

FACTOR FOCUS: VOLATILITY

IN THE REALM OF INVESTING, A FACTOR IS ANY CHARACTERISTIC THAT HELPS EXPLAIN THE LONG-TERM RISK AND RETURN PERFORMANCE OF AN ASSET. MSCI FACTOR INDEXES ARE DESIGNED TO CAPTURE THE RETURN OF FACTORS WHICH HAVE HISTORICALLY DEMONSTRATED EXCESS MARKET RETURNS OVER THE LONG RUN.

MSCI Factor Indexes are rules-based, transparent indexes targeting stocks with favorable factor characteristics – as backed by robust academic findings and empirical results – and are designed for simple implementation, replicability, and use for both traditional passive and active mandates.

DEFINING VOLATILITY

A minimum volatility strategy involves buying stocks based on the estimate of their volatility and correlations with other stocks. Minimum volatility is categorized as a “defensive” factor, meaning it has tended to benefit during periods of economic contraction (see “Performance and Implementation”). This type of strategy is more concerned with volatility management than with maximizing gains.

Paradoxically, the strategy has produced a premium over the market for long periods, contravening the principle that investors should not

be rewarded with higher risk-adjusted returns for taking less than market risk.

The key objective of a minimum volatility strategy is to capture regional and global exposure to stocks with potentially less risk. Historically, the MSCI Minimum Volatility Indexes, for example, have realized lower volatility and lower drawdowns (peak-to-trough declines) relative to their parent index during significant market downturns.

WHY INSTITUTIONAL INVESTORS HAVE USED MINIMUM VOLATILITY STRATEGIES

Tactical investors have used MSCI Minimum Volatility Indexes to reduce risk during market downturns, while retaining exposure to equity. Strategic investors have recognized (1) the benefits of minimum volatility strategies in asset allocation and (2) that minimum volatility strategies have tended to outperform high volatility strategies on a risk-adjusted basis in the long run.

There are several behavioral explanations for the minimum volatility premium, which was identified in the early 1970s by economist Fischer Black and elaborated on by others since then (see sources below). One theory posits that investors underpay for low volatility stocks, viewing them as less rewarding, and overpay for high volatility stocks that are seen as long-shot opportunities for higher returns. A secondary academic explanation holds that investors can be overconfident in their

ability to forecast the future, and that their opinions differ more for high volatility stocks, which have less certain outcomes, leading to higher volatility and lower returns.

In terms of methodology, the main approaches to implementing a minimum volatility strategy fall into two groups: (1) simple rank and selection and (2) optimization-based solutions.

A simple approach ranks the universe of stocks by their expected volatility, selects a subset of the constituents from the universe and then applies a weighting method. These approaches generally ignore the correlation between stock returns, which can have a significant impact on the overall volatility strategy.

While a simple rank and selection method reflects the volatility

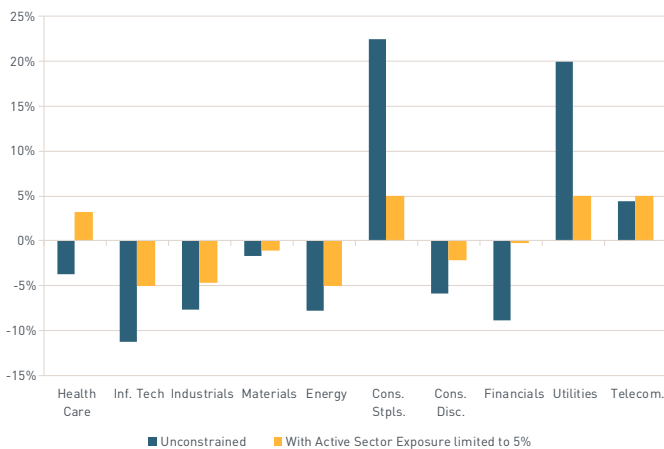
of individual stocks, optimization-based approaches account for both volatility and correlation effects, i.e., the magnitude and the degree to which stocks move in tandem. However, a naive unconstrained minimum volatility strategy has its own set of challenges, such as biases toward certain sectors and countries, unwanted factor exposures and potentially high turnover at rebalancing. Well-designed optimizations with carefully constructed constraints, however, may be able to neutralize these shortcomings.

The MSCI Minimum Volatility Indexes are calculated by using an optimization designed to produce an index with the least overall volatility with a given set of sector, country, and factor constraints in addition to ensuring index replicability and investability.

For illustration purposes, the chart below compares the sector exposure of a constrained minimum volatility index to that of an unconstrained index. Without these constraints, we see large biases toward consumer staples and utilities.

