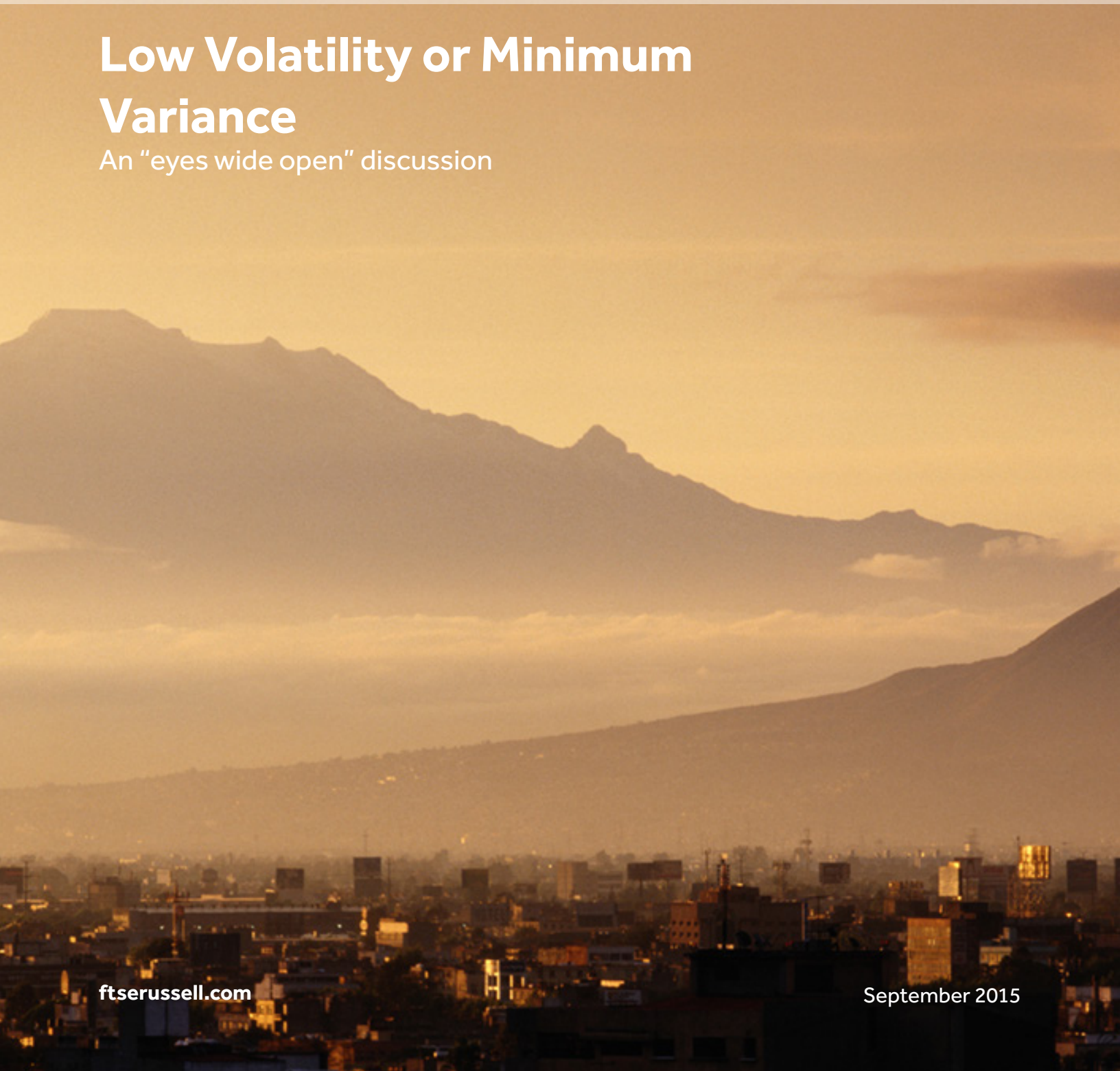
Research

FTSE Russell

Low Volatility or Minimum Variance

An "eyes wide open" discussion



ftserussell.com

September 2015

Introduction

An investor can face a dilemma when looking for assistance in building an investment portfolio. Myriad sources offer advice, often rendering the decisions to be made difficult at best. Soldiering on with the advice and reading through literature, the investor will fairly soon come across a discussion on volatility, as reducing portfolio volatility has been a notable recent theme. Reading on, the investor will shortly realize that although sometimes considered together as "low volatility" strategies, the two most commonly-stated strategies for volatility are very different. The first, resulting from the observation of increased stock market volatility and its correlation with market drawdowns, seeks to reduce portfolio drawdowns by lowering the overall volatility of the portfolio. The second, a subject of much practitioner and investor interest due to its conflict with the generally accepted Capital Assets Pricing Model (CAPM), is the creation of portfolios designed to capture the "low volatility effect". The low volatility effect is based on the observation that stocks with lower price volatility historically have offered higher returns than stocks with higher price volatility.

The investor, convinced by one argument or the other, may look for ways of reducing equity volatility in the hopes of avoiding some portion of those drawdowns or benefitting from that low volatility, and may entrust active fund managers with that task.

More recently, various indexes have been developed that look to achieve volatility reduction within the index through transparent, mechanistic approaches. Low-volatility, that looks to benefit from the low volatility effect and minimum variance that looks to avoid market drawdowns are two of the best known strategies incorporated in indexes. These "smart beta" indexes have proven extremely popular since their introduction, especially in Canada & Continental Europe where they are evaluated and used by asset owners more frequently than any other smart beta index.[1]

Funds tracking low-volatility and minimum variance indexes typically result in reduced levels of volatility, compared to those tracking a market capitalization weighted index. However, despite appearing similar, each is different in concept with important differences in index methodologies. This paper will briefly explain the difference between these two types of indexes and explain how they may be used. The paper will then focus on the minimum variance strategy and methodology, explaining the basis for the strategy and index, why the index methodology works as it does and a brief discussion of historical performance characteristics.

Low Volatility Indexes and their Challenges

