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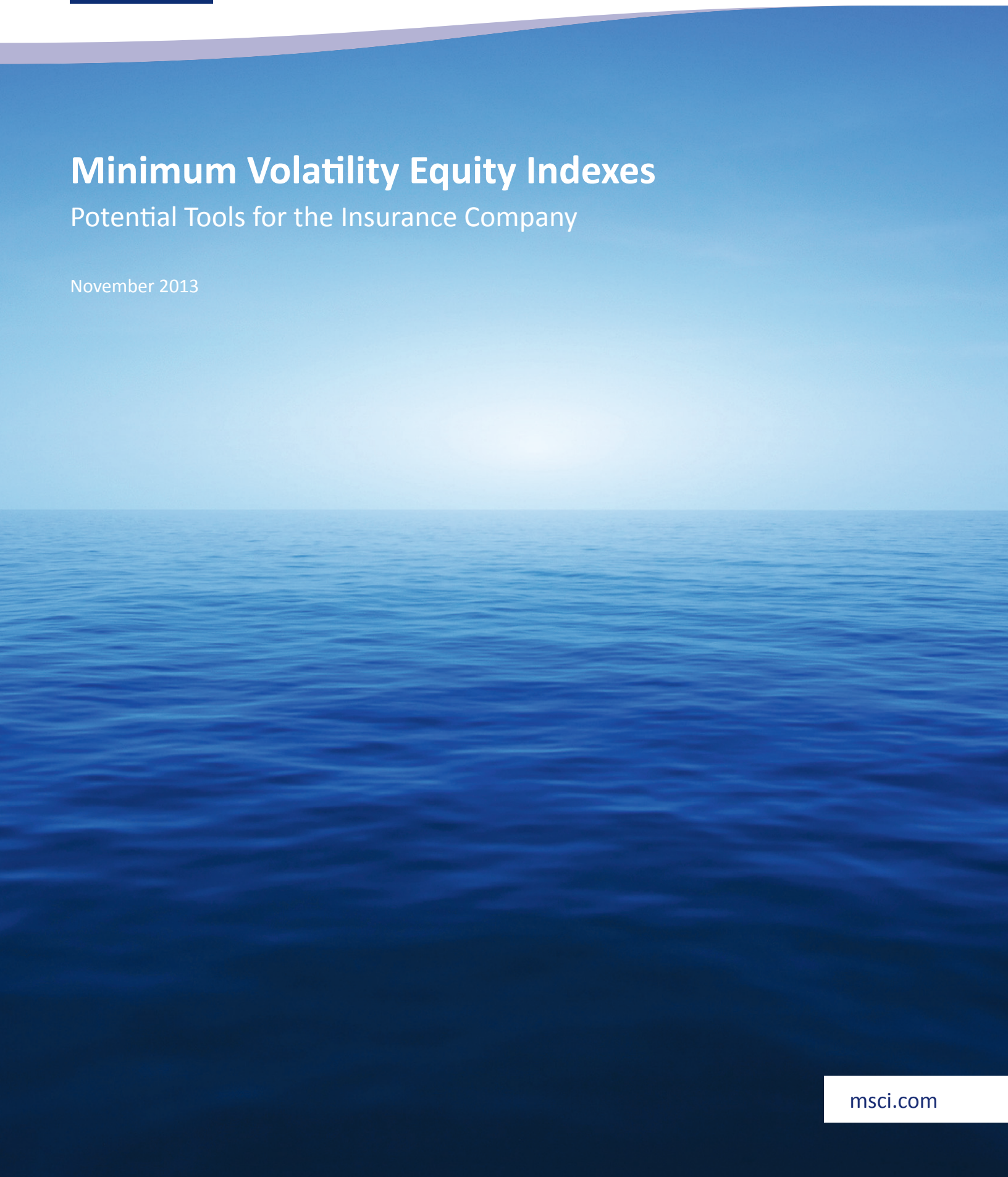
Minimum Volatility Equity Indexes

Potential Tools for the Insurance Company

November 2013



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Overview

- Insurers looking for greater risk-adjusted returns from their portfolios often consider minimum volatility strategies
- Over the long-term, minimum volatility indexes have consistently delivered lower realized volatility, with returns that are close to those of their market cap weighted parent indexes, which has led to higher Sharpe ratios
- We have examined the impact of adding small increments of equities (using minimum volatility indexes and market cap weighted indexes, US and global) to a hypothetical pure fixed income allocation. We found that the MSCI Minimum Volatility Indexes helped to significantly decrease the risk and increase the return of the hypothetical portfolio

Minimum Volatility Equity Indexing for the Insurer

A persistent concern for insurance companies lies in the need to generate higher risk-adjusted returns from their investment portfolios. While equities can potentially increase long-term performance, their returns are more volatile than those of bonds, even over longer horizons. Moreover, insurers are extremely sensitive to the volatility and downside risks in their investments. Given this risk profile, is there an efficient way to include equities in the insurance company's investment strategy? We have found that the behavior of minimum volatility strategies over time can prove beneficial in the insurance asset allocation process.

