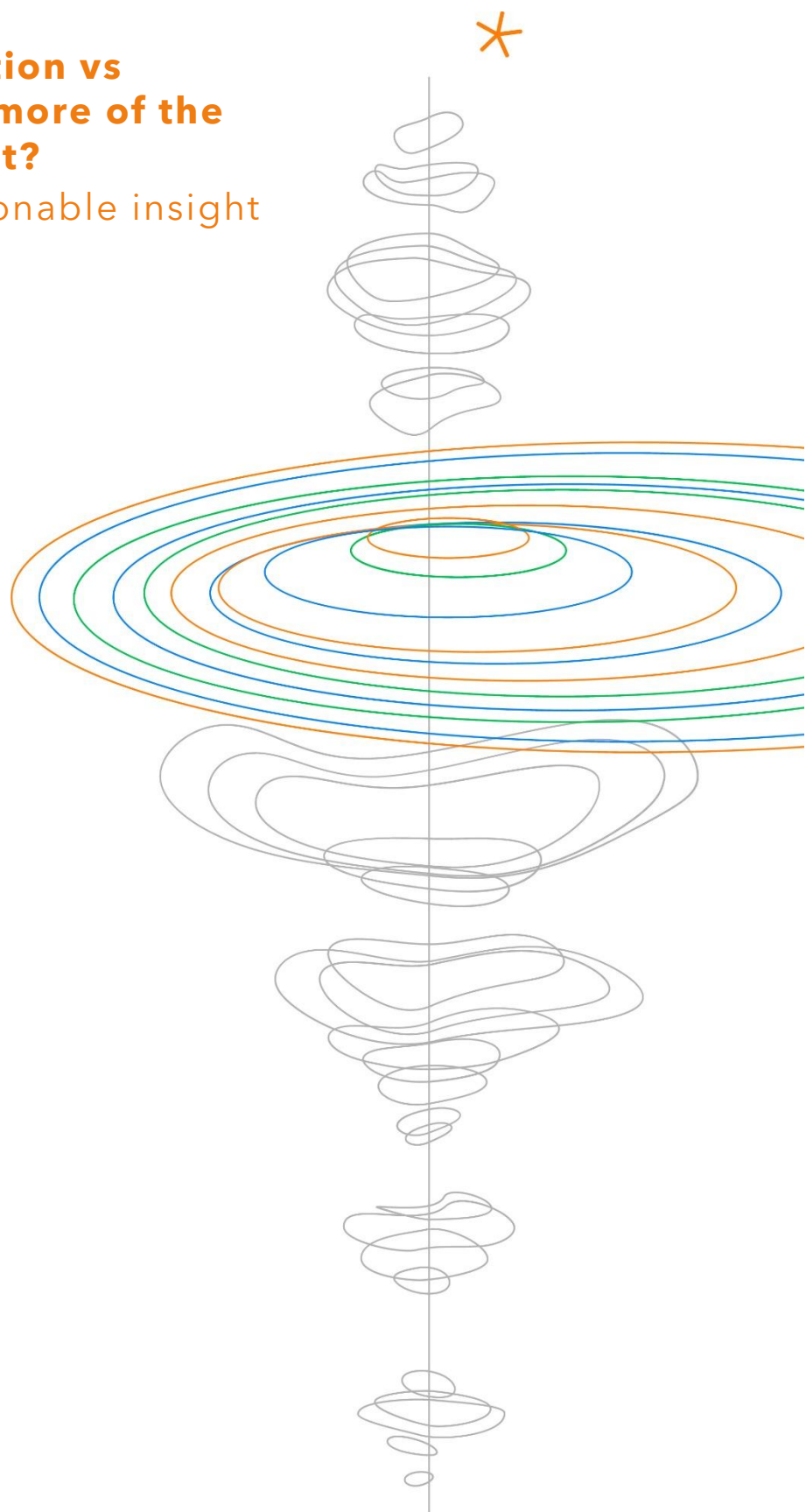


Maximum Diversification vs Minimum Volatility - more of the same or truly different?

Original research, actionable insight



November 2022

For Professional Investors

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A note from the Research desk...

After mounting evidence of the risks involved in investing in a concentrated, inefficient, biased, and poorly constructed market capitalization weighted index, investors are (yet again) increasingly turning towards the alternative weighting schemes also known as the “Smart Beta” strategies. These alternative weighting schemes are seen by investors as alternatives that are expected to offer better return, or risk adjusted return over the long term when compared to cap-weighted indices.

Investors who anticipate that markets are close to or have already reached an inflection point, tend to look for strategies that are well-known for their risk reducing properties. As such, we often hear the question asking to what extent - ‘Maximum Diversification’ and ‘Minimum Volatility’ are different.

Based on diversification metrics of the market, there never was a better time to change from a market-cap weighted portfolio to a truly diversified one. So, looking at different options, it might be worthwhile making the distinction between ‘Maximum Diversification’ and ‘Minimum Volatility’ the subject of this dashboard.

In what follows, we attempt to highlight **the difference between ‘Maximum Diversification’ and ‘Minimum Volatility’ portfolio optimization approaches in terms of their construction methodology and the implications of these construction choices in their risk-return performance profiles.** We notably highlight:

- how both portfolios achieve better diversification and risk-adjusted returns over the cap-weighted index in the long run
- how ‘Maximum Diversification’, with its pure focus on diversification, achieves better diversification and risk-adjusted returns over the cap-weighted index in an unbiased way
- how ‘Minimum Volatility’ takes on bets on ‘Low Volatility’ stocks in order to achieve risk reduction, and some not-so-obvious empirical consequences of these bets

In section 1, we discuss the differences in portfolio construction methodology of Maximum Diversification® and Minimum Volatility approaches with an easy-to-understand example. Section 2 shows several empirical results that differentiate the Minimum Volatility from the Maximum Diversification approach because of the differences in the two portfolio construction techniques. We discuss the consequences of the low volatility bias of a Minimum Volatility approach in terms of its conditional performance in various market environments, interest rate risk and time-varying exposure to the other risk factors. Finally, we conclude by summarizing the benefits of taking an unbiased approach to build a better diversified and more efficient portfolio compared to the market capitalization weighted portfolio.

