



- Beta, R^2, VaR = risk side.
- Next: Are we delivering returns above what risk exposures predict?
  - Roadmap: CAPM alpha → FF3 → FF5 → q-factor.
  - Big Question: Is our performance true stock-picking skill or just factor tilts?

Introduction to CAPM Alpha



- Expected return = Risk-free rate + β × (Market return – Risk-free).
- Alpha = Extra return beyond CAPM prediction.
  - Think of it as the “skill” or “edge”:
  - $\alpha > 0$: Outperformed what risk exposure explains.
  - $\alpha = 0$: Matched the market, no edge.
  - $\alpha < 0$: Underperformed, even after adjusting for risk.
- Why it matters: Separates luck (beta exposure) from manager skill.

CAPM Alpha

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=== CAPM (Daily) ===
{'alpha_per_period': 0.000239653045755998, 'alpha_annual': 0.0603925675305115, 'alpha_t': 1.6285011270831522, 'beta_mkt': 0.691313401890930
3, 'R2': 0.8812680866899348, 'n': 373}
```

- Alpha ≈ +6% annualized → small but positive (barely significant, t ≈ 1.6)
- Beta ≈ 0.69 → we're less volatile than the market
- R^2 ≈ 0.88 → most of our returns explained by SPY (not pure stock-picking)
- Interpretation: CAPM says we're slightly beating the market.

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WHO ARE FAMA & FRENCH?

Eugene Fama

- Professor of Finance, University of Chicago Booth School of Business
- Known as the “Father of the Efficient Market Hypothesis”
- Awarded the 2013 Nobel Prize in Economics for his work on asset pricing.

Kenneth French

- Professor of Finance, Dartmouth College Tuck School of Business
- Research focus on asset pricing, portfolio theory, and risk management
- Recognized as one of the most influential voices in modern finance

UNC CHARLOTTE STUDENT MANAGED INVESTMENT FUND

Quick Introduction to the Fama-French Models

- Fama–French 3-Factor (FF3)
  - Market (MKT-RF): The excess return of the market over risk-free.
  - Size (SMB = Small Minus Big): Small-cap stocks outperform large-caps, on average.
  - Value (HML = High Minus Low): Value stocks (high book-to-market) outperform growth stocks.
- Fama–French 5-Factor (FF5)
  - Profitability (RMW = Robust Minus Weak): Profitable firms outperform weak ones.
  - Investment (CMA = Conservative Minus Aggressive): Firms that invest conservatively outperform heavy-investment firms.

If we control for common knowledge, how good are you?

Fama-French 3 Factor Model

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=== FF-3 (Monthly) ===
{'alpha_per_month': -0.4197797431809547, 'alpha_annual': -5.037356918171456, 'alpha_t': -40.23039633719106, 'betas': {'MKT_RF': 0.711414552
7853654, 'SMB': 0.43100177607920875, 'HML': -0.7240473537937718}, 'R2': 0.6496134314166067, 'n': 10}
```

- Alpha ≈ –5% annualized → underperforms once size/value factors are controlled
- MKT-RF beta ≈ 0.71 → still strongly tied to the market
- SMB beta ≈ +0.43 → tilted toward small-cap/growth exposure
- HML beta ≈ –0.72 → heavily tilted against value (i.e., toward growth stocks)
- R^2 ≈ 0.65 → less variance explained vs. CAPM (model shows tilts matter more than market alone)
- Interpretation: Once factor tilts are accounted for, “alpha” disappears → our “skill” looks like a growth/small-cap tilt, not pure stock-picking.

Fama-French 5 Factor Model

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=== FF-5 (Monthly) ===
{'alpha_per_month': -0.41773011922021036, 'alpha_annual': -5.0127614306425246, 'alpha_t': -28.96399977852263, 'betas': {'MKT_RF': 0.7188747
035331247, 'SMB': 0.4114365303765656, 'HML': -0.90221598891176, 'RMW': -0.2078326678737919, 'CMA': 0.2019309051147641}, 'R2': 0.64936434360
94576, 'n': 10}
```

- Alpha ≈ –5% annualized → portfolio underperforms once size, value, profitability, and investment factors are stripped out.
- Factor exposures:
  - SMB (+0.41) → tilted toward smaller stocks.
  - HML (–0.90) → strongly tilted toward growth (anti-value).
  - RMW (–0.21) → low-profitability tilt.
  - CMA (+0.20) → slight conservative investment tilt.
- R^2 ≈ 65% → most of our returns explained by common factors, not unique stock-picking.

Q-Factor Model

- Developed by Hou, Xue, and Zhang (2015) as an alternative to Fama-French
- Grounded in investment-based asset pricing theory rather than pure empirical anomalies
- Four factors:
  - Market (broad market excess return)
  - Size (small minus big)
  - Investment (conservative vs. aggressive firm investment)
  - Profitability (robust vs. weak operating profitability)
- Interprets anomalies as outcomes of firm decisions on investment and profitability
- Claims greater parsimony and theoretical foundation than Fama-French
- Alpha represents true stock-picking skill after controlling for these economic drivers

Q-Factor Model

```
=== Q-Factor (Monthly) ===
{'alpha_per_month': -0.42646857508120384, 'alpha_annual': -5.117622900974446, 'alpha_t': -33.91033264478919, 'betas': {'MKT': 1.3274371054366
572, 'ME': -0.45448477834696116, 'IA': 0.024940748250184355, 'ROE': -0.9594242973399166}, 'R2': 0.7258193217636186, 'n': 10}
```

- Alpha (monthly): –0.43% → Portfolio underperforms the Q-factor model by ~0.43% per month
- Alpha (annualized): –5.12% → That compounds to about –5% per year of "negative skill" after accounting for factors
- Alpha t-stat: –33.9 → Extremely statistically significant
- Market Beta (MKT = 1.33) → Portfolio is more volatile/risk-exposed than the market
- Size loading (ME = –0.45) → Tilts toward large-cap stocks (negative on small-minus-big factor)
- Investment loading (IA = 0.02) → Basically neutral exposure to conservative vs aggressive investors
- Profitability loading (ROE = –0.96) → Tilted away from high-profit firms (more weight on low-profitability firms)
- $R^2 = 0.73$ → About 73% of the returns are explained by these factors; the rest is idiosyncratic noise
- n = 10 → Regression is based on 10 monthly observations

QUESTIONS?