Minimum variance strategies aim to mitigate the effects of volatile equity markets and cushion potential downside events. The MSCI Minimum Volatility Indexes seek to reflect the performance of such strategies. The MSCI USA Minimum Volatility Index, for example, significantly outperformed the US broad market through the 2008 global financial crisis and over the following periods of continued volatility. (See ***Figure 1.***) In addition, the MSCI USA Minimum Volatility Index reduced the risk of its parent by close to 23% over the period Nov 2001 – Sep 2013. (See ***Figure 3a.***)

Crisis periods are typically characterized by spikes in market volatility.

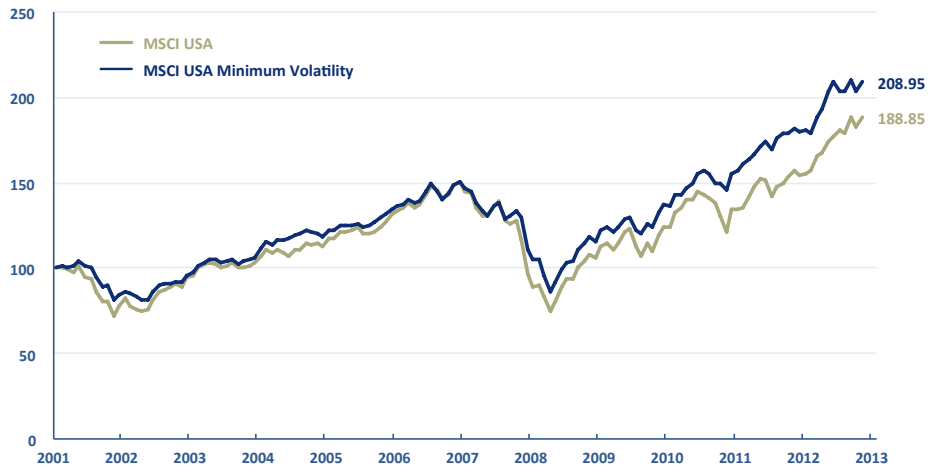

Figure 1:
The MSCI USA Minimum Volatility Index cumulatively mitigated downturns, ultimately outperforming the MSCI USA Index, its parent index. (Gross Index Returns, Nov 2001 – Sep 2013)

This behavior of minimum volatility strategy indexing was not unique to the US market; in global markets the MSCI Minimum Volatility Indexes substantially reduced the risk and outperformed their respective broad market cap weighted parent indexes. (See the MSCI ACWI Minimum Volatility chart in ***Figure 2.***)

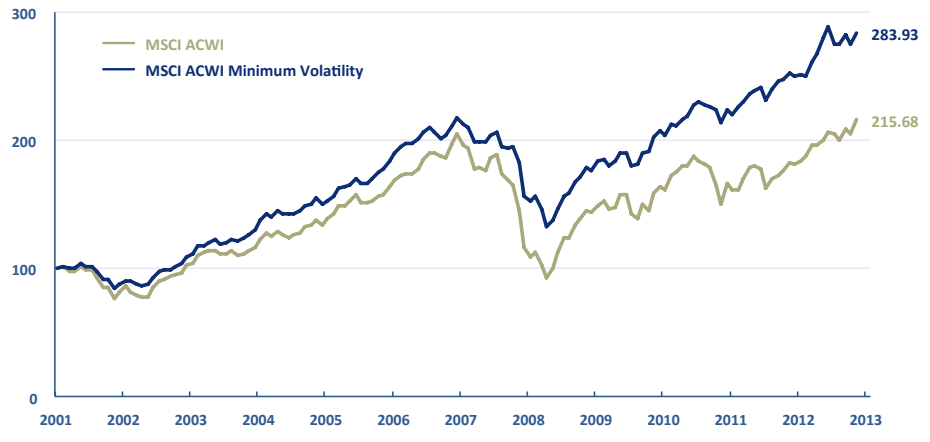

Figure 2:
The MSCI ACWI Minimum Volatility Index, covering developed and emerging markets, outperformed its MSCI parent index by lessening the impact of the parent index downturns, especially during the financial crisis. (Gross Index Returns Nov 2001 – Sep 2013)

The MSCI Minimum Volatility Indexes have generally provided higher risk-adjusted returns versus their broad parent indexes across global markets over the long-term.