We aspire that this dashboard helps investors to understand both strategies better and make educated investment decisions in this precarious market environment.

We hope you enjoy reading this note as much as we enjoyed writing it!

Tatjana & Siva

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out-of-the-box thinking

noun. Thinking that moves away from established convention to incorporate alternative perspectives and which sometimes leads to novel ideas and solutions.

I. Differences in Portfolio Construction

Key take-aways of this section

- Despite the fact that the Maximum Diversification Portfolio (MDP) and the Minimum Volatility Portfolio (MVP) are both based on optimization processes, the objective functions of these optimizations are different.
- The MVP purely minimizes volatility. While this currently results in a higher diversification than the benchmark, it also makes it biased toward low vol stocks, which means that the MVP can be very little diversified.
- The MDP maximizes Diversification Ratio®(DR) and hence is not exposed to any concentration risks, including concentration in low vol stocks. The volatility reduction is a by-product of the diversification effect.

In this section, we review the fundamental differences in the portfolio construction approaches for Maximum Diversification® and Minimum Volatility portfolios (MDP and MVP). Both portfolios are based on quantitative optimization process, but the objective functions of the optimization problem are different. The weights of MDP are obtained by maximizing the Diversification Ratio®(DR), where DR is defined as the ratio of weighted average volatility of the holdings to the volatility of the portfolio.

$$DR(w) = \frac{\sum_{i=1}^N w_i * \sigma_i}{\sqrt{\sum_{i=1}^N \sum_{j=1}^N w_i * \sigma_i * \rho_{i,j} * w_j * \sigma_j}}$$

The weights of the Minimum Volatility portfolio are obtained by minimizing the variance (or volatility) of the portfolio.

$$Var(w) = \sum_{i=1}^N \sum_{j=1}^N w_i * \sigma_i * \rho_{i,j} * w_j * \sigma_j$$

If we notice the formula for DR, the volatility terms in the numerator are countered by the volatility terms in the denominator and the portfolio weights are inversely related to the correlations amongst the stocks. However, the weights of MVP are inversely related to the volatilities of the stocks as well as the correlations amongst the stocks. Thus, MVP, by construction, has a bias towards low volatility stocks. The following simple three-stock hypothetical portfolios illustrate the above. In Figure 1, we have three hypothetical stocks - A, B and C with similar volatilities and Stocks A and B are lowly correlated whereas Stock C is highly correlated to the other stocks. In this case, because all the stocks have the same volatility, both MDP and MVP pick the lowly correlated stocks A and B. The resulting portfolios of MDP and MVP are one and the same.

Figure 1: Minimizing Volatility vs Maximizing Diversification - Case A - When stocks have same volatility

PANEL A: Portfolio Weights

| | Volatility | Correlation | | | Average Cross Correlation | AB Weights | MV Weights |
|----------------|------------|-------------|---------|---------|---------------------------|------------|------------|
| | | Stock A | Stock B | Stock C | | | |
| Stock A | 20% | 100% | 25% | 75% | 50% | 50% | 50% |
| Stock B | 20% | 25% | 100% | 75% | 50% | 50% | 50% |
| Stock C | 20% | 75% | 75% | 100% | 75% | 0% | 0% |

PANEL B: Portfolio Volatility and DR²

| | AB | MV |
|---------------------------------|-------|-------|
| Portfolio Volatility | 15.8% | 15.8% |
| Portfolio DR² | 1.60 | 1.60 |

Source: TOBAM. AB refers to Anti-Benchmark®

In Figure 2, we introduce a small change by reducing the volatility of the highly correlated stock C significantly. The MDP still picks the two lowly correlated stocks A and B whereas the MVP, on the other hand, picks the least volatile stock (C) even when it is highly correlated to the 2 other ones (A & B). The resulting portfolios have similar volatility, but the MDP is much better diversified than the MVP.

Figure 2: Minimizing Volatility vs Maximizing Diversification - Case A - When stocks have different volatility

PANEL A: Portfolio Weights

| | Volatility | Correlation | | | Average Cross Correlation | AB Weights | MV Weights |
|----------------|------------|-------------|---------|---------|---------------------------|------------|------------|
| | | Stock A | Stock B | Stock C | | | |
| Stock A | 20% | 100% | 25% | 75% | 50% | 50% | 0% |
| Stock B | 20% | 25% | 100% | 75% | 50% | 50% | 0% |
| Stock C | 15% | 75% | 75% | 100% | 75% | 0% | 100% |

PANEL B: Portfolio Volatility and DR²

| | AB | MV |
|---------------------------------|-------|-------|
| Portfolio Volatility | 15.8% | 15.0% |
| Portfolio DR² | 1.60 | 1.00 |

Source: TOBAM.

To summarize, given the nature of the objective function of the portfolio optimization process, the Minimum Volatility portfolio by construction exhibits significant bias towards less volatile stocks. The Maximum Diversification® portfolio picks its holdings purely based on correlations and as such it is the most diversified long-only portfolio. Given that the holdings of MDP are as lowly correlated as possible, MDP, by construction, is unbiased to any specific bet including low volatility bet.

How do these (theoretical) differences between the two portfolio optimization methods shine through in real data? To answer this question, we provide in the next section empirical evidence highlighting the consequences of the low volatility bet of Minimum volatility and compare this with the unbiased MDP.

II. Empirical characteristics - Minimum Volatility vs. MDP

Key take-aways of this section

- The MVP has a significant low volatility bias.
- As a consequence, it suffers more in market rebounds than the MDP and exhibits lower risk adjusted long-term returns despite having a similar level of volatility and drawdown reduction.

