– Group 1 – Volatility-Managed Portfolio Analysis

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Part I: Volatility-Managed Portfolio - Regression

Generating alpha and reducing market exposure with volatility-managed portfolios

Data & Methodology:

- Based on the paper from Moreira & Muir (2017) – adjusting the realized variance estimate by using all daily returns within that month

Data:
- U.S. stock market data from Kenneth French's data library
- From 1926 to 2015

Estimate monthly realized variance and monthly excess returns:
- Using all daily returns within that month
- Different than in Moreira & Muir (2017)

Construct the volatility-managed portfolio:

$$f^{\sigma}_{t+1} = \frac{c}{\hat{\sigma}^2_t(f)} f_{t+1}$$

$$with\ c = sd(f)/sd\left(\frac{1}{\hat{\sigma}^2_t(f)} f_{t+1}\right)$$

Sort months into variance quintiles:
- Compute the 0.2, 0.4, 0.6 and 0.8 quantiles by lagged variance
- Label groups from "Low Vol" (lowest variance) to "High Vol" (highest variance)

Regression on original portfolio:

- Volatility-managed returns explained by original returns
- Results are annualized and in percent
- Standard errors are Newey-West corrected due to heterogeneity in returns

$$f^{\sigma}_t = \alpha + \beta f_t + \varepsilon_t$$

	Coefficient	Std. error	p-value
Intercept (%)	4.80	1.69	0.004 **
Original Return	0.61	0.08	0.000 ***

R^2	# of obs.	RSME
37.22 %	1073	51.31

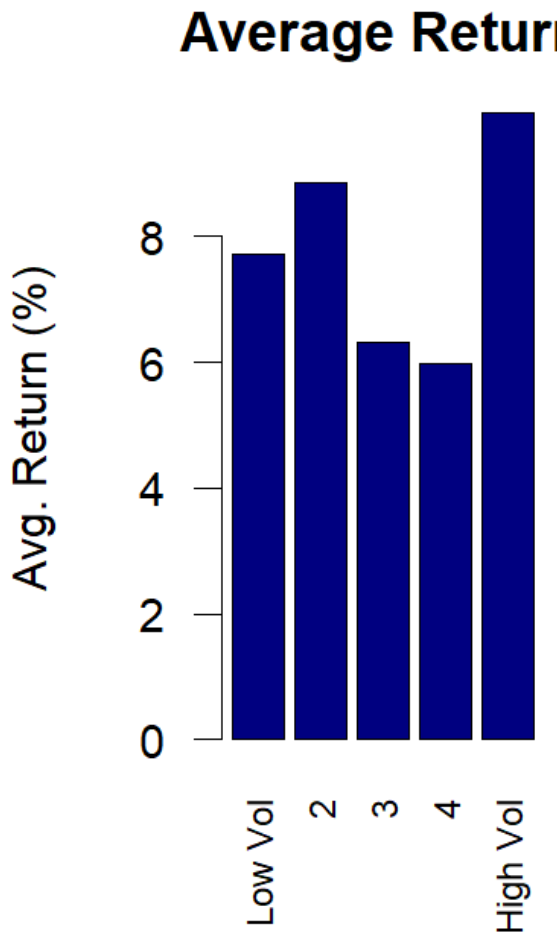
Key Insights:

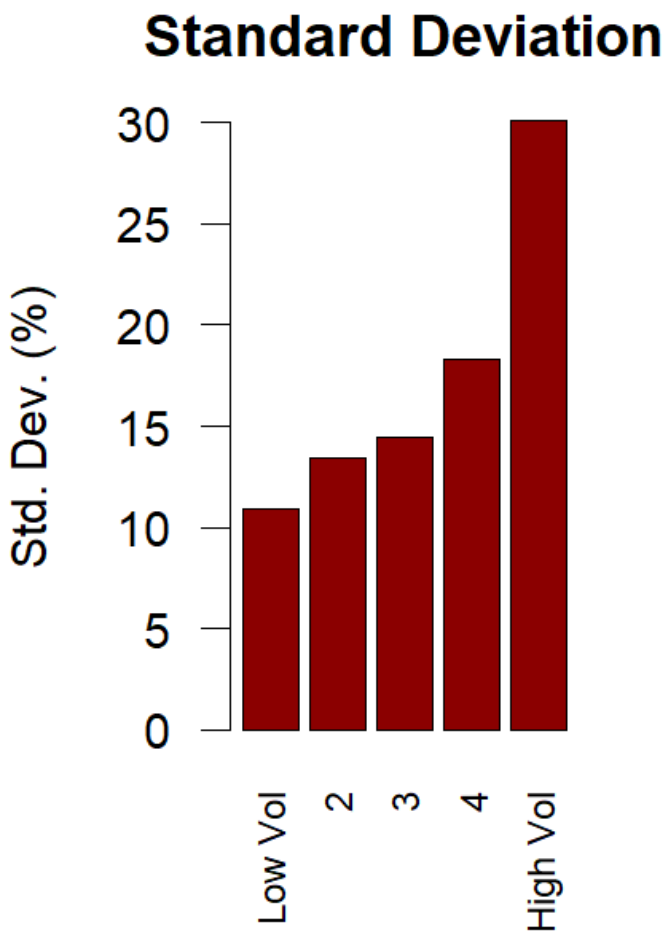
- **Significant Alpha:** The **intercept of 4.80%** represents a large, statistically significant alpha, indicating that the strategy generated excess returns not explained by the market.
- **Reduced Market Risk:** The **slope (beta) of 0.61** shows that the portfolio has significantly less market exposure than a buy-and-hold strategy, confirming the volatility timing mechanism works.
- **Strategy vs. Market:** The **R-squared of 37.22%** means the market explains less than 40% of the strategy's performance, proving that the volatility-timing component itself is a major driver of the results.
- **Model Fit:** The regression is robust, based on **1073 observations**, with an **RMSE** (residual standard error) of **51.31**.