Figure 3a shows the annualized gross return, volatility and dividend yield for the MSCI ACWI and MSCI USA Minimum Volatility Indexes (and their parent indexes). In each case, the MSCI Minimum Volatility Index appreciably reduced the risk of its parent index while still outperforming the parent over the period and providing a slightly higher dividend yield. The MSCI ACWI Minimum Volatility Index, for example, not only reduced risk by 32% on an annualized basis from Nov 2001-Sep 2013, but it also outperformed the MSCI ACWI Index by 38% over the period. Finally, its dividend yield was some 15% higher than that of the parent as of Sep 30, 2013. ***Figure 3b*** displays annualized returns for the four MSCI Minimum Volatility Indexes over different time periods through September 2013.

(Nov 2001 - Sep 2013)	MSCI Parent Index	MSCI Min Vol Index
Annualized Returns (%)		
MSCI ACWI	6.71	9.22
MSCI EAFE	7.21	10.54
MSCI Emerging Markets	13.83	17.72
MSCI USA	5.52	6.43
Annualized Volatility (%)		
MSCI ACWI	16.72	11.45
MSCI EAFE	18.19	12.90
MSCI Emerging Markets	23.28	18.41
MSCI USA	15.29	11.78
Dividend Yield (%)		
MSCI ACWI	2.57	2.96
MSCI EAFE	3.08	3.30
MSCI Emerging Markets	2.74	3.20
MSCI USA	2.09	2.62

Figure 3a:
Risk, return and yield characteristics of MSCI parent indexes relative to the MSCI Minimum Volatility Indexes.

	1-Yr	3-Yr	5-Yr	10-Yr	Since Nov-2001	Since Inception	Inception Date
MSCI ACWI Min Vol	4.52%	11.98%	9.27%	10.71%	9.70%	6.12%	May-08
MSCI EAFE Min Vol	14.84%	9.33%	10.82%	9.69%	10.44%	8.82%	Nov-09
MSCI EM Min Vol	4.52%	5.07%	19.21%	15.51%	17.22%	11.26%	Nov-09
MSCI USA Min Vol	14.76%	16.29%	16.38%	8.26%	6.87%	8.99%	May-08

Figure 3b:
Performance characteristics of the MSCI Minimum Volatility Indexes over time.

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Background on Minimum Volatility Indexing

The Low Volatility Effect

Numerous studies have shown that over the long-term, minimum volatility strategies have historically delivered lower realized volatility with returns that are close to those of their market cap weighted parent indexes, leading to higher Sharpe ratios. The low volatility effect is considered an anomaly because it challenges standard investment theory that riskier assets should be rewarded with higher expected returns while less risky assets receive lower expected returns. Instead, some theorists have suggested that investors may be consistently drawn to more visible, higher volatility stocks, thus providing opportunities for investors willing to seek out lower volatility opportunities.

Research has shown that this low volatility effect has historically persisted even after adjusting for a range of other explanatory variables including stock size, book-to-market pricing, liquidity or leverage, as well as across different economic regimes and high and low volatility regimes.

The Minimum Variance Portfolio

Research on the minimum variance (MV) portfolio has a long history, since 1952. Minimum variance strategies came into favor as far back as the early 1990s.

The theoretical minimum variance (MV) portfolio has been widely known since the appearance of Dr. Harry Markowitz's seminal paper, "Portfolio Selection," first published in the Journal of Finance in 1952. The theoretical minimum variance portfolio in ***Figure 4*** is positioned at the leftmost point of the mean-variance efficient frontier and represents the lowest return-variance for a given stock universe. The theoretical minimum variance portfolio is the one portfolio on the efficient frontier that minimizes risk *without* requiring an expected return input.

All other portfolios on the efficient frontier have an optimal combination of stocks that minimize risk for a given expected return (they have an optimum risk/return ratio). This optimum ratio is composed from the risk/return ratio of all stocks in the portfolio together with the risk/return ratios of the stocks to one another.