In the previous section, it became clear that the MVP has a bias towards low volatility stocks. The MDP on the other hand invests in lowly correlated stocks, which are, by definition, as different to one another as possible, thereby resulting in a well-diversified unbiased portfolio. How do these differences show up in the historical behavior of the MVP and MDP? Note that in this section and throughout the rest of the dashboard, we use the MSCI USA Minimum Volatility Index and the Anti-Benchmark® USA portfolio as investible proxies for the Minimum Volatility and the Maximum Diversification strategies. We use long-term data going back to 1998, or to the earliest possible timeframe, from which we can obtain the necessary data to compute the analytics in order to avoid a sample bias.¹

The Low Volatility Bias of Minimum Volatility

Figure 3 illustrates the weight distributions of the Anti-Benchmark® USA and the MSCI Minimum Volatility portfolios across various volatility and correlation buckets as of September 2022. The vertical axis represents the exposure in terms of weight, the z-axis groups stocks according to their average correlation and the x-axis groups stocks according to their volatility.

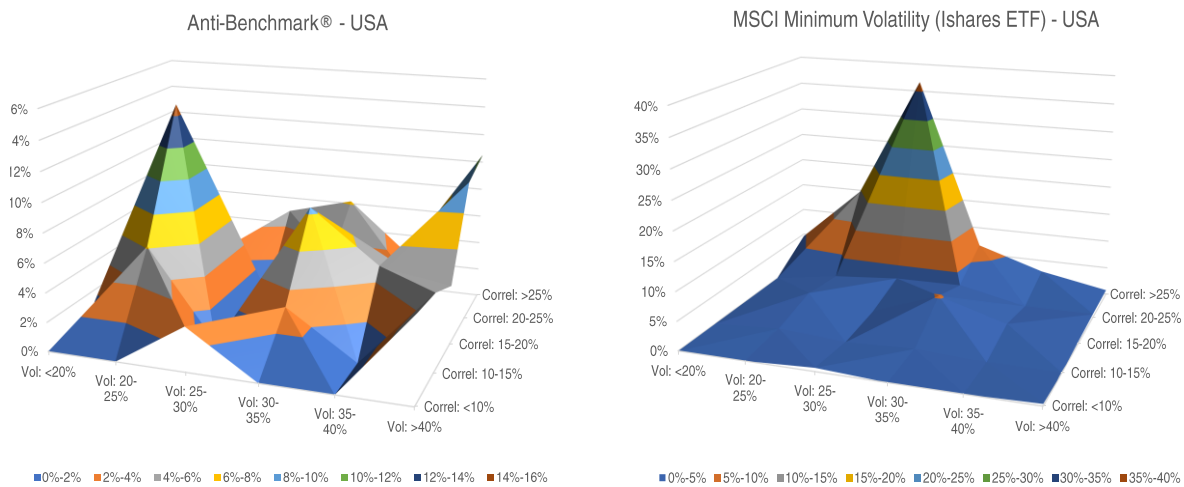
The figure highlights that the MVP invests a significant portion of its stocks in the low volatility buckets.

The MDP on the other hand has a balanced distribution across different volatility buckets while investing predominantly in lowly correlated diversifying stocks. Hence, Figure 3 provides empirical evidence for the Minimum Volatility portfolios' bias towards low volatility stocks. Moreover, it is worth noting that many commercial implementations of minimum volatility strategies exhibit a significant market capitalization bias towards the largest stocks thereby retaining the concentration risks of the traditional market cap-weighted indices. Panel B of Figure 3 provides evidence of the same for MSCI Minimum Volatility portfolio.

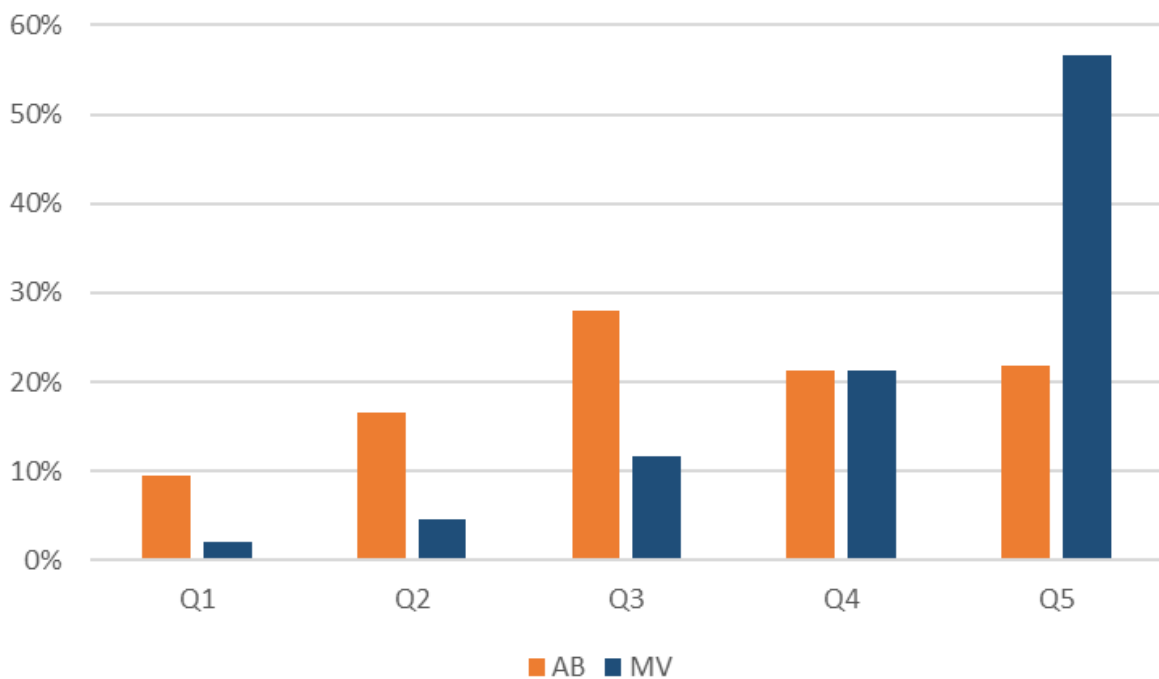
¹ It is worth noting that there are several constraints included in both the strategies (Anti-Benchmark® and MSCI Minimum Volatility), in order to construct investible portfolios, that make them different from the theoretical unconstrained portfolios. We found this important since for this exercise to be meaningful, we should compare investible portfolios. Also, there are different providers of Minimum Volatility strategies, we stuck to the one with most AuM deployed and hence the probably most well-known one. Note further that we used the holdings of the iShares MSCI USA Minimum Volatility ETF in this analysis as it is a 100% physical replication of the MSCI Minimum Volatility index.