Part I: Volatility-Managed Portfolio – Quintile Analysis

Deconstructing the Anomaly: Volatility is Predictable, Compensation is Not

Quintile analysis (annualized)





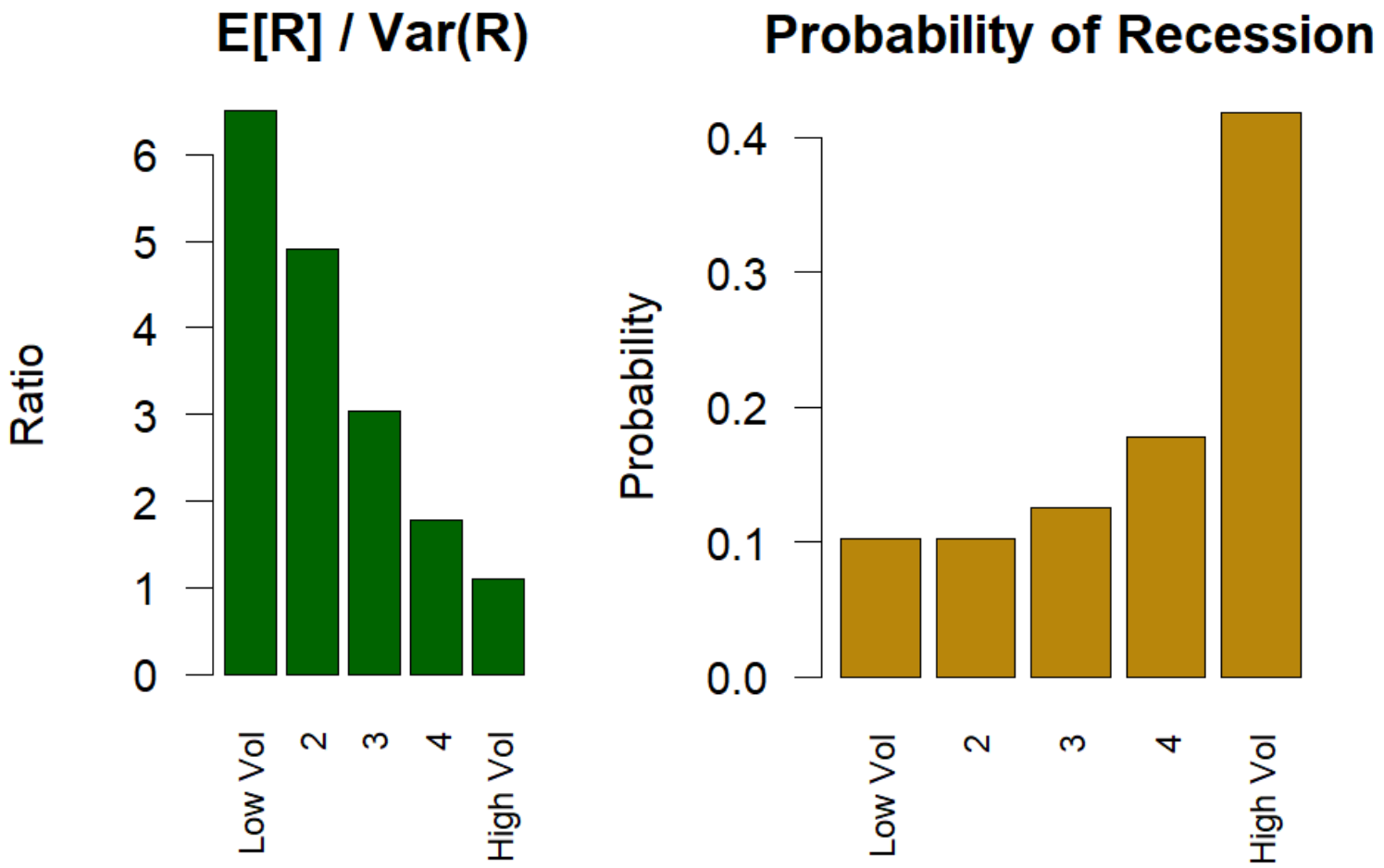
Key Insights:

- **No Simple Risk-Return Trade-off:**
  - The **"Average Return" plot shows no clear, positive relationship**. While the highest volatility quintile has high returns, so does the lowest, and the relationship is not monotonic. This suggests investors are **not proportionally compensated for bearing more (predictable) volatility.**
- **Volatility is Highly Predictable:**
  - The **"Standard Deviation" plot shows a strong, monotonic increase**. This confirms that sorting by the previous month's volatility is an effective way to forecast the next month's volatility.