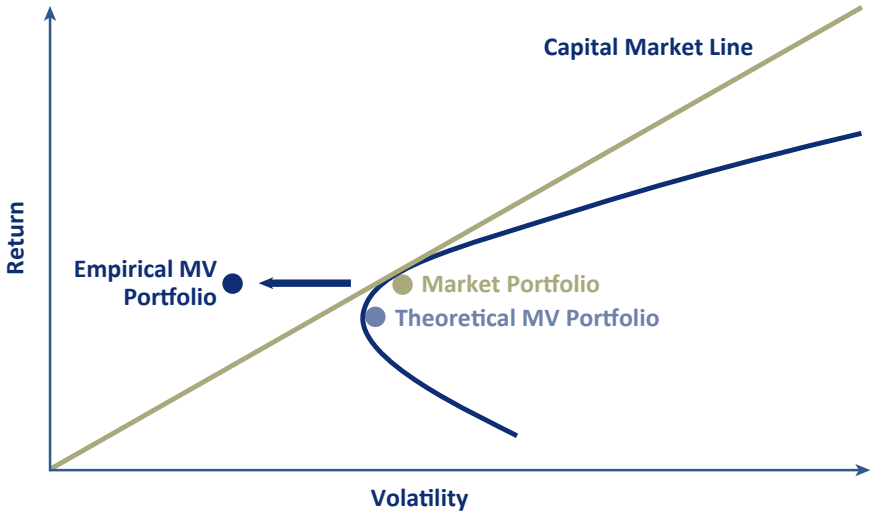

Figure 4:
The *theoretical* minimum variance (MV) portfolio lies at the far left tip of the efficient frontier. The *empirical* MV portfolio reflects the observations of numerous studies that demonstrate the superior risk-adjusted returns of a minimum variance strategy relative to the market.

The empirical minimum volatility portfolio in ***Figure 4*** reflects empirical studies observing that minimum variance strategies have historically delivered superior long-term realized risk-adjusted performance relative to capitalization weighted market indexes. The MSCI Minimum Volatility Indexes are similarly constructed to reduce the risk of the parent index, while maintaining similar returns over the long-term. Of course, short-term results have demonstrated varying characteristics under different market regimes.

The Logic behind Minimum Variance Strategies

Whether one measures risk by beta or by volatility, minimum volatility indexes have historically shown lower risk and comparable returns versus broad market indexes over the long-term. As individual stock betas are usually clustered closely around 1 in stable markets, an index composed of low-beta stocks does not lose much in terms of return in low volatility periods.

When markets become stressed, however, stock betas become far more dispersed. This is when a focus on low-beta stocks has proven particularly effective. As the broad market falls, the low-beta index will likely lose value, but it will likely lose proportionally less than the market cap weighted index with riskier stocks.

The lower drawdowns of minimum volatility indexes in turbulent times have led to higher risk-adjusted returns versus their broad market parent indexes.

With lower drawdowns in volatile markets, minimum volatility indexes have produced superior risk-adjusted returns relative to their broad market equivalents. If an index falls 10%, for example, it must appreciate 11% to get back to where it started; if it falls 20%, it must appreciate 25% to return to its original level. With compounding, the lower drawdowns of a minimum volatility index have historically enhanced the impact of its longer-term upside potential in an absolute sense.

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Adding Minimum Volatility Indexes to Fixed Income Allocations

Some insurance companies have considered the addition of small increments of US equities to help increase the potential return of a pure fixed income allocation. ***Figure 5*** illustrates various combinations of the Barclays U.S. Aggregate Index, with the addition of 5% increments of the MSCI USA Index.

Over the period Sep 2002 – Sep 2013, a substitution of 15% of the Barclays U.S. Aggregate Index with the MSCI USA Index, for example, resulted in a 17.7% increase in annualized return (from 4.7% to 5.5%) and a 4.5% decrease in annualized risk. This demonstrates the potential diversification effect of including equities in the insurance company's asset allocation.

However, larger allocations to US equities come with increased portfolio risk. For example, by increasing the MSCI USA Index to 20% of total assets, the risk is increased from 3.1% to 3.3%.

Instead, if the insurance company had incorporated minimum volatility indexes into the portfolio over the same period, it would have been able to include more equity with less risk. Replacing 20% of the Barclays U.S. Aggregate Index fixed income allocation with the MSCI USA Minimum Volatility Index, for example, resulted in a 20.5% increase in return and a 12.4% reduction in risk over the same timeframe.

We examined the impact of adding equities--in small increments--to a fixed income allocation. Adding MSCI Minimum Volatility Indexes significantly decreased the risk and increased the return of a pure fixed income allocation.

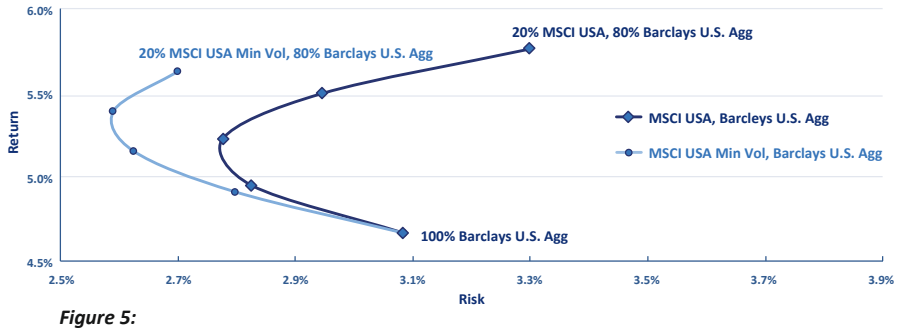

Figure 5:
Adding a rather small US equity allocation to a 100% fixed income insurance allocation, increased return and reduced risk. By adding 15% of the MSCI USA Index and reducing the Barclays U.S. Aggregate Index fixed income allocation to 85%, increased return by 17.7% and reduced risk by 4.5% over the 11-year period from Sep 2002 – Sep 2013. Further, with an addition of 20% of the MSCI USA Minimum Volatility Index and a reduction of the Barclays U.S. Aggregate Index fixed income allocation to 80% resulted in a 20.5% increase in return and a 12.4% reduction in risk over the period.

