Factor Investing

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To: Dynamic Asset Strategies Investment Committee
Subject: Evaluation of Volatility Timing for the U.S. Profitability (RMW) Factor

This memorandum presents the results of an empirical study evaluating whether volatility targeting can enhance the performance of the firm's existing factor-based strategies. The analysis focuses on the U.S. profitability factor (RMW) and examines the long/short and the long-only profitability portfolios which are included in the dataset provided. Using daily and monthly data, a volatility-timed strategy is constructed. The performance of the strategy is assessed relative to the unmanaged factor. The methodology is then extended to long-only portfolios in order to evaluate the potential benefits of combining the managed and unmanaged strategies in a two-asset allocation framework. The analysis also includes the consequences of volatility targeting for turnover, drawdowns, skewness, kurtosis, and overall factor exposures, all of which have practical implications for the feasibility of deploying such a strategy in production. Finally, the memo evaluates whether combining the unmanaged RMW factor with its volatility-targeted counterpart through mean-variance optimization produces superior outcomes relative to holding either strategy individually.

Volatility Timing the Long/Short USA Profitability Factor

For the volatility-timing rule, we first set a target level of risk for the strategy. We define the target volatility, σ_{target}, as the full-sample annualized volatility of the unmanaged RMW long/short factor. Using the complete monthly history of the RMW premium, we compute the standard deviation of its monthly returns and then annualize this value by multiplying by $\sqrt{12}$. This annualized volatility represents the typical risk of the original factor over the sample period and matches the constant volatility level of our volatility-timed strategy.

To generate the time-series of volatility-timing weights, we combine the target volatility with our monthly volatility estimates which we derive from the given daily data. For each month t, we use the daily RMW returns to compute a rolling volatility estimate, which serves as our forecast of next month's risk. We then calculate the weight w_t as the ratio of the target volatility to this estimated volatility.

$$w_{i,t} = \frac{\sigma_{\text{target}}}{\hat{\sigma}_{i,t}}$$

This produces a full sequence of monthly portfolio weights that adjusts the RMW position according to changes in its risk.

For the long/short U.S. Profitability factor, we evaluate performance for both the unmanaged portfolio (based on the RMW premium series) and the RMW Managed Portfolio (based on the RMW VT Strategy return series generated using the RMW VT Weights). Using the full sample of monthly returns, we compute the mean monthly return and annualize it, as well as the annualized volatility, Sharpe ratio, skewness, kurtosis and maximum drawdown.
The unmanaged RMW portfolio delivers a mean annualized return of 3.25% with an annualized volatility of 7.71%, which implies a Sharpe ratio of 0.421.
The volatility-timed RMW strategy, constructed to have the same overall volatility of 7.71%, increases the mean annualized return to 3.55% and the Sharpe ratio to 0.461. The strategy reduces the maximum drawdown slightly from 41.8% to 37.1%, which we measure as the largest peak-to-trough loss in the cumulative wealth series over the sample period. A negative skew and a decline in kurtosis indicates a reduction in extreme tail outcomes. Finally, we measure RMW VT Turnover as the average absolute change in the RMW VT Weight, which yields an annualized turnover of approximately 1.21 (121% of notional per year), which indicates that the improved risk-adjusted performance is achieved at the cost of relatively high trading activity.

Our results are summarized in the table below:

Metrics	**Unmanaged Portfolio**	**RMW Managed Portfolio**
Mean Annualized Return	3.2454	3.5506
Annualized Volatility	7.7111	7.7111
Sharpe Ratio	0.4209	0.4605
Skew	-0.3144	-0.3520
Kurtosis	11.1734	3.5720
Max Drawdown	41.7752	37.0787
Turnover	–	1.2134

Table 1: Performance analysis of unmanaged and volatility-managed RMW portfolios.

Relative to the unmanaged RMW factor, the volatility-timed strategy delivers a higher risk-adjusted return at the same overall volatility. Both portfolios have an annualized volatility of 7.71%, but the mean annualized return increases from 3.25% for the unmanaged portfolio to 3.55% for the RMW Managed Portfolio, raising the Sharpe ratio from 0.421 to 0.461. The risk profile also improves. Maximum drawdown falls from roughly 41.8% to 37.1%, and kurtosis drops sharply from 11.17 to 3.57, indicating a substantial reduction in extreme tail outcomes, even though skew remains modestly negative in both cases. The main cost of this improvement is turnover: the managed strategy requires an average annualized turnover of about 1.21 times the portfolio notional, which implies higher trading activity than the passive factor.