THE EXPOSURES OF CONSTRAINED VS. UNCONSTRAINED MINIMUM VOLATILITY STRATEGIES

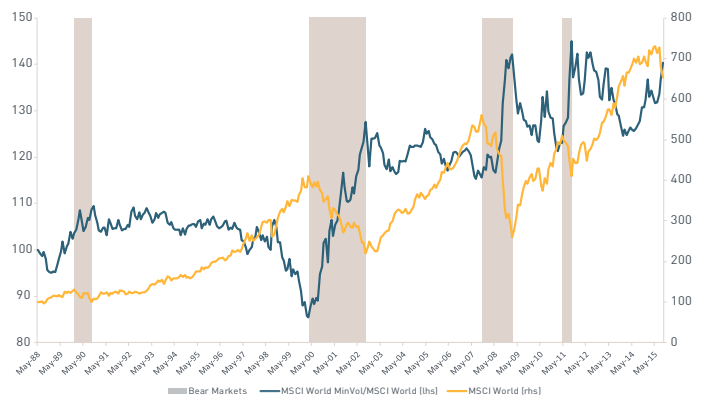
To see how a constrained minimum volatility index performed,



The universe of stocks is the MSCI World Index as of Nov. 25, 2014, constrained only to prohibit short positions (bets that prices will fall) and to keep sector exposures within 5 percentage points of the parent-index weighting.

we can look at the MSCI World Minimum Volatility Index (WMVI) backtested over the 26-year period to May 2014 (chart below), which includes four bear markets (defined here as a decline of 20% or more in the parent MSCI World Index that lasts for at least two months).

THE MSCI WORLD MINIMUM VOLATILITY INDEX HAS HISTORICALLY PROVED LESS VOLATILE THAN ITS PARENT INDEX

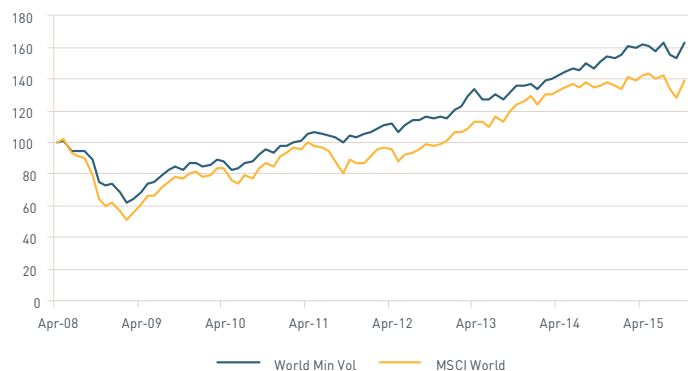


The WMVI posted significantly lower drawdowns and lower realized volatility than its parent index during these downturns. This index also outperformed a negative market 88% of the time, by an average of 8.8 percentage points based on rolling one-year periods. In cases where the index underperformed the market, the average shortfall was only 1.24 percentage points.

In years when market return exceeded 10%, the WMVI underperformed, as one would expect, and the gap widened with increasing market returns. However, for more moderate positive-return periods (defined as 10% or less), the WMVI outperformed the market 67% of the time.

As shown below, the WMVI returned about 80% during its first eight years, through April 2016, while the market gained about 40%. The index's volatility over this period (calculated using monthly returns) was 12.5%, compared with 17.6% for the parent index, a roughly 30% reduction.