Without Minimum Volatility					
	100%	95%/5%	90%/10%	85%/15%	80%/20%
Barclays U.S. Agg	100%	95%	90%	85%	80%
MSCI USA	0%	5%	10%	15%	20%
Total	100%	100%	100%	100%	100%
Annualized Return	4.7%	4.9%	5.2%	5.5%	5.8%
Annualized Risk	3.1%	2.8%	2.8%	2.9%	3.3%

With Minimum Volatility					
	100%	95%/5%	90%/10%	85%/15%	**80%/20%**
Barclays U.S. Agg	100%	95%	90%	85%	**80%**
MSCI USA Min Vol	0%	5%	10%	15%	**20%**
Total	100%	100%	100%	100%	**100%**
Annualized Return	4.7%	4.9%	5.2%	5.4%	**5.6%**
Annualized Risk	3.1%	2.8%	2.6%	2.6%	**2.7%**

Data from Sep 2002 – Sep 2013

Using a global equity framework for greater equity diversification and to reduce single-country risk, represents another alternative for potentially enhancing the risk/return profile of a 100% fixed income allocation. In ***Figure 6***, for example, we see that adding the MSCI ACWI Index in 5% increments increased the return of a pure fixed income allocation. Here, a substitution of 20% of the Barclays U.S. Aggregate Index with the MSCI ACWI Index, resulted in a 27.4% increase in annualized return (from 4.7% to 5.9%) but with an 18.3% increase in annualized risk (over the period Sep 2002 – Sep 2013).

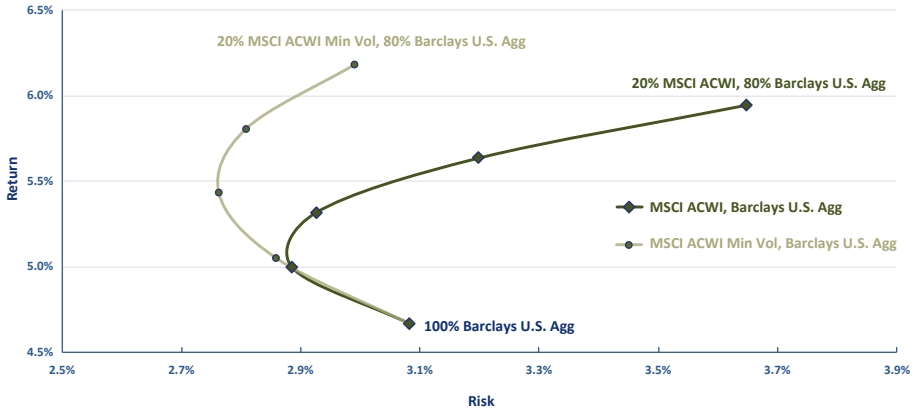

Figure 6:
Adding 10% of the MSCI ACWI Index and reducing the Barclays U.S. Aggregate Index fixed income allocation to 90%, increased return by 14.0% and reduced risk by 5.1% over the 11-year period from Sep 2002 - Sep 2013. Further, an addition of 20% of the MSCI ACWI Minimum Volatility Index and a reduction of the Barclays U.S. Aggregate Index fixed income allocation to 80% resulted in a 32.4% increase in return and a 3.1% reduction in risk over the period.

Without Minimum Volatility					
	100%	95%/5%	90%/10%	85%/15%	80%/20%
Barclays U.S. Agg	100%	95%	90%	85%	80%
MSCI ACWI	0%	5%	10%	15%	20%
Total	100%	100%	100%	100%	100%
Annualized Return	4.7%	5.0%	5.3%	5.6%	5.98%
Annualized Risk	3.1%	2.9%	2.9%	3.2%	3.6%

With Minimum Volatility					
	100%	95%/5%	90%/10%	85%/15%	**80%/20%**
Barclays U.S. Agg	100%	95%	90%	85%	**80%**
MSCI ACWI Min Vol	0%	5%	10%	15%	**20%**
Total	100%	100%	100%	100%	**100%**
Annualized Return	4.7%	5.1%	5.4%	5.8%	**6.2%**
Annualized Risk	3.1%	2.9%	2.8%	2.8%	**3.0%**

Data from Sep 2002 – Sep 2013

On the other hand, using the MSCI ACWI Minimum Volatility Index enabled an increase in the equity allocation with less risk. Replacing 20% of the Barclays U.S. Aggregate Index fixed income allocation with the MSCI ACWI Minimum Volatility Index resulted in a 32.4% increase in return and a 3.1% reduction in risk over the same period.