Volatility Timing the Long-Only USA Profitability Portfolios

Having evaluated the volatility-timed strategy for the long/short RMW factor, we now extend the analysis to the long-only profitability portfolios included in the dataset. Unlike the long/short factor, these portfolios hold only long positions. We therefore construct volatility-managed versions of each long-only portfolio and assess their performance alongside their unmanaged counterparts.

1. *SMALL LoOP*

We begin with the SMALL LoOP portfolio, which represents firms in the smallest size group with low operating profitability. We construct a volatility-managed version of the portfolio using the same framework applied in the long/short case and compare how volatility scaling affects its performance and risk profile. Our results are summarized in the table below:

Metrics	**Unmanaged Portfolio**	**SMALL LoOP Managed Portfolio**
Mean Annualized Return	11.5564	10.0557
Annualized Volatility	22.8586	22.8586
Sharpe Ratio	0.5056	0.4399
Skew	-0.2174	-0.8656
Kurtosis	2.0880	6.5800
Max Drawdown	61.8939	70.8366
Turnover	–	1.3279

Table 2: Performance analysis of unmanaged and volatility-managed SMALL LoOP portfolio.

For the SMALL LoOP portfolio, volatility timing does not improve performance. The managed portfolio is constructed to match the unmanaged portfolio's annualized volatility (22.86%), but its mean annualized return falls from 11.56% to 10.06%, which lowers the Sharpe ratio from 0.506 to 0.440. The risk profile also deteriorates: skew becomes more negative (from –0.22 to –0.87), kurtosis rises markedly (from 2.09 to 6.58), and maximum drawdown increases from 61.9% to 70.8%.

2. *ME1 OP2*

The ME1 OP2 portfolio represents mid-sized firms with medium levels of operating profitability. We apply the same volatility-timing framework used previously and scale monthly exposure according to the portfolio's estimated volatility:

Metrics	**Unmanaged Portfolio**	**ME1 OP2 Managed Portfolio**
Mean Annualized Return	14.5724	12.9183
Annualized Volatility	18.6963	18.6963
Sharpe Ratio	0.7794	0.6910
Skew	-0.4524	-0.9207
Kurtosis	2.3964	5.7352
Max Drawdown	54.2287	66.0809
Turnover	–	1.2387

Table 3: Performance analysis of unmanaged and volatility-managed ME1 OP2 portfolio.

For ME1 OP2, the volatility-timed strategy again underperforms the buy-and-hold portfolio on a risk-adjusted basis. Both portfolios are held at the same annualized volatility of 18.70%, but the mean annualized return falls from 14.57% for the unmanaged portfolio to 12.92% for the managed version, whereas the Sharpe ratio is reduced from 0.779 to 0.691. The managed portfolio also exhibits more negative skew

(–0.92 vs –0.45), substantially higher kurtosis (5.74 vs 2.40) and a deeper maximum drawdown (66.1% vs 54.2%), despite requiring annualized turnover of about 1.24 times notional.

3. *SMALL HiOP*

   The SMALL HiOP portfolio is composed of small-cap firms with high operating profitability. We apply the same volatility-timing procedure as before, adjusting the portfolio's monthly weight in line with its estimated volatility. We are therefore able to assess whether volatility management adds value for a concentrated, high-profitability small-cap portfolio, both in terms of risk-adjusted return and downside risk:

Metrics	**Unmanaged Portfolio**	**SMALL HiOP Managed Portfolio**
Mean Annualized Return	15.2397	13.0472
Annualized Volatility	21.2878	21.2878
Sharpe Ratio	0.7159	0.6129
Skew	-0.4695	-0.9964
Kurtosis	2.8882	5.6161
Max Drawdown	61.9665	72.8645
Turnover	–	1.2844

Table 4: Performance analysis of unmanaged and volatility-managed SMALL HiOP portfolio.

   For SMALL HiOP, the managed portfolio performs worse than the buy-and-hold version. At the same annualized volatility (21.29%), the mean annualized return falls from 15.24% to 13.05%, and the Sharpe ratio drops from 0.716 to 0.613. Skew becomes more negative, kurtosis increases, and max drawdown rises from 62.0% to 72.9%, with annualized turnover around 1.28.

4. *BIG LoOP*

   The BIG LoOP portfolio holds large-cap firms with low operating profitability. This segment tends to be less volatile than the small-cap portfolios but offers lower expected returns, making it a good test case for whether volatility timing can still add value when baseline risk is more moderate. Its performance is summarized as shown below:

   For BIG LoOP, the volatility-timed strategy slightly underperforms the buy-and-hold portfolio on a risk-adjusted basis. Setting the volatility at 17.89% for both portfolios, the mean annualized return declines from 9.63% to 9.36%, and the Sharpe ratio decreases from 0.538 to 0.523. Skewness and kurtosis remain constant, yet the managed portfolio offers notable downside protection by reducing maximum drawdown from 72.3% to 57.5%, with an annualized turnover of around 1.32.