Let us assume an investor is convinced by discussions of the "low volatility effect". While low-volatility indexes fall under the general category of volatility reduction, their specific aim is the "factor capture" of the "low volatility effect"[2]. As mentioned above, the low volatility effect suggests that stocks which have exhibited lower volatility have had returns above what would be implied by their

[1] http://www.russell.com/documents/indexes/research/smart-beta-survey.pdf

[2] In brief, a starting universe of stocks is screened for those with the lowest price volatility over a chosen time period. These stocks are then market capitalization weighted or if substantial low volatility capture is required an alternative weighting is applied, perhaps according to the inverse of their historical volatility.

level of risk.[3] Differing explanations for this effect exist[4] but the most common states that active fund managers looking to outperform their benchmarks are more likely to hold higher risk/higher volatility stocks due to their theoretically higher return potential. As a result, lower volatility stocks may become under-priced relative to those with higher volatility[5].

These indexes are therefore designed to capture the "low volatility factor effect"; not necessarily by reducing overall volatility, but by focussing on individual stock volatilities. The strategy can therefore be described as primarily "factor capture".

Whether weighted by capitalization or by volatility, the underlying methodologies of indexes built to capture the low volatility effect may result in significant "tilts" away from the starting universe of stocks. There is always a trade-off between the desire to capture the low volatility factor and the avoidance of secondary or unintended exposures in the index. These are worth discussing in brief:

- **Size Tilts**
  A move away from market cap weighting can result in a tilt towards smaller cap stocks, which may have an effect on performance.
- **Sector Tilts**
  Companies in the same industry/sector tend to have similar volatility characteristics. Some sectors or industries are lower volatility in nature. This may lead to unintended over/under weights.
- **Reduced Diversification**
  The more aggressive selection criteria used to narrow the number of stocks leads to reduced diversification.
- **Illiquidity**
  Some stocks that exhibit lower volatility may also be relatively illiquid. The move away from the market-capitalization weighting may increase the number of such stocks included in the indexes, and therefore increase trading costs and/or reduce the capacity of funds that track the index.

As a result, the index designer has to consider the relative importance of these secondary exposures, balancing increases in them against increased exposure to low volatility.

An Alternative: The Minimum Variance Approach

If however, an investor is more concerned by the possibility of significant drawdowns and therefore with the overall volatility of their equity portfolio, they may find themselves desiring reduced volatility but also wanting to maintain a full and balanced exposure to the relevant equity benchmark. We might characterize the investor as "risk aware", rather than preferring "factor capture."