Some academic researchers have also shown that certain active investors in the insurance industry who have the benefits of using leverage, have been able to use minimum volatility equity strategies to improve the risk and return characteristics of their allocations[1].

[1] Frazzini, Kabiller, and Pedersen (2013), "Buffett's Alpha", Department of Economics, Yale University.

MSCI Minimum Volatility Index Characteristics

The MSCI Minimum Volatility Indexes are designed to reflect broad market performance with less risk.

The MSCI Minimum Volatility Indexes are designed to reflect broad market performance with less risk. Each Minimum Volatility Index is based on an established market cap weighted MSCI parent index and, over the long-term, has outperformed the parent index on a risk-adjusted basis—especially in periods of financial crisis when volatility is at a high level.

Although minimum volatility index strategies have historically outperformed the market with lower risk, their short-term behaviors in different market conditions have varied. The MSCI Minimum Volatility Indexes have shown the following general characteristics across global markets and in the US over various time frames that have been tested as far back as 1988[2]:

- Low index beta relative to their capitalization weighted parent indexes; minimum volatility index betas have averaged about .70
- An average of 25-30% less volatility than their capitalization weighted parent index, although this figure can fluctuate over time and by markets
- A bias towards stocks with low total and idiosyncratic risk
- A bias towards stocks with lower market capitalization than the average stock within the parent index

Minimum Volatility Index Risk Measures

Figure 7 illustrates the rolling 3-year realized volatility of the MSCI ACWI Minimum Volatility Index in comparison to its parent index, MSCI ACWI. The chart highlights the significant risk reduction of the minimum volatility index versus the cap weighted parent index, especially during the global crisis in 2008 and in the following years of turmoil.

[2] The original study was published by Haugen in 1990 for the US. In 1995 Kleeberg showed similar results for international markets. In 2006 Clarke et al., repeated Haugen's tests for longer and more recent periods.

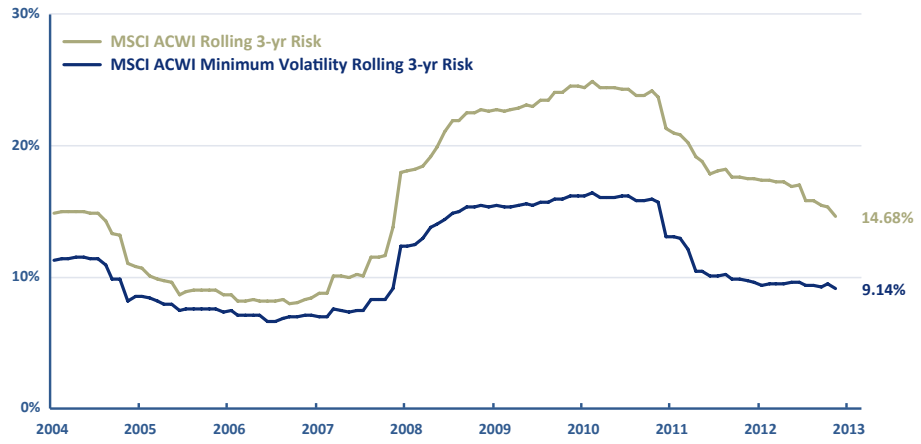

Figure 7:
The 3-year rolling volatility of the MSCI ACWI Minimum Volatility Index is consistently lower than that of the parent index; however, the chart displays significantly lower volatility relative to its parent index during the financial crisis of 2008 and beyond.

In late 2005 through 2007 when the volatility of the MSCI ACWI Index was at its lowest, the risk reduction for the MSCI ACWI Minimum Volatility Index was also at its lowest. In contrast, following the onset of the global crisis, the MSCI ACWI Minimum Volatility Index reduced the risk of its parent substantially.

Upside and Downside Capture

Another property of minimum volatility strategy indexes is shown through their upside and downside capture ratios.