Figure 3: Weights of holdings (as of 30-Sep-2022)

PANEL A: Based on Volatility and Correlation buckets



PANEL B: Based on Market Capitalization quintiles



Source: TOBAM, Bloomberg. Period: 30-Sep-2022. Correlations and Volatility are estimated using the past two years. iShares MSCI USA Minimum Volatility ETF holdings are used as proxy for Minimum volatility portfolio. Q1 - Lowest market capitalisation quintile and Q5 - Highest market capitalisation quintile

Long-term performance analysis

One of the main objectives of any well-diversified portfolio is to reduce portfolio volatility through well-balanced risk exposures, provide downside protection and better long-term risk adjusted returns than the market capitalization weighted index. Figure 4 summarizes the long-term performances of the market capitalization weighted benchmark, Anti-Benchmark®(AB) and MSCI Minimum Volatility strategies. Both AB and MSCI Minimum Volatility strategies reduce risk and suffer lower drawdowns than the benchmark. The magnitude of risk reduction and maximum drawdowns over the horizon

under observation are very similar for both strategies. However, given the low volatility bias, the MSCI Minimum Volatility is not as diversified as that of AB.

The consequence of this lower level of diversification of the MVP is that it is unable to capture as much of the long-term equity risk premium as it is the case for the MDP, as evidenced by the lower Diversification Ratio® and risk adjusted returns. It is worth highlighting again that the Minimum Volatility portfolio achieves risk reduction through its direct objective of minimizing volatility by investing in low volatility stocks whereas the MDP achieves similar risk reduction as a by-product by focusing primarily on diversification, i.e., trying to capture returns as widely as possible and being as unbiased as possible.

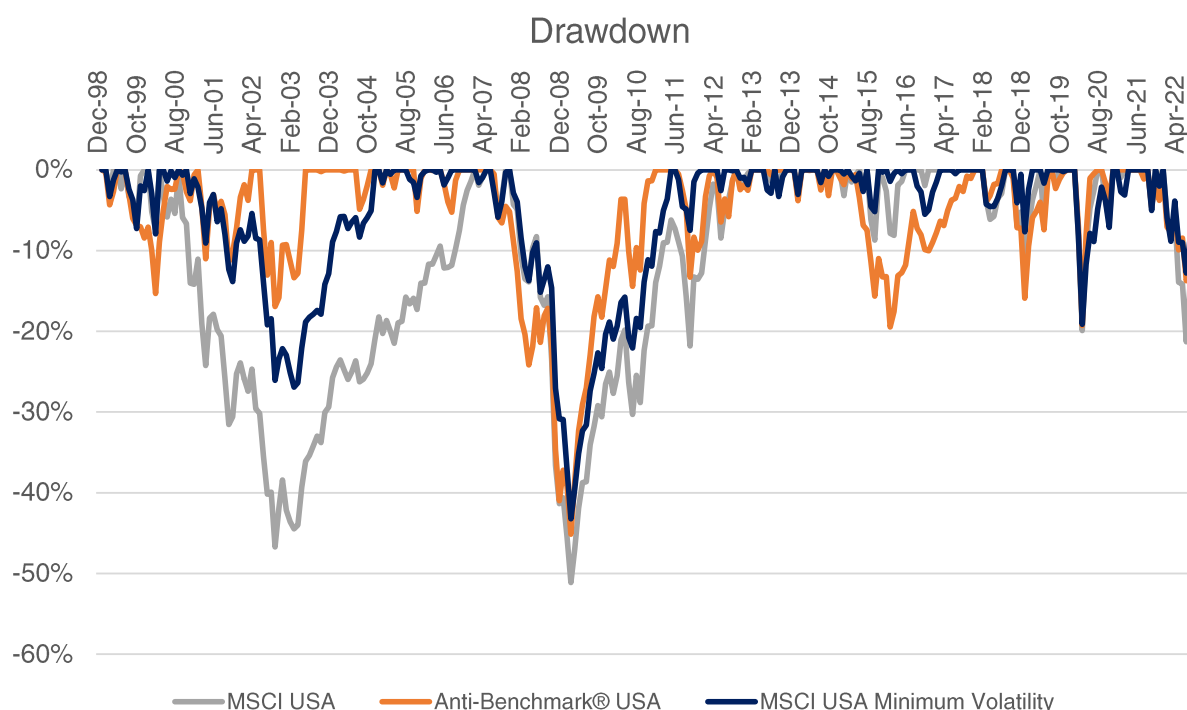
Figure 4: Minimizing Volatility vs Maximizing Diversification - Long Term Risk and Returns (December 1998- September 2022)

| | Benchmark | Anti-Benchmark® | MSCI Minimum Volatility |
|---|-----------|-----------------|-------------------------|
| Annualized Returns | 5.88% | 8.83% | 6.63% |
| Volatility | 20.02% | 16.29% | 16.34% |
| Return/Risk | 0.29 | 0.54 | 0.41 |
| Diversification Ratio (DR²) * | 2.58 | 6.66 | 3.86 |
| Maximum Drawdown | 55.36% | 49.46% | 48.63% |

Source: TOBAM, Bloomberg. Period: 31-Dec-1998 to 30-Sep-2022. MSCI USA Minimum Volatility Net Total Return Index is used as an investible proxy for Minimum Volatility Strategy. MSCI USA Net Total Return Index is used as the market benchmark. * DR² is computed as of 30-Sep-2022 using the data over the last two years. To compute the DR² of Minimum Volatility, the holding data of iShares MSCI USA Minimum Volatility ETF is used.

Figure 5 compares the historical drawdowns of the three strategies (benchmark, AB, and Minimum Volatility). Both the AB and the Minimum Volatility strategies suffer from lower drawdowns and faster recoveries during the market crisis periods compared to the cap-weighted benchmark index and the drawdowns of both strategies are of similar magnitude.