[3] See, for example: Baker, M., B. Bradley, and J. Wurgler (2011), "Benchmarks as Limits to Arbitrage: Understanding the Low Volatility Anomaly," Financial Analysts Journal (Jan./Feb.); Blitz, D., J. Pang, and P. van Vliet (2007), "The Volatility Effect: Lower Risk without Lower Return," Journal of Portfolio Management (Fall).

[4] For example, Baker, Bradley, and Wurgler (2011) suggest investors look to high beta stocks as a worthwhile "lottery ticket" due to their implicit leverage to market returns, and Brennan, Cheng and Li (2012) think that the return may persist in part because of poorly-functioning arbitrage due to the benchmark constraints many institutional investors operate under.

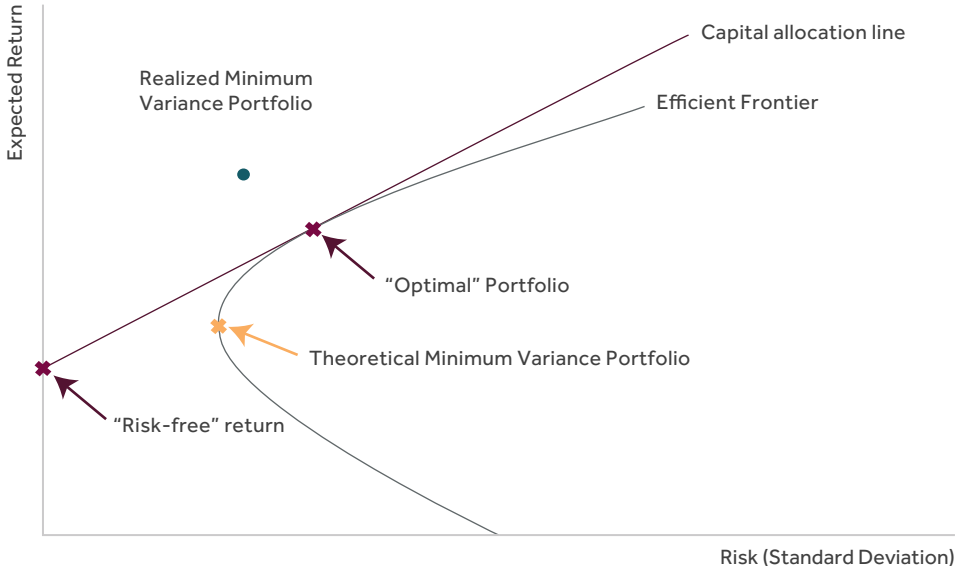
[5] See, for example: Frazzini, Pederson (2014), "Betting Against Beta", Journal of Financial Economics.

Here, an investor will be unlikely to turn to low volatility indexes, due to the difficult choice between market capitalization-based weighting schemes that are not designed to reduce volatility by the required amount, and non-market capitalization weighting approaches that can achieve substantial volatility reduction but that bring the potential disadvantages discussed earlier. The investor may then decide to consider approaches that look to reduce the aggregate level of volatility while controlling for secondary exposures using optimization techniques.

The minimum variance approach[6] has recently come to the fore with the introduction of a number of indexes.[7] In contrast to the low volatility approach described earlier, the intention of minimum variance is to create a *portfolio* of stocks with the lowest *overall* volatility, subject to defined constraints.

As shown in Chart 1, modern portfolio theory suggests that the tangent or optimal investment portfolio is that portfolio where the capital allocation line meets the efficient frontier.[8] A minimum variance investor is aiming to capture a portfolio that sits on the efficient frontier and has the highest return but the lowest possible variance (the ''theoretical minimum variance portfolio''). Additionally however, due to the low volatility effect discussed above, some empirical results show an investor may actually achieve a portfolio above the efficient frontier with a higher than expected return for a given amount of risk - the "realized minimum variance portfolio" shown.[9]

Chart 1: Minimum Variance and the Efficient Frontier



Charts and graphs are provided for illustrative purposes only.

The aggregate volatility of a portfolio depends on the combination of individual stock volatility and correlations with other stocks. Imperfect correlations therefore provide scope to reduce aggregate volatility through diversification.