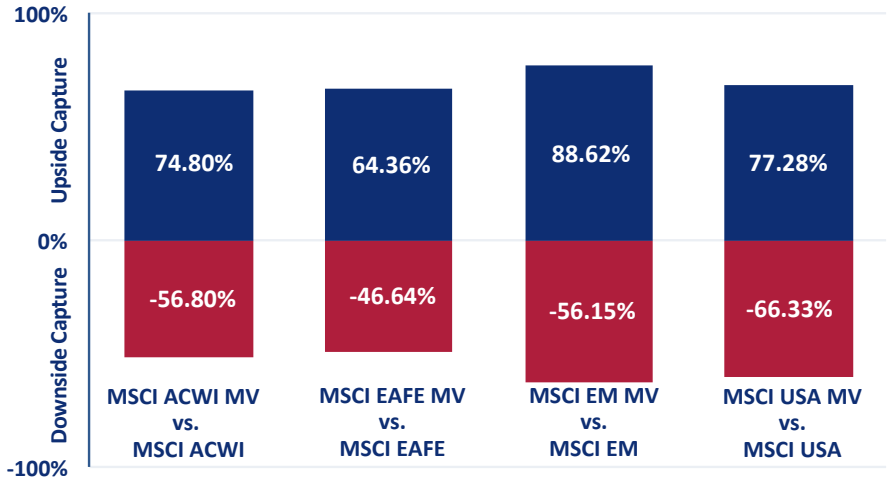

Figure 8:
The chart displays the average upside and downside capture ratios of the MSCI Minimum Volatility (MV) Indexes relative to their parent indexes since Nov 2001. It illustrates that while the MSCI Minimum Volatility Indexes have produced significantly lower drawdowns, they have also substantially participated on the upside.

The upside and downside capture ratios indicate whether a given index has out-performed its parent index over periods of market strength and weakness, and if so, by how much. Since November 2001, the MSCI ACWI Minimum Volatility Index, for

example, captured 74.8% of the positive returns of its parent index, the MSCI ACWI Index; simultaneously, the MSCI ACWI Minimum Volatility Index lost 56.8% relative to the losses of the parent index. Over the 142-month period since November 2001, the MSCI ACWI Minimum Volatility Index outperformed the parent index in 49 of the 57 months when the parent index's returns were negative. Conversely, in the 85 months when the MSCI ACWI Index had positive returns, the MSCI ACWI Minimum Volatility Index outperformed its parent in 28 of those 85 months.

Over the long-term, minimum volatility investing has provided access to the equity premium, but with lower downside risk. Historically, we have also seen that minimum volatility strategy indexes have outperformed their respective parent indexes (or market benchmarks). However, they have tended to outperform less frequently when markets were trending upward. This pattern is reversed when markets have faced headwinds.

Minimum Volatility Index Constituents

It is informative to consider the top ten constituents of the MSCI USA Minimum Volatility Index and their weights relative to the MSCI USA Index. (See ***Figure 9.***) Certainly, large cap technology names such as Apple and Google which are among the top ten stocks in the MSCI USA Index, and which tend to be volatile, do not show up in the list of the top ranked stocks in the MSCI USA Minimum Volatility Index. Instead, the Information Technology sector is represented by more quality growth dividend-paying companies like Paychex or ADP.

Historically, minimum volatility indexes usually outperformed their broad market parent indexes when equity markets were falling; they have also lagged their parent indexes when markets rallied.

MSCI USA Minimum Volatility Index		
Top 10 Constituents	**Index Wt. (%)**	**Parent Index Wt. (%)**
TJX Companies	1.66	0.26
Paychex	1.64	0.08
Bristol-Myers Squibb	1.62	0.48
ADP	1.57	0.22
Chubb	1.54	0.15
Johnson & Johnson	1.51	1.54
Lockheed Martin	1.51	0.22
General Mills	1.49	0.2
Pepsico	1.48	0.78
Ecolab	1.45	0.17

Data as of Sep 30, 2013

Figure 9:
A list of the top ten constituents of the MSCI USA Minimum Volatility Index does not include many of the "big" large cap names in the MSCI USA Index, such as Apple, Exxon Mobil or Google. In addition, the highest weighted company, TJX, reflects the constraints imposed during the rebalancing process, in which the weight of each stock is constrained to the lower of 1.5% or 20x its weight in the MSCI USA Index. (See ***Figure 10.***)

MSCI Minimum Volatility Index Construction

Each MSCI Minimum Volatility Index is based on a broad market parent index and seeks to target a subset of stocks from the parent index with reduced volatility characteristics.

The process of calculating the best combination of stocks from the parent index with the lowest absolute volatility is called "optimization" and relies on the factor exposures of each stock in the parent index and their interaction with one another. The optimization process also involves the application of a series of constraints which are designed to maintain the country, sector and style characteristics of the parent index, thus preventing unintended stock, sector and country bets. The optimization process is also designed to keep the MSCI Minimum Volatility Index turnover low—to an annual maximum of 20%.

Minimum Volatility indexes are constructed using an optimization process that selects the best mix of low volatility stocks from a parent index, while simultaneously maintaining the country, sector and style characteristics of the parent.