Part I: Volatility-Managed Portfolio – Quintile Analysis

Exploiting the Anomaly: Risk-Adjusted Returns Collapse as Recession Risk Rises

Quintile analysis (annualized)



Key Insights:

- **The Core Anomaly:**
  - The "E[R]/Var(R)" plot is the key. It shows the **risk-return trade-off (the reward per unit of risk) is excellent when volatility is low and collapses when volatility is high**. This is the inefficiency the strategy exploits.
- **Volatility is "Bad Times":**
  - The "Probability of Recession" plot shows that **high volatility periods are strongly correlated with NBER recessions**. This means the **risk-return trade-off is worst precisely during bad economic times.**

Part II

Volatility-managed portfolios increase Sharpe ratios & decrease drawdowns

Data & Methodology:

- Compared to Part I, we adapt the realized variance calculation and add the value factor into our dataset

Adjustments to part I

Data:

- Daily returns of
  - U.S. stock market
  - Momentum factor
- From 1926 to 2024

Estimate monthly realized variance and monthly excess returns:

- For month t, using last **D = 17** daily returns to end of that month

$$\hat{\sigma}_t^2 = \frac{D}{22}\sum_{d=1}^{D}\left(f_{(t+1)-d} - \frac{\sum_{d=1}^{D} f_{(t+1)-d}}{D}\right)^2$$

Construct the volatility-managed portfolio:

$$f_{t+1}^{\sigma} = \frac{c}{\hat{\sigma}_t^2(f)} f_{t+1}$$

$$with\ c = sd(f)/sd\left(\frac{1}{\hat{\sigma}_t^2(f)} f_{t+1}\right)$$

Compare metrics

- Investigate differences between original portfolios and volatility-managed portfolios
- Metrics: SR, Max drawdown, alphas

Results Sharpe Ratios and Maximum Drawdown

	SR (monthly)	SR (annualized)	Max. Drawdown
Original Market	0.1022	0.3647	-84.73 %
Managed Market	0.1176	0.4219	-60.14 %
Original Mom	0.0731	0.2567	-75.11 %
Managed Mom	0.1991	0.7166	-39.94 %

Key Insights:

- **Market Portfolio (Success):** Volatility management continues to work for the market portfolio.
  - **Risk-Adjusted Return:** SR increases from **0.3647 to 0.4219 p.a.**
  - **Downside Protection:** improving Max Drawdown from **-84.73% to -60.14%**
- **Momentum Portfolio (Major Success):** The D=17 strategy is extremely effective for the Momentum factor
  - **Risk-Adjusted Return:** SR **nearly triples**, jumping from 0.2567 to a very high 0.7166
  - **Downside Protection: almost halving** the Max Drawdown from -75.11% to -39.94%

Part II

Volatility-managed portfolios generate significant alpha for both market and momentum

Alpha relative to the market and to original portfolio respectively:

- Standard errors and p-values are adjusted using Newey-West (lag = 6)

On market	Alpha (%)	t value	p-value
Original Market	0	n/a	n/a
Managed Market	4.24	2.64	0.01 **
Original Mom	5.95	6.03	0.00 ***
Managed Mom	9.35	7.57	0.00 ***

On orig. portfolio	Alpha (%)	t value	p-value
Original Market	0	n/a	n/a
Managed Market	4.24	2.64	0.01 **
Original Mom	0	n/a	n/a
Managed Mom	7.4	6.65	0.00 ***

Key Insights:

- **Managed Market (Success):** The D=17 strategy works for the market.
  - The managed portfolio generates a **statistically significant alpha of 4.24% (p = 0.01)** relative to the original, unmanaged market. This confirms the strategy itself is adding value.
- **Managed Momentum (Success):** The strategy is also highly successful for the momentum factor.
  - The bottom table shows the key result: the "Managed Momentum" portfolio generates a massive, **statistically significant alpha of 7.40% (p < 0.001)** relative to the "Original Momentum" portfolio.
  - This proves the management process itself adds substantial, statistically significant value on top of the existing momentum strategy.

This specific (D=17) volatility scaling rule proved highly effective, clearly improving Sharpe ratios, reducing maximum drawdowns, and generating significant, positive alpha for both the market and the momentum factor