[6] "Variance" is the square of volatility (as measured by standard deviation). The terms are sometimes used interchangeably.

[7] For example, the FTSE Global Minimum Variance Index Series, of which details are available at http://www.ftse.com/products/indices/Min-Variance.

[8] An efficient frontier shows the possible investment portfolios that offer the highest expected return for a given level of risk, or the lowest risk level achievable for a given level of expected return. By definition no theoretical portfolios can exist above/left of the efficient frontier and portfolios that are below/right of it are sub-optimal as they provide a lower return than is possible for the same level of risk. The Capital Allocation Line is a line of all possible combinations of risky and risk-free assets.

[9] For example as discussed in "Minimum-Variance Portfolios in the U.S. Equity Market", Clark, de Silva & Thorley (2006).

To construct a minimum variance index, the index provider first determines the historical return volatilities and correlations of all the individual stocks in the base index. Then, using this data, an optimization is performed to select and weight constituents in such a way that in aggregate will produce a basket of stocks with the lowest expected risk, based on the historical relationship between the stock returns. Interestingly, this approach means that a minimum variance index could in principle (and has on occasion been seen to) contain some constituents with relatively high volatility: due to their low levels of correlation with other stocks these higher volatility stocks would appear in the index because they contribute to the overall reduction of aggregate index volatility.

While the overall goal is to produce an index with the lowest expected volatility, the optimization is constrained to avoid many of the significant tilts discussed earlier with respect to indexes designed to capture the low volatility effect. This particularly includes the possibility of overly-concentrated exposure to sector, country or individual stocks.

Complications with Optimization

Using an optimization process to construct an index has benefits and drawbacks. There are a number of specific issues that are often a feature of optimized approaches to index creation:

- Proprietary risk models are often used to estimate the covariance matrix, with the result that although optimizers can resolve many of the problems discussed above, they will reflect specific choices made by the creator of the risk model during its design.
- Optimization is an opaque process.
- The interactions between constraints make it possible that the optimization process will result in an index with too few constituents[10].
- Similarly, the use of each additional constraint may result in overly constrained outcomes, pushing the resulting index away from the theoretical minimum variance portfolio.
- The decision to add each additional constraint implies that the index provider "knows the answer", deliberately constraining outcomes to result in a pre-imagined index rather than allowing the process to operate.
- The use of turnover constraints creates "path dependency", where the choice of an index's starting date will lead to variations in the index's constituents and weightings at a future point in time, when compared with the constituents that result at that same time from a different starting point.

A number of different approaches[11] to the creation of minimum variance indexes can be seen in the market. Each offering uses different combinations of optimizers, underlying risk models, constraints and so on, potentially giving rise to significantly different indexes, index characteristics and index returns. Users of minimum

[10] Although individual additional constraints could have the opposite effect: adding a diversification constraint would be expected to increase the number of constituents, for example.

[11] Minimum variance indexes have been introduced by MSCI, STOXX, Ossiam, FTSE Russell and others.

variance indexes are best served by ensuring they thoroughly understand the methodologies, underlying technologies and the possible outcomes.

The FTSE Russell Approach to Minimum Variance[12]

FTSE Russell's approach to the creation of minimum variance indexes has been to take a "light touch" approach to the index methodology, i.e. limiting the number of constraints and ensuring diversified outcomes. It also avoids using a proprietary risk model to generate the covariance matrix, instead using a "principal components" approach which is agnostic to named risk factors.

Given a starting index universe, a covariance matrix of constituent volatilities and correlations is formed from daily stock returns. This is used to inform an optimization algorithm to determine the minimum variance index constituents and weightings. These are subject to various constraints, the first of which (and always binding, to avoid the possibility of high concentration in individual sectors, countries or stocks) is the diversification constraint: that no individual stock can represent more a given percentage[13] of the index by weight at index review. Also, individual industries cannot represent more than 20% of the index at index review.[14]

Note that as liquidity and capacity measures are included in the underlying universe indexes, and to avoid the "path dependency" complication discussed above , there are no additional liquidity[15] or turnover constraints.