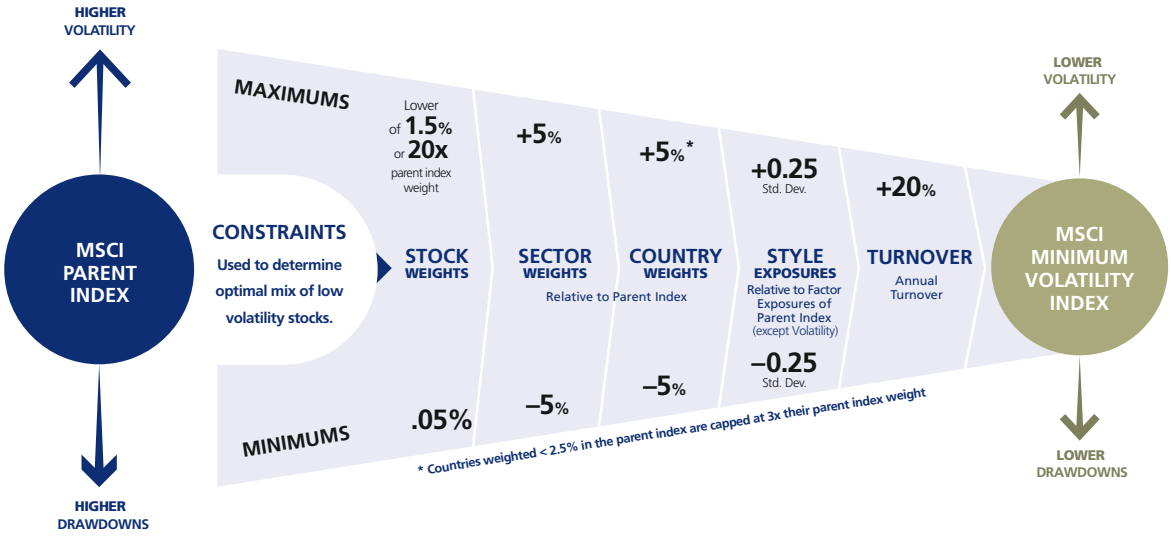

Figure 10:
The optimization, or rebalancing, process occurs semiannually and involves the application of a series of constraints. Sector weights, country weights and style exposures are all restricted to reflect the characteristics of the parent index.

Figure 10 shows, for example, that the sector weights of an MSCI Minimum Volatility Index are constrained at each rebalancing so that they do not deviate more than ±5% from the sector weights of the parent index. (See also ***Figure 11.***) Similarly, the style exposures are constrained so that all risk factors of an MSCI Minimum Volatility Index are restricted to ±0.25 standard deviations relative to the parent index (except

for the volatility factor, which is unconstrained so the MSCI Minimum Volatility Index can achieve the lowest possible risk relative to the parent index).

Sector	MSCI USA Min Vol (%)	MSCI USA (%)
Health Care	17.98	12.74
Financials	15.82	16.00
Consumer Staples	15.02	9.79
Info Tech	13.73	18.43
Consumer Discretionary	9.25	13.14
Utilities	7.92	3.11
Industrials	7.25	10.40
Energy	5.64	10.48
Telecom Services	4.46	2.46
Materials	2.95	3.45

Data as of Sep 30, 2013

Figure 11:
The minimum volatility optimization, or rebalancing, process applies constraints to the sector weights, so that sectors still reflect the relative sector diversification characteristics of the parent index.

Optimization constraints enable the MSCI Minimum Volatility Indexes to provide lower volatility and lower drawdowns while still reflecting their relative broad equity parent indexes without significant bias in countries, sectors and styles.

A comparison of the sector weights of the MSCI USA Minimum Volatility Index with the MSCI USA Index, for example, demonstrates that the minimum volatility index retains the broad representation of all sectors in the parent index—even as of September 30, 2013, which is between rebalancing periods. The index construction process ensures that the MSCI Minimum Volatility Indexes do not include extreme sector overweights in Utilities, for example—a sector which is traditionally considered to be composed of low volatility stocks. (See ***Figure 11.***)

Conclusion

Many insurance companies look to achieve higher long-term risk-adjusted returns from their investment portfolios. While equities are the natural vehicles for obtaining higher potential yield, they tend to incur downside risk and volatility that is often beyond the insurer's risk tolerance.

Minimum volatility indexes have helped to cushion and diversify extreme equity risk and they have offered the potential to capture the "low volatility effect." We have shown that a minimum volatility strategy can have a constructive role to play in the insurer's portfolio.

In exploring various scenarios to see how relatively small additions of a minimum volatility equity strategy—as represented by the MSCI Minimum Volatility Indexes—could be incorporated in a 100% fixed income portfolio, we showed that the strategy offers a sensible approach to enhancing the risk/return profile of the fixed income portfolio.

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[1] *As of March 31, 2013, as reported on July 31, 2013 by eVestment, Lipper and Bloomberg.*

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