THE MSCI WORLD MINIMUM VOLATILITY INDEX OUTPERFORMED ITS PARENT IN THE EIGHT YEARS AFTER ITS LAUNCH

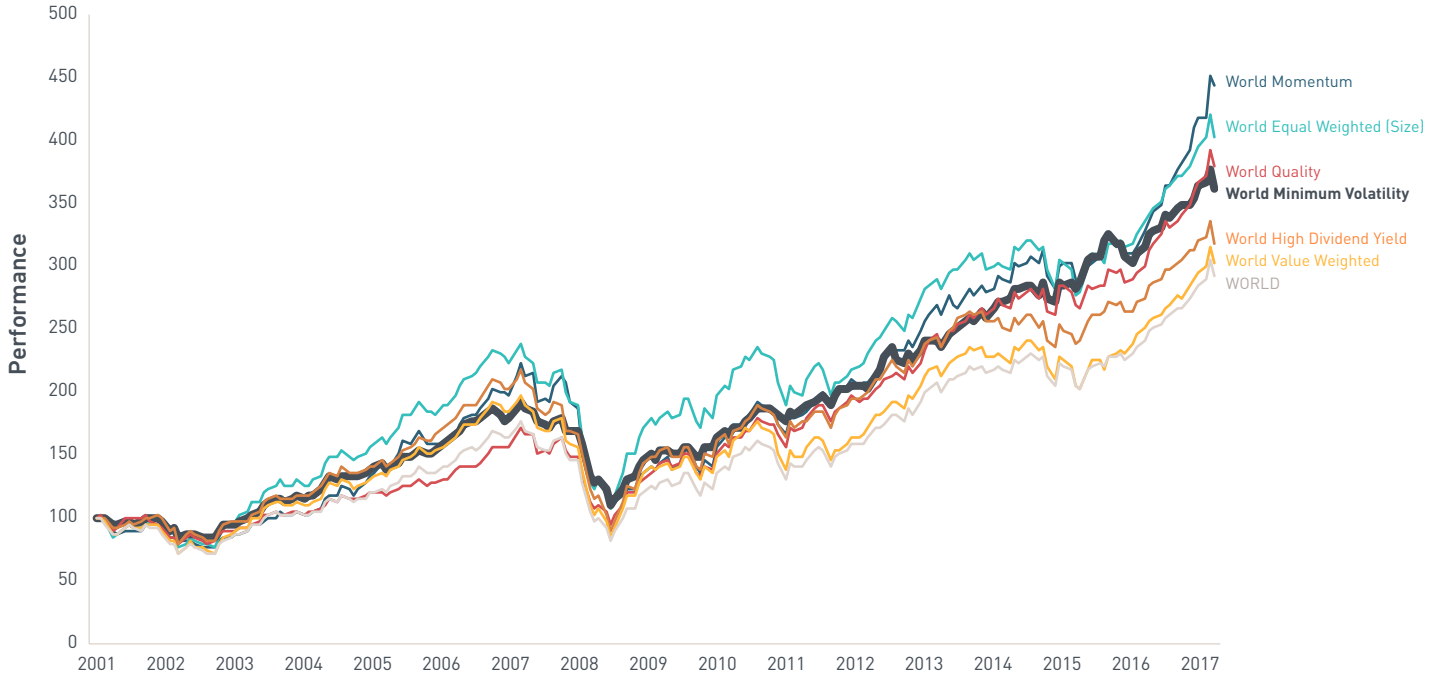


MSCI World Minimum Volatility (USD) was launched on April 14, 2008.

PERFORMANCE & IMPLEMENTATION

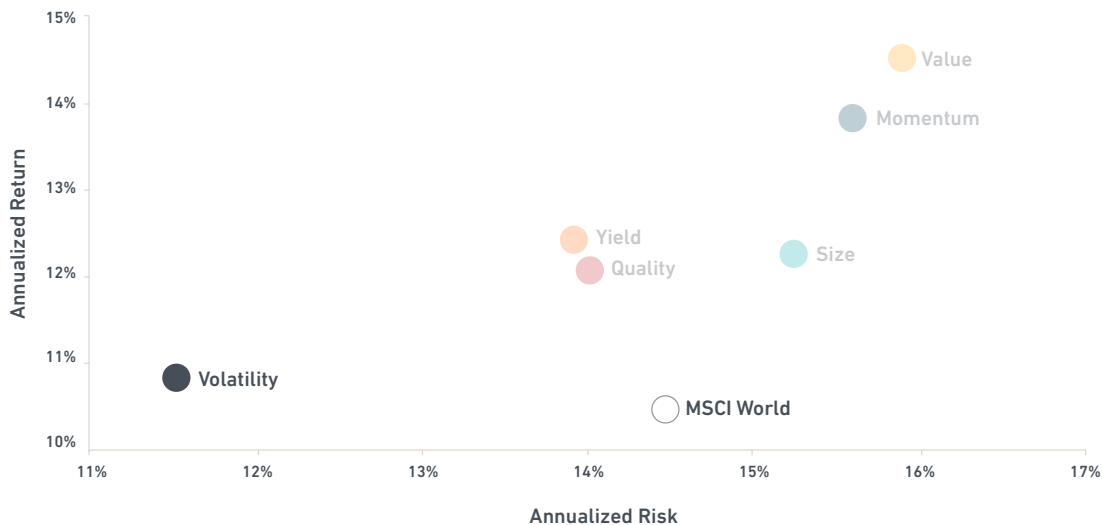
Over time, individual factors have delivered outperformance relative to the market (see chart below).

MSCI WORLD FACTOR INDEXES



From a longer-term perspective, the chart below shows that the MSCI Minimum Volatility Index (represented by the MSCI Top 300 Volatility Tilt prior to 1988 and by the MSCI Minimum Volatility Index afterwards) generated an annualized return of approximately 11% during a 40-year period. In contrast to the other key factors MSCI has identified, the MSCI Minimum Volatility Index has realized significantly lower risk relative to the parent index.