Figure 5: Drawdown of Defensive Strategies vs Cap-Weighted Benchmark (December 1998 - September 2022)



Source: TOBAM, Bloomberg. Period: 31-Dec-1998 to 30-Sep-2022. MSCI USA Minimum Volatility Net Total Return Index is used as an investible proxy for Minimum Volatility Strategy. MSCI USA Net Total Return Index is used as the market benchmark.

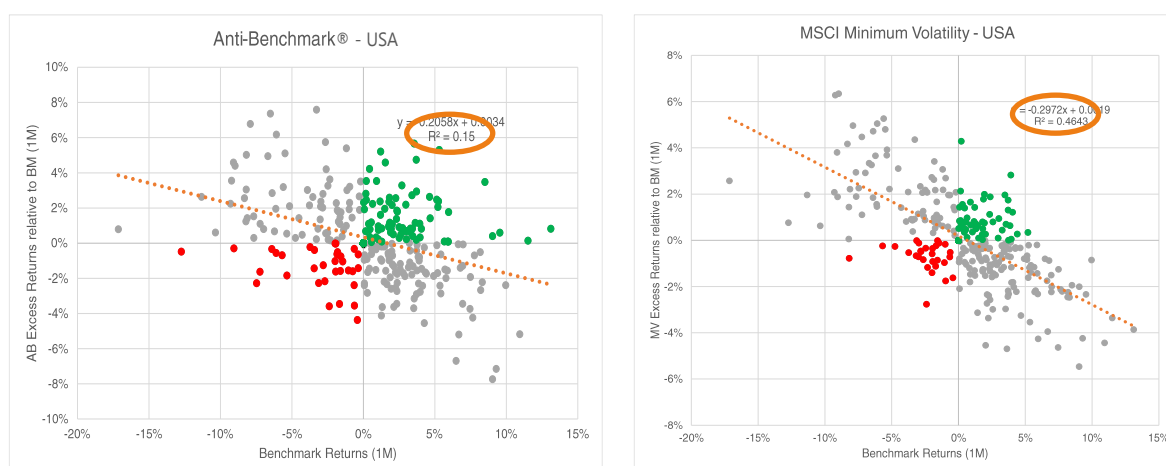
Conditional Performance Analysis

We observed in the previous subsection that both the MDP as well as the MVP provided downside protection and risk reduction of similar magnitude, whereas the MVP achieved better diversification and risk adjusted returns. This discrepancy is mainly due to the low volatility bias of the MVP. In this subsection, we try to investigate this discrepancy in more detail by assessing the performances of the two strategies conditional on the market performance. We use the cap-weighted index as a proxy for the market.

Well-diversified strategies tend to provide downside protection, i.e., to outperform the market during bear markets. However, downside protection comes at the cost of losing some of the upside, i.e., underperformance during bull markets. Particularly low volatility stocks are known to lag behind the market during bull runs, and as such, given the low volatility bias, the MVP is typically quite limited in its ability to participate in the upside of bull markets. This translates into a performance for the MVP that exhibits stronger conditionality – an inverse relationship to be precise – with regards to the cap weighted index's performance.

Figure 6 plots the monthly relative returns of the two strategies against the monthly returns of the cap-weighted benchmark. The plot can be divided into four quadrants based on whether the benchmark posted positive returns or negative returns and on whether the diversified portfolio strategy outperformed or underperformed the benchmark. If the relative performances of the strategies were unconditional on benchmark returns, the R-squared of the regression fit would be negligible. In other words, the point scatter would be completely random and more evenly distributed among all four quadrants. However, in both cases there exists some inverse relationship between the relative performance of the strategies and the benchmark returns. This inverse relationship is to be expected from diversified strategies as they are expected to outperform during bad times. **Nevertheless, the conditionality of the MVP's returns is much stronger than that of the MDP's as witnessed by the higher R-squared of 46%.**

Figure 6: Conditional performances relative to the market (December 1998 - September 2022)

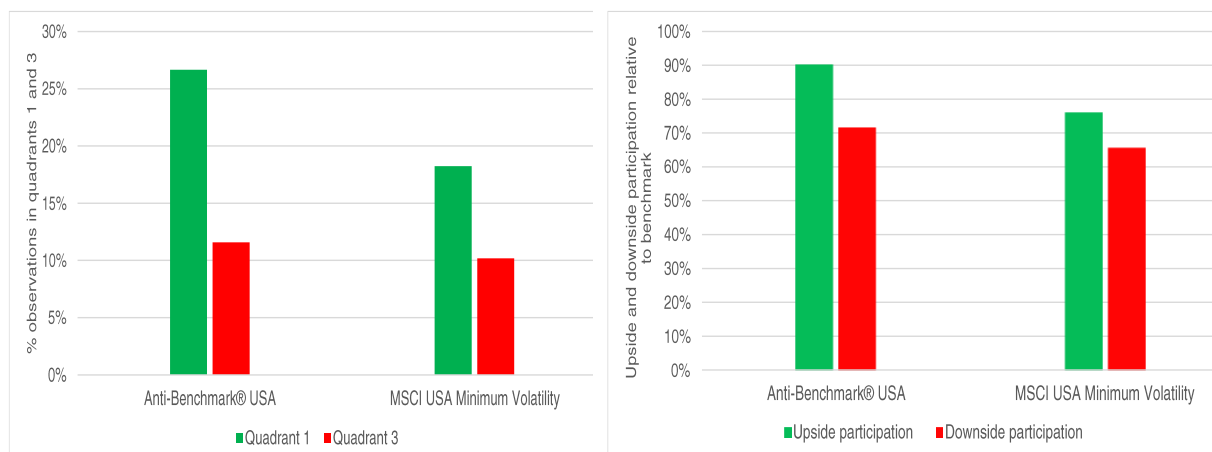


Source: TOBAM, Bloomberg. Period: 31-Dec-1998 to 30-Sep-2022. MSCI USA Minimum Volatility Net Total Return Index is used as an investible proxy for Minimum Volatility Strategy. MSCI USA Net Total Return Index is used as the market benchmark. The monthly relative returns with respect to the benchmark of both the Anti-Benchmark and Minimum Volatility strategies are plotted against the monthly returns of the benchmark.