5. *ME2 OP2*

   The ME2 OP2 portfolio consists of mid- to large-cap stocks with intermediate operating profitability. It lies between the more extreme small and large profitability

Metrics	Unmanaged Portfolio	BIG LoOP Managed Portfolio
Mean Annualized Return	9.6265	9.3633
Annualized Volatility	17.8931	17.8931
Sharpe Ratio	0.5380	0.5233
Skew	-0.5117	-0.5063
Kurtosis	1.8169	1.8177
Max Drawdown	72.3487	57.5450
Turnover	–	1.3152

Table 5: Performance analysis of unmanaged and volatility-managed BIG LoOP portfolio.

buckets and therefore offers a more diversified risk profile. We again implement the volatility-timing rule to scale the portfolio's exposure month by month, and then compare the managed series with the unmanaged ones in terms of return, risk, and drawdown behaviour:

Metrics	Unmanaged Portfolio	ME2 OP2 Managed Portfolio
Mean Annualized Return	10.9227	10.1382
Annualized Volatility	15.1903	15.1903
Sharpe Ratio	0.7191	0.6674
Skew	-0.3720	-0.4151
Kurtosis	1.6322	1.3092
Max Drawdown	55.7850	44.6937
Turnover	–	1.3329

Table 6: Performance analysis of unmanaged and volatility-managed ME2 OP2 portfolio.

In ME2 OP2, the managed strategy yields inferior risk-adjusted returns compared to the unmanaged benchmark. It maintains the same annualized volatility (15.19%) and the mean annualized return decreases from 10.92% to 10.14%, causing the Sharpe ratio to fall from 0.719 to 0.667. Although the strategy exhibits slightly more negative skewness, it lowers kurtosis and reduces the maximum drawdown from 55.8% to 44.7%, with an annualized turnover of 1.33.

6. *BIG HiOP*

The BIG HiOP portfolio contains large firms with high operating profitability. As this portfolio already exhibits relatively balanced risk characteristics, it offers a useful benchmark for assessing whether volatility targeting adds value in the portfolio's construction:

The managed portfolio yields slightly inferior risk-adjusted returns compared to the buy-and-hold benchmark. Annualized volatility is fixed at 15.21%, the mean annualized return falls from 12.43% to 12.07% and the Sharpe ratio is reduced from 0.818 to 0.794. While skewness remains relatively stable, the strategy lowers kurtosis and improves the maximum drawdown from 47.7% to 42.8%, with annualized turnover around 1.30.

Volatility timing appears to work best for the long/short RMW factor, rather than

Metrics	Unmanaged Portfolio	BIG HiOP Managed Portfolio
Mean Annualized Return	12.4343	12.0718
Annualized Volatility	15.2083	15.2083
Sharpe Ratio	0.8176	0.7938
Skew	-0.3847	-0.3664
Kurtosis	1.5501	1.1452
Max Drawdown	47.7389	42.7787
Turnover	–	1.3003

Table 7: Performance analysis of unmanaged and volatility-managed BIG HiOP portfolio.

for the long-only portfolios.

For the long/short RMW premium, scaling exposure by volatility increases the Sharpe ratio and modestly improves drawdowns while keeping overall volatility unchanged. The combined long–short position is scaled either up or down, so the strategy remains fully invested in the factor and volatility timing mainly adjusts the size of the factor exposure over time.

For the long-only portfolios, the mechanism is different. When the weight w_t is below 1, we invest the remaining $1 - w_t$ in the risk-free asset; when w_t is above 1, we borrow $w_t - 1$ at the risk-free rate to lever the portfolio. In practice, this may result in holding a smaller equity position in high-volatility periods and spending more time in cash, which reduces the realized equity premium. As a result, the managed long-only portfolios typically show lower average returns and lower Sharpe ratios than their buy-and-hold counterparts, despite matching volatility and in some cases achieving slightly better drawdown outcomes.

Optimal Combination

Before combining the two strategies, we first evaluated them on a standalone basis. The unmanaged long/short RMW factor delivers an average monthly return of 0.27%, which corresponds to an expected annualized return of 3.25% and an annualized Sharpe ratio of 0.421. The volatility-timed RMW strategy has a slightly higher average monthly return of 0.30%, giving an expected annualized return of 3.55% and an annualized Sharpe ratio of 0.461, at the same annualized volatility by construction. Using the full monthly sample, we then estimated the joint risk of the two strategies. The monthly covariance matrix of unmanaged and managed returns is:

$$\Sigma = \begin{pmatrix} 4.955 & 4.301 \\ 4.301 & 4.955 \end{pmatrix}$$

Where the diagonal terms are the monthly variances of the unmanaged and managed RMW series, and the off-diagonal term is their covariance. These inputs are used in the mean–variance optimization to find the optimal mix of unmanaged and managed exposure.