LONG-TERM PERFORMANCE: JANUARY 1977 TO DECEMBER 2017



Although factor strategies have exhibited long-term outperformance, in the short-term factor performance has been cyclical and has generated periods of underperformance.

HOW THE SIX FACTORS HAVE PERFORMED RELATIVE TO EACH OTHER: VOLATILITY

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|--|-------|--------|--------|--------|-------|-------|-------|-------|-------|--------|-------|-------|--------|-------|-------|-------|-------|-------|-------|
| | 45.6% | 1.5% | -4.5% | -9.6% | 56.7% | 28.6% | 28.4% | 31.0% | 19.9% | -29.2% | 42.0% | 18.2% | 8.0% | 16.7% | 32.7% | 12.1% | 5.8% | 10.3% | 32.6% |
| | 40.1% | 1.2% | -8.0% | -9.8% | 50.4% | 24.1% | 17.2% | 28.9% | 16.8% | -35.5% | 41.9% | 16.5% | 4.8% | 16.5% | 30.3% | 9.0% | 4.5% | 9.4% | 26.6% |
| | 25.3% | 0.3% | -10.0% | -13.6% | 33.8% | 21.3% | 15.2% | 22.1% | 10.3% | -39.9% | 33.8% | 12.8% | 4.8% | 15.0% | 27.7% | 7.0% | 4.2% | 8.9% | 23.9% |
| | 20.5% | -2.1% | -11.5% | -14.4% | 30.5% | 20.8% | 10.0% | 21.2% | 9.6% | -40.3% | 35.5% | 12.3% | 4.4% | 14.8% | 27.4% | 5.5% | -0.3% | 8.2% | 23.1% |
| | 18.4% | -10.2% | -12.0% | -15.1% | 26.0% | 20.0% | 8.5% | 20.7% | 7.3% | -41.9% | 30.8% | 11.4% | -5.0% | 13.7% | 26.5% | 4.6% | -1.0% | 8.2% | 22.9% |
| | 8.6% | -12.9% | -16.5% | -16.5% | 25.9% | 15.2% | 8.3% | 19.1% | 6.4% | -42.4% | 17.2% | 9.1% | -9.3% | 13.3% | 22.9% | 3.4% | -2.4% | 5.1% | 19.2% |
| | 8.4% | -18.9% | -20.5% | -19.5% | 22.0% | 12.7% | 6.0% | 16.8% | 6.1% | -42.6% | 14.8% | 7.2% | -11.0% | 8.9% | 19.4% | 3.3% | -2.7% | 4.7% | 18.0% |

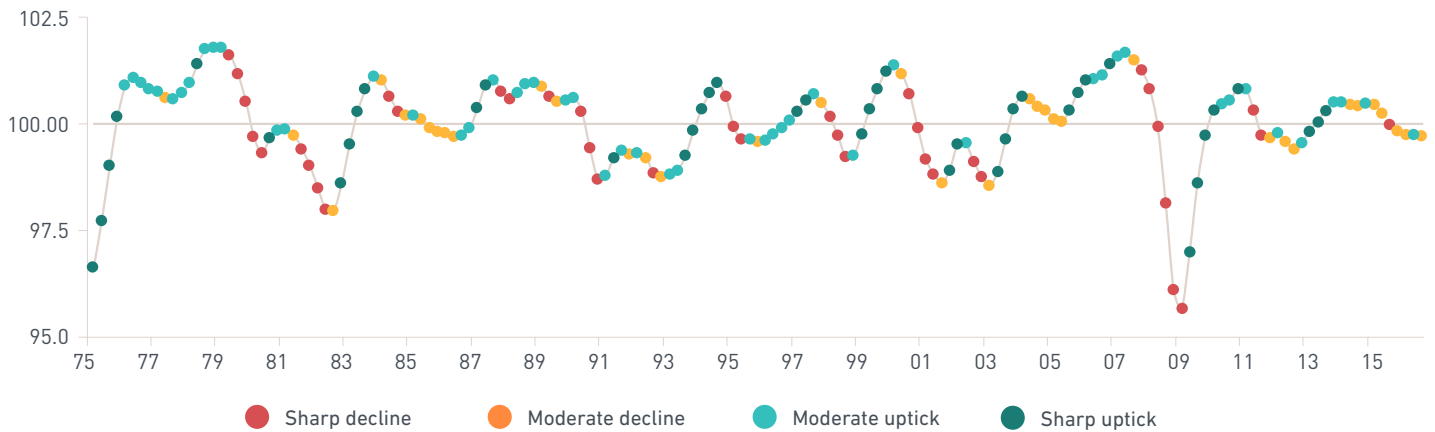
Volatility
 Yield
 Quality
 Momentum
 Value
 Size
 World

The analysis and observations in this report are limited solely to the period of the relevant historical data, backtest or simulation. Past performance — whether actual, back tested or simulated — is no indication or guarantee of future performance. None of the information or analysis herein is intended to constitute investment advice or a recommendation to make (or refrain from making) any kind of investment decision or asset allocation and should not be relied on as such.