In Figure 7, quadrant 1 (the diversified strategy outperformed when the market returns are positive) and quadrant 3 (the diversified strategy underperformed when the market returns are negative) are of particular interest. The frequency of points in quadrant 3 is roughly the same for both strategies. For roughly 10% of the months both strategies underperformed when the market returns were negative.

However, the MDP had more outperforming months (roughly 25%) when the market returns were positive than the MVP (roughly 18.5%). Thus, the MDP captures more of the upside than the MVP and thus has a better upside participation rate. The MDP has a 90% upside participation and a 71% downside participation whereas the Minimum Volatility strategy has a 76% upside and 65% downside participation rate. The reduced upside participation of the Minimum Volatility strategy is a consequence of its low volatility bias.

Figure 7: Conditional performances relative to the market (December 1998 - September 2022)



Source: TOBAM, Bloomberg. Period: 31-Dec-1998 to 30-Sep-2022. MSCI USA Minimum Volatility Net Total Return Index is used as an investible proxy for Minimum Volatility Strategy. MSCI USA Net Total Return Index is used as the market benchmark. The monthly relative returns with respect to the benchmark of both the Anti-Benchmark and Minimum Volatility strategies are plotted against the monthly returns of the benchmark. Quadrant 1 contains the monthly relative returns that are positive when the benchmark returns are positive (Bull). Quadrant 3 contains the monthly relative returns that are negative when the benchmark returns are negative (Bear). Upside participation is the ratio of the average returns of the strategy divided by the average returns of the market when the market returns are positive. Downside participation is the ratio of the average returns of the strategy divided by the average returns of the market when the market returns are negative.

Interest Rate Risk

Another question or major concern of investors is whether there is an inherently higher interest rate risk associated with defensive investing. It is well-known that defensive stocks are more rate sensitive than aggressive stocks all else equal. The economic intuition behind this is two-fold. First, companies in more defensive sectors usually have a high share of physical assets and it is easier for them to take on a relatively higher amount of leverage. This implies, however, that increasing interest rates might potentially hurt them more than other companies because it will potentially increase their cost of capital in a more important way. Another potential channel is the fact that investors might view high yielding, stable and less volatile companies as substitutes for bonds especially in a low interest rate environment, which would also be a reason for an increased interest rate sensitivity of these stocks since no more bond proxies are needed once bonds yield again a visible amount of interest.

Equity markets, in general, and defensive stocks have benefitted from a prolonged low interest rate environment and loose fiscal and monetary policies by central banks all over the world for more than a decade now. However, the staggering sovereign debts, deficits, and soaring consumer prices in recent times due to the recent Covid crises imply that the low interest rate environment may not last longer. A change in interest rate regime has already begun. Therefore, interest rate sensitivity of an equity portfolio is an important risk to look out for as an investor.

Given that an MVP by construction carries a bias towards low volatility stocks and overweighs them compared to an unbiased portfolio, it is reasonable to expect that a MVP is more rate sensitive than a MDP.

Figure 8 provides empirical evidence that indeed the MVP is more rate sensitive than the MDP. To assess the rate sensitivity, both the Anti-Benchmark® US and MSCI USA Minimum volatility strategies are regressed against the equity market benchmark, the 3-month US Treasury bill rate, the term spread,

as measured by the difference in yields between 10-year and 2-year US Treasury bonds, and the credit spread, as measured by the difference in yields between ICE BofA High Yield Index and ICE BofA AAA Index. Figure 8 summarises the results of the regressions. The MVP is twice as exposed to the term spread as the MDP. The empirical results based on historical data suggest that a 1% rise in the slope of the yield curve (10-year minus 2-year) would result in a 49 bps and 168 bps drop in the Anti-Benchmark® US and the MSCI USA Minimum volatility strategies respectively.

Moreover, the low R-squared and statistically significant unexplained returns of the Anti-Benchmark® US imply that there are more risk and return drivers to the portfolio than the broad equity and bond market factors. This is not surprising as we would expect a well-diversified unbiased portfolio to be exposed to as many independent risk factors as possible and not just a few. On the contrary, the high R-squared and insignificant unexplained portion of the historical long-term returns of the MSCI USA Minimum Volatility strategy implies that its risks and returns are well-explained by just the broad equity and bond market factors.

Figure 8: Interest Rate Sensitivity (December 1998 - September 2022)

| USA | Anti-Benchmark® | MSCI Minimum Volatility |
|--------------------------|-----------------|-------------------------|
| Unexplained (annualized) | 3.8% | 1.3% |
| Mkt-Rf | 0.77 | 0.79 |
| T-bill (Δ) | 0.96 | -0.25 |
| Term Spread (Δ) | -0.49 | -1.68 |
| R-squared | 75.9% | 88.6% |

Source: TOBAM, Bloomberg. Period: 31-Dec-1998 to 30-Sep-2022. MSCI USA Minimum Volatility Net Total Return Index is used as an investible proxy for Minimum Volatility Strategy. MSCI USA Net Total Return Index is used as the market benchmark. T-bill is the 3-month US Treasury bill rate; the term spread is measured by the difference in yields between 10-year and 2-year US Treasury bonds. The first order difference is used for bond yield factors and returns are used for equity market factor. Statistically significant coefficients are highlighted in bold fonts.

