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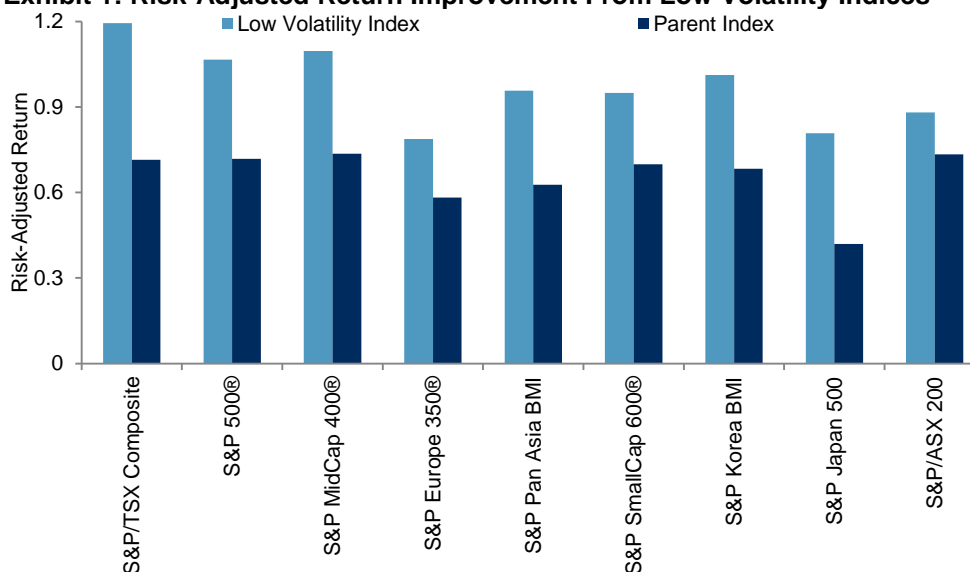
# Low Volatility: A Practitioner's Guide

S&P Dow Jones Indices (S&P DJI) produces a range of low volatility indices, covering various single-country and international markets. These indices offer a perspective on the returns of lower volatility equities and provide a basis for index-linked products and benchmarks globally. This practitioner's guide:

- Explains the construction of low volatility indices;
- Identifies the role of broader market trends, valuations, interest rates, and sector exposures in determining their performance;
- Highlights the potential applications of low volatility strategies; and
- Summarizes the evidence for the existence and potential persistence of the so-called "low volatility anomaly."

Exhibit 1 illustrates an important aspect of low volatility indices: their potential to offer higher risk-adjusted returns than the market benchmark from which they were derived.

**Exhibit 1: Risk-Adjusted Return Improvement From Low Volatility Indices**



Source: S&P Dow Jones Indices LLC. Data from April 2003 to April 2018. Index performance based on annualized monthly total return in local currency, except for the S&P Pan Asia BMI, which uses USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

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# 低波动性：从业者的指导

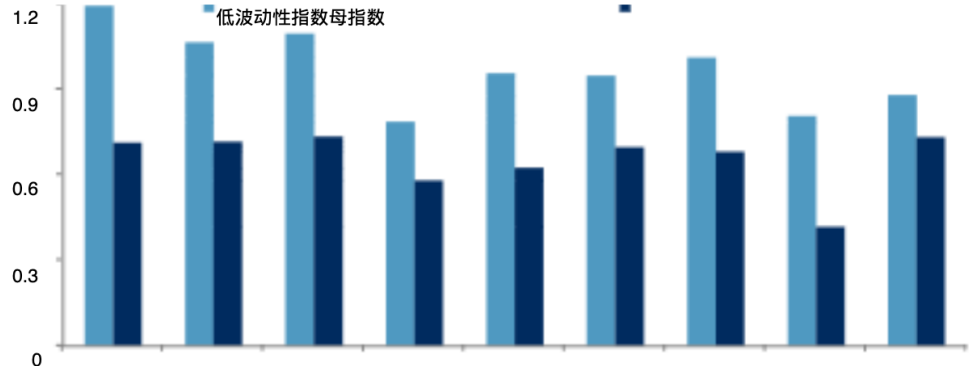
标普道琼斯指数 (S&PDJI) 产生一系列低波动性指数，涵盖各个单一国家和国际市场。这些指数提供了波动性较低的股票回报的视角，并为全球指数挂钩产品和基准提供了基础。这

## 从业者指南：

- 解释低波动性指数的构建；
- 确定更广泛的市场趋势、估值、利率和行业风险敞口在决定其业绩方面的作用；
- 强调低波动性策略的潜在应用；和
- 总结了所谓“低波动性异常”的存在和潜在持续性的证据。

图表 1 说明了低波动性指数的一个重要方面：与衍生它们的市场基准相比，它们有可能提供更高的风险调整回报。

图表 1：低波动性指数带来的风险调整回报改善



资料来源：标普道琼斯指数有限责任公司。2003年4月至2018年4月的数据。指数表现基于以当地货币计算的年化月度总回报，但标普泛亚 BMI 除外，该指数使用美元。过去的表现并不能保证将来的结果。图表仅供说明之用，反映假设的历史表现。请参阅本文档后面的性能披露，了解与回测性能相关的固有限制。