The time periods covered in the charts in this paper were dictated by the data available when we conducted the simulations which produced them.

There are frequently material differences between backtested or simulated performance results and actual results subsequently achieved by any investment strategy

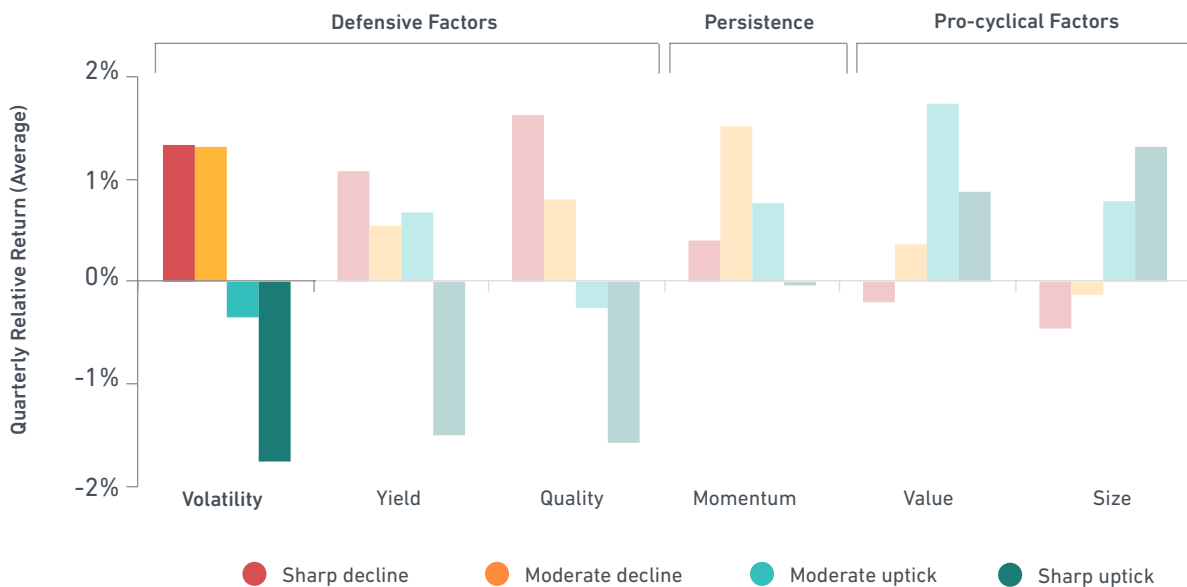
MACRO EFFECTS ON FACTOR PERFORMANCE



In general, factor performance has been cyclical in nature. Individual factors have been shown to outperform during different macroeconomic environments. As the charts on this page illustrate, the minimum volatility factor falls into the “defensive” category, meaning that this type of strategy historically outperformed during declining market conditions over the study period.

The Composite Leading Indicator used here, designed to provide early-warning signals on business-cycle turning points, is an aggregate time series displaying a reasonably consistent leading relationship with the reference series for the macroeconomic cycle

While categorized as “defensive” when looking at the cyclical nature of factor performance, minimum volatility indexes have been considered as a core holding due to their long-term risk/return profile, as demonstrated in Long-term Performance chart on p4.



Data from November 28, 1975 to September 30, 2016.



VOLATILITY

CONCLUSION

Minimum volatility is one of the few factors that have performed well in turbulent markets, serving as a means of capital preservation. Moreover, over long periods of time, this defensive strategy has produced a premium over the market, contravening one of the most basic theories in finance — that one should not be rewarded with greater returns for taking less than market risk.

While naïve minimum volatility indexes may have unintended exposures to other factors, optimization based minimum volatility strategies have been calibrated to achieve targeted levels of country, sector and style exposure without significantly increasing volatility risk itself. The MSCI USA Minimum Volatility Indexes aim to reflect the performance characteristics of a minimum volatility strategy by optimizing towards the lowest absolute risk within a given set of constraints to minimize unintended risks and exposures.

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