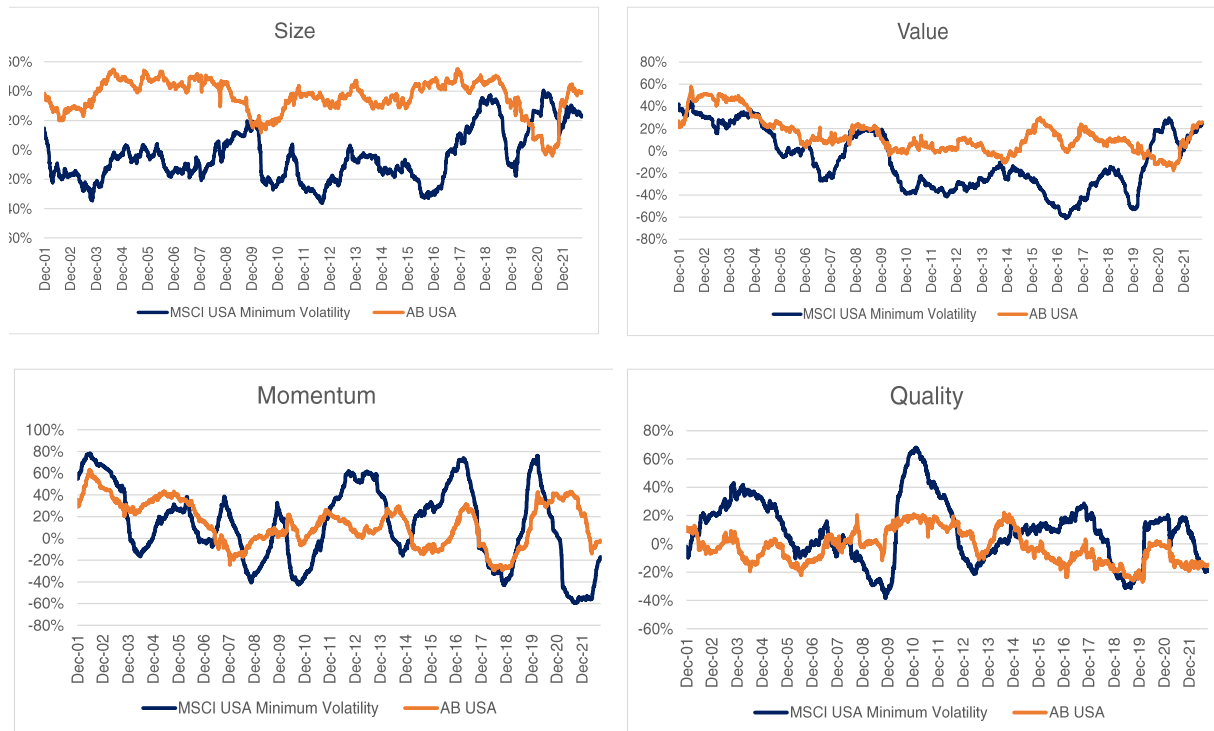
Exposure to other risk factors

A well-diversified portfolio is a portfolio that is diversified not in the number of stocks it holds but in terms of the number of independent risk factors it is exposed to. As shown in Choueifaty et al. (2013)², the MDP maximizes the number of independent effective risk factors it is exposed to. Moreover, given the unbiased nature of the portfolio, MDP has a stable and balanced exposure to all the risk factors. However, the MVP is agnostic to the balancing out of exposures to risk factors but focuses only on risk reduction. This may result in uncontrolled and uneven risk exposures of the MVP. Moreover, as the MVP is biased towards low volatility stocks, it is more sensitive to the macro shifts that apply to the low volatility stocks, and this inadvertently translates into time varying biases in risk exposures, reducing the overall portfolio diversification. Given that these biases are unpredictable, uncontrollable, and unintentional, they carry the potential of adverse effects on the risk and return of the portfolio.

Figure 9 illustrates this by plotting the exposures as measured by correlations of both Anti-Benchmark® and MSCI Minimum Volatility strategies to the well-known risk factors such as Size, Value, Momentum and Quality. As we can see, the exposures of Anti-Benchmark® portfolio is more stable across time compared to those of MSCI Minimum Volatility. The latter strategy exhibits biases with extreme variations in the range of -60% to +80% at different points in time.

² Choueifaty, Yves, Froidure, Tristan and Reynier, Julien, 2013, Properties of the Most Diversified Portfolio, Journal of Investment Strategies, 2(2), pp. 1-22.

Figure 9: Stability of exposures (correlations) to well-known factors (December 2000 - September 2022)

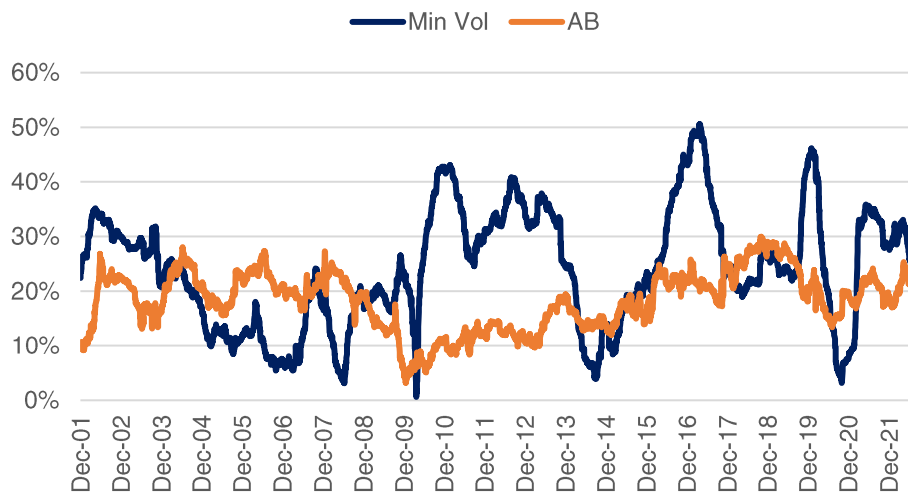


Source: TOBAM, Bloomberg. Period: 31-Dec-1998 to 30-Sep-2022. MSCI USA Minimum Volatility Net Total Return Index is used as an investible proxy for Minimum Volatility Strategy. MSCI USA Net Total Return Index is used as the market benchmark. The longest period for which data are available for all the factors is chosen for this analysis. CAPM residuals of MSCI USA Equal Weight Index, MSCI USA Enhanced Value Index, MSCI USA Momentum Index and MSCI USA Quality Index are used as proxies of Size, Value, Momentum and Quality factors respectively. One-year rolling correlations of Anti-Benchmark® USA and MSCI USA Minimum Volatility strategies to each of the four factors (Size, Value, Momentum and Quality) are plotted.

To illustrate the time variation of the exposures even better, Figure 10 exhibits the standard deviation of the exposures to the four factors – Size, Value, Momentum and Quality over time for both the both Anti-Benchmark® and MSCI Minimum Volatility strategies. The AB US strategy seems to have a more balanced exposure to all the factors most of the time as evidenced by the lower standard deviation compared to the Minimum Volatility strategy.