We then set up a portfolio that invests weight w in the unmanaged factor and $1 - w$ in the managed strategy and calculated the portfolio's expected return, variance

and Sharpe ratio as functions of w. Using a standard mean–variance optimization framework, we evaluated multiple possible weight combinations in the two strategies to find the allocation that delivers the highest Sharpe ratio under the constraint that the weights sum to one. The optimization selected approximately 18.2% in the unmanaged factor and 81.8% in the managed strategy. At these weights, the combined portfolio has an expected annualized return of about 3.50%, an annualized volatility of roughly 7.6%, a monthly Sharpe ratio of 0.134 and an annualized Sharpe ratio of 0.462. This compares with an annualized return of 3.25% and Sharpe ratio 0.421 for a 100% unmanaged allocation, and 3.55% and 0.461 for a 100% managed allocation. The combined portfolio achieves a slightly higher Sharpe ratio than either the pure unmanaged or pure managed strategy. It can therefore be concluded that holding both exposures together is more efficient than relying on a single strategy.

Recommendation & Practical Considerations

Based on the analysis, we conclude that volatility timing can modestly add value for the long/short RMW factor, but not for the long-only profitability portfolios.

For the long/short RMW premium, the volatility-timed strategy achieves the same overall volatility as the unmanaged factor, while delivering a higher Sharpe ratio and slightly smaller drawdowns. The mean–variance optimization suggests that the best risk–return trade-off is achieved with a portfolio that invests both in the volatility-timed RMW strategy and in the unmanaged factor, rather than holding the unmanaged factor on its own. For this factor, therefore, volatility-timing appears justified, and we recommend that the firm implements this strategy, provided that sensible limits on how much we lever the position and how much we trade are also set.

For the long-only portfolios, volatility timing does not improve risk-adjusted performance. The managed versions match the volatility of their buy-and-hold benchmarks but generally earn lower average returns and lower Sharpe ratios, and they require high levels of turnover while offering limited improvement in drawdowns or tail behaviour. A main constraint in the long-only setting is that whenever the volatility-timing weight falls below 100%, some of the capital is moved from equities into risk-free assets (e.g. short-term Treasury bills). This means the portfolio spends less time invested in stocks and more time in cash, so it captures less of the equity premium that normally drives returns in these long-only strategies. Conversely, if the weight exceeds 100%,the position is financed by borrowing at the risk-free rate.

Our recommendation is that the firm adopts volatility timing, potentially in combination with the unmanaged factor as indicated by the mean–variance results, but does not extend the same approach to the long-only profitability portfolios. Any implementation should also incorporate realistic assumptions about trading costs and leverage limits, as these will materially affect the net benefit of the strategy.

In this strategy, leverage appears in two places: inside the managed RMW leg (when the volatility-timing weight $w_t > 1$) and at the overall portfolio level (when the MVO solution allocates about 80% to the managed leg). When $w_t > 1$, the factor position is larger than the available capital and the difference is financed by borrowing at the

risk-free rate. If, at the same time, most of the portfolio is allocated to this managed leg, the effective exposure to the RMW factor can be well above 100% of capital. In practice, this may conflict with the firm's internal risk limits or regulatory constraints on leverage. An implementable version of the strategy would therefore need explicit caps on the maximum volatility-timing weight (for example, not allowing w_t to exceed a set multiple such as 1.5×) and on the maximum allocation to the managed strategy, so that total factor exposure remains within agreed limits.

The strategy also generates high and persistent turnover. The volatility-timed RMW portfolio changes its weight every month as the volatility estimate moves, and the combined portfolio must be rebalanced regularly to maintain the chosen split between unmanaged and managed RMW. In our results, the managed leg alone shows average annualized turnover above 100% of notional, meaning that, on average, an amount similar to the full portfolio value is traded each month. In a real portfolio, this implies frequent trades in the underlying stocks used to build the RMW factor, each trade incurring bid–ask spreads, commissions and possibly market impact. These costs directly reduce realised returns, and with this level of turnover they can meaningfully lower the effective Sharpe ratio relative to the backtest. Any implementation would therefore need realistic assumptions on trading costs and, if needed, a rule to slow down rebalancing when changes in the volatility estimate are small.