Results

The key metric for measuring the success of a minimum variance approach is the reduction in index volatility, presented as Chart 2. This shows the volatility of both the underlying FTSE All-World Index and the FTSE All-World Minimum Variance Index, together with the reduction in volatility that the latter achieves. The index has both historically and post-launch been able to reduce overall index volatility by an average of 24%, and generally within a range of approximately 15 to 35%.

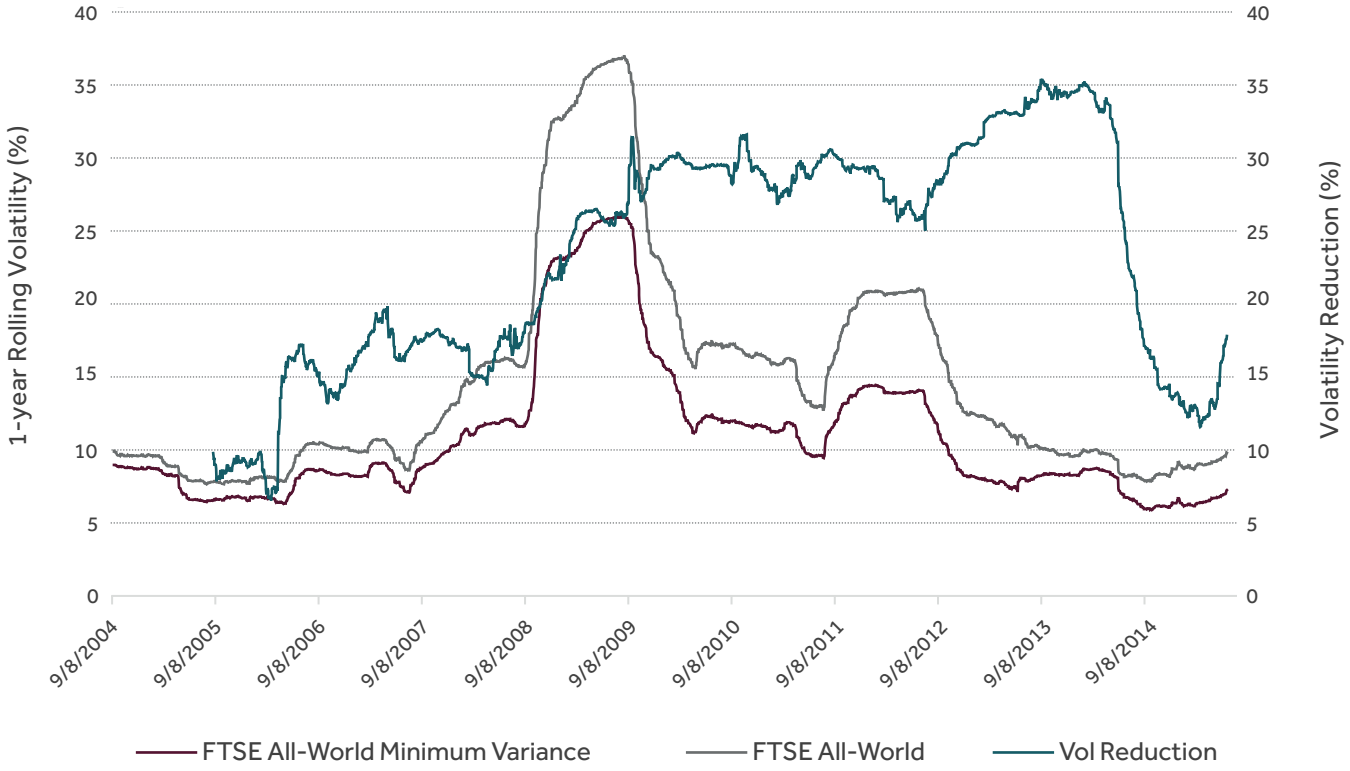
[12] A full explanation is available in the Ground Rules for the FTSE Minimum Variance Index Series.

[13] The figure is specific to each FTSE Minimum Variance Index. See the Ground Rules for the FTSE Minimum Variance Index Series for further information.

[14] A full list of constraints is included in the Ground Rules.

[15] There are however liquidity requirements in the underlying FTSE universe indexes which ensure illiquid companies do not reach the FTSE Minimum Variance Index Series.