Both Figure 9 and Figure 10 confirm that a biased and less diversified portfolio such as the MVP has less stable and less balanced exposures to the well-known risk factors compared to a well-diversified and unbiased portfolio such as the MDP.

Figure 10: Standard Deviation of exposures (correlations) to well-known factors (December 2000 - September 2022)



Source: TOBAM, Bloomberg. Period: 31-Dec-1998 to 30-Sep-2022. The longest period for which data are available for all the factors is chosen for this analysis. CAPM residuals of MSCI USA Equal Weight Index, MSCI USA Enhanced Value Index, MSCI USA Momentum Index and MSCI USA Quality Index are used as proxies of Size, Value, Momentum and Quality factors respectively. One-year rolling correlations of Anti-Benchmark® USA and MSCI USA Minimum Volatility strategies to each of the four factors (Size, Value, Momentum and Quality) are computed and the Standard Deviation of the exposures is plotted.

III. Conclusion

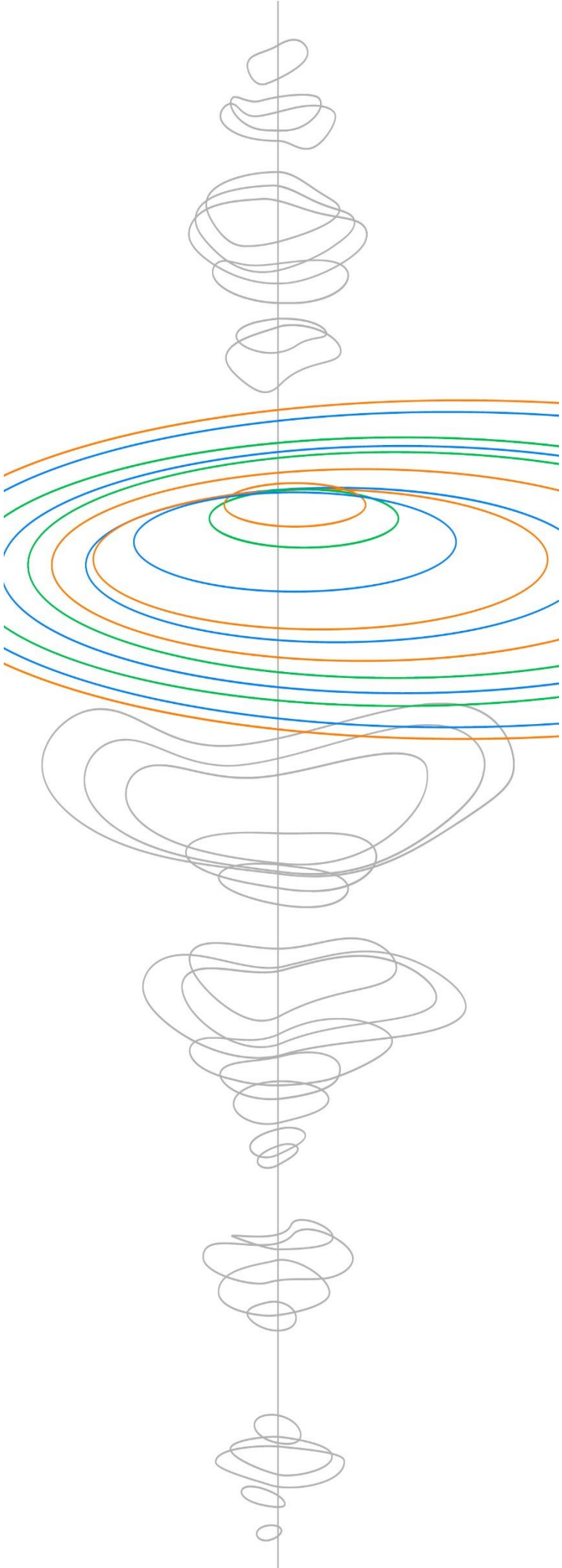
In this dashboard, we outlined the theoretical differences between the two related but very different portfolio objectives - Minimizing Volatility and Maximizing Diversification. We highlighted that the portfolio that minimizes volatility tends to pick predominantly low volatility stocks and exhibits a low volatility bias compared to an unbiased portfolio such as the 'Maximum Diversification Portfolio'.

We also emphasized the potential risks and the empirical consequences of the low volatility bias. While both the MDP and MVP delivered similar levels of risk reduction and downside protection in the long run relative to the market, the inherent low volatility bias of the MVP limited the ability of upside participation during bull markets. As a result, the long-term risk adjusted performance of MVP was lower than that of the MDP.

Additionally, the low volatility bias also means that the relative performance of MVP is more conditional on the broad market performance - outperformance during the bear markets and underperformance during the bull markets - than that of the unbiased MDP.

Another important risk associated with defensive investing that is not to be ignored is the 'Interest Rate' risk, especially given the current macroeconomic context. The MVP, due to its low volatility bias, is more exposed to interest rate risk than its unbiased counterpart - the MDP. Moreover, the MDP being the unbiased portfolio has a more stable and balanced exposure to all the risk factors capturing the full breadth of the equity risk premium including the well-known risk factors such as Size, Value, Momentum and Quality.

Investing in a risk efficient portfolio is a prudent choice for investors especially in the current investment climate, but it is important to avoid unintended and unnecessary bets and build a robust, well-diversified portfolio.



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TOBAM is an asset management company offering innovative investment capabilities designed to increase diversification. Its mission is to provide rational and professional solutions to long term investors in the context of efficient markets.

The Maximum Diversification® approach, TOBAM's flagship investment process founded in 2006, is supported by original, patented research and a mathematical definition of diversification and provides clients with diversified core exposures, across equity and fixed income markets.

In line with its mission statement and commitment to diversification, TOBAM also launched a separate activity on cryptocurrencies in 2017.

As at December 2021, TOBAM manages approx. \$10 billion on behalf of clients globally. TOBAM's team is composed of 51 professionals.

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