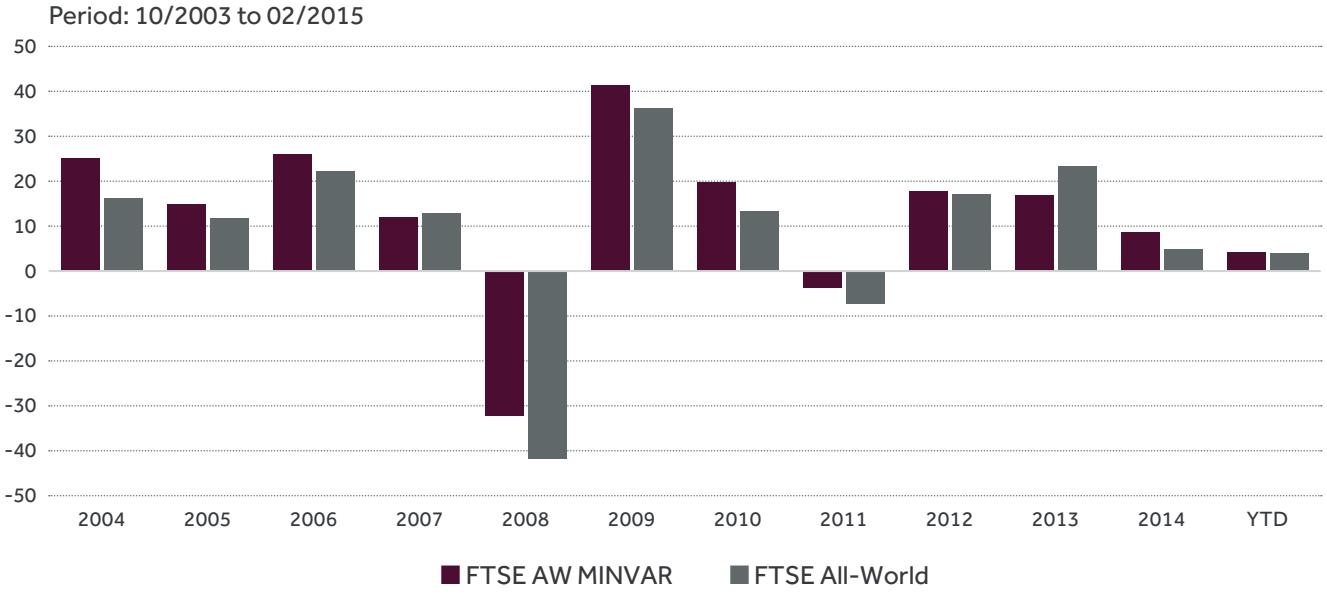
Chart 2: 252 Day Rolling Volatility and Percentage Volatility Reduction



Source: FTSE Russell. Past performance is no guarantee of future results. Please see the final page for important legal information.

Chart 3 shows the annualized returns of the FTSE All World Minimum Variance and FTSE All World indexes over the same period. On the one hand it clearly demonstrates the reduced downside capture. On the other hand, as mentioned above, there are a number of periods of outperformance versus the cap-weighted counterpart.

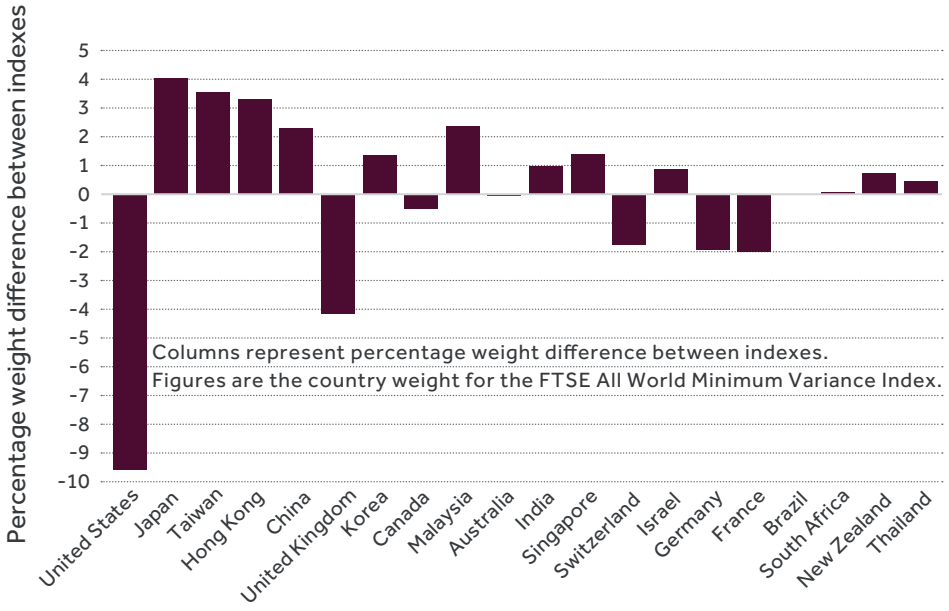
Chart 3: Annualized Index Returns



Source: FTSE Russell. Past performance is no guarantee of future results. Please see the final page for important legal information.

In Chart 4, below, we see that exposure to the USA is noticeably reduced in the FTSE All World Minimum Variance Index and that Asian economies tend to be overweighted by the Minimum Variance approach. The higher exposure of western markets to the relatively volatile financials and oil & gas sectors, when compared to Asian markets, may explain some of the effect.[16]

Chart 4: Comparative Country Weights



Source: FTSE Russell. Data as of December 31, 2014. Past performance is no guarantee of future results. Please see the final page for important legal information.

[16] The optimizer constraints could be set tighter, to reduce the over/under weights. Their level reflects an active decision to use the country and sector weights as a safety net removing the chance of excessive differences, while allowing the optimizer "more room" to seek out reduced volatility.

Conclusion

This paper discusses low volatility and minimum variance indexes and identifies their possible uses.[17] It also discusses the various balancing exercises that are implicit in designing such indexes.

"Factor capture" investors look to use a low volatility index to help them capture the "low volatility effect". As we discussed above, "risk aware" investors looking to reduce the aggregate level of variability to achieve improvements in risk adjusted outcomes may consider using a minimum variance index to assist them in their investment decisions. This approach delivers reduced volatility while maintaining full and balanced exposure to the relevant equity segment.

FTSE Russell's approach to minimum variance seeks to meet the needs of those looking to reduce overall variability, rather than to focus on the low volatility effect. As such, the FTSE Minimum Variance Index Series is built with these main characteristics:

- "Risk aware"/volatility focussed, rather than performance focussed.
- Designed to manage overall variability.
- Built with diversification constraints to limit index concentration.
- Constructed with a limited number of constraints to explicitly target volatility reduction through diversified outcomes that do not overly impact trading capacity.
- Created and managed from a transparent methodology, using publicly-available data and risk models.

[17] We note that at least one more method exists for reducing volatility, that of using company fundamentals such as financial leverage and earnings variability. The Russell Stability Index Series of "Defensive" and "Dynamic" companies takes this approach.

For more information about our indexes, please visit ftserussell.com.

About FTSE Russell

FTSE Russell is a leading global provider of benchmarking, analytics and data solutions for investors, giving them a precise view of the market relevant to their investment process. A comprehensive range of reliable and accurate indexes provides investors worldwide with the tools they require to measure and benchmark markets across asset classes, styles or strategies.

FTSE Russell index expertise and products are used extensively by institutional and retail investors globally. For over 30 years, leading asset owners, asset managers, ETF providers and investment banks have chosen FTSE Russell indexes to benchmark their investment performance and create ETFs, structured products and index-based derivatives.

FTSE Russell is focused on applying the highest industry standards in index design and governance, employing transparent rules-based methodology informed by independent committees of leading market participants. FTSE Russell fully embraces the IOSCO Principles and its Statement of Compliance has received independent assurance. Index innovation is driven by client needs and customer partnerships, allowing FTSE Russell to continually enhance the breadth, depth and reach of its offering.

FTSE Russell is wholly owned by London Stock Exchange Group.

For more information, visit www.ftserussell.com.

To learn more, visit www.ftserussell.com; email index@russell.com, info@ftse.com; or call your regional Client Service Team office:

EMEA
+44 (0) 20 7866 1810

North America
+1 877 503 6437

Asia-Pacific
Hong Kong +852 2164 3333
Tokyo +81 3 3581 2764
Sydney +61 (0) 2 8823 3521