## INTRODUCTION

Basic financial theory is predicated on the idea that higher-risk investments should be priced to offer commensurately higher returns. Unfortunately for the theory, a growing body of empirical evidence—accumulated since the 1970s<sup>1</sup>—suggests that, across a wide range of time horizons, geographies, and market segments,<sup>2</sup> **stocks with lower volatility have displayed higher risk-adjusted returns.**

S&P Dow Jones Indices' Low Volatility Indices track the performance of a portfolio of the least volatile stocks selected from a given benchmark universe.

Meeting the need for low volatility benchmarks, S&P DJI's low volatility indices **track the performance of a portfolio of the least volatile stocks selected from a given benchmark universe**, such as the [S&P 500](#). Indeed, the first-ever low volatility index was the [S&P 500 Low Volatility Index](#), launched in April 2011. Many more have been produced since.<sup>3</sup>

**The performance and risk/return characteristics of these indices**, both over hypothetical back tests and subsequent to their launch dates, **provide further confirmation that lower-risk stocks can offer superior performance characteristics.** Exhibit 1 provides a summary for a selection of low volatility indices based on various benchmarks over the last 15 years, displaying the improved risk/return ratios of each low volatility index in comparison to its corresponding parent benchmark.

In light of the growing popularity of products (such as ETFs) offering access to low volatility strategies, **a growing body of research identifying and quantifying the drivers of low volatility performance has emerged.** These include the role of sectoral allocations, interest rate sensitivities, and equity valuations. In what follows, **we shall briefly summarize the salient points that emerge from this research.**

The S&P 500 Low Volatility Index rebalances quarterly to the 100 least volatile constituents.

More directly to practitioners' interests, we shall also examine the **portfolio applications** of low volatility strategies, in either a multi-factor or multi-asset context. We conclude by addressing the question of whether or not the so-called "low volatility anomaly" of higher risk-adjusted returns might continue.

Note that while our results extend in spirit to many similar equity strategies, our focus will be restricted to the indices produced by S&P DJI. Accordingly, we begin with a summary of the methodology used to construct our low volatility indices, and a brief examination of the practical consequences of using historical volatility rankings to form equity portfolios.

<sup>1</sup> Jensen, Michael C., Fischer Black, and Myron S. Scholes, "[The Capital Asset Pricing Model: Some Empirical Tests](#)," Studies in the Theory of Capital Markets, Praeger Publishers Inc., 1972.

<sup>2</sup> Chan, Fei Mei and Craig J. Lazzara, "[Is the Low Volatility Anomaly Universal?](#)," S&P Dow Jones Indices, April 2015.

<sup>3</sup> Please see Exhibit 19 in the Appendix for a full list of the low volatility indices offered by S&P DJI as of April 2018.

## 介绍

基本金融理论的基础是这样的理念：高风险投资的定价应提供相应更高的回报。对于该理论来说不幸的是，自 20 世纪 70 年代以来积累的越来越多的经验证据表明，在广泛的时间范围、地域、

在细分市场中，波动性较低的股票表现出较高的风险调整回报。

标准普尔道琼斯指数的低波动性指数跟踪从给定基准范围中选择的波动性最小股票的投资组合的表现。

满足低波动性基准的需求，标普道琼斯指数的低波动性指数跟踪从给定基准范围（例如标准普尔 500 指数）中选择的波动性最小股票的投资组合的表现。

事实上，第一个低波动性指数是 2011 年 4 月推出的标准普尔 500 低波动性指数。此后又推出了更多低波动性指数。

这些指数的表现和风险/回报特征

通过假设的回溯测试以及发布日期之后，提供进一步证实低风险股票可以提供优越的回报

性能特点。图表 1 总结了过去 15 年基于各种基准的一系列低波动性指数，显示了每个低波动性指数与其相应母基准相比的风险/回报率的改善。

鉴于提供接入的产品（例如 ETF）越来越受欢迎

对于低波动性策略，越来越多的研究确定和量化低波动性绩效的驱动因素。

其中包括部门分配的作用、利率敏感性和股权估值。接下来，我们将简要总结本研究的要点。

标准普尔 500 指数低点波动性指数每季度重新调整 100 个波动性最小的成分股。

更直接地考虑从业者的兴趣，我们还将研究低波动性策略在多因素或多资产背景下的投资组合应用。最后，我们解决了风险调整回报较高的所谓“低波动性异常”是否可能持续的问题。

请注意，虽然我们的结果本质上适用于许多类似的股票策略，但我们的重点将仅限于标普道琼斯指数生成的指数。因此，我们首先总结用于构建低波动性指数的方法，并简要审查使用历史波动性排名形成股票投资组合的实际后果。

1 Jensen, Michael C.、Fischer Black 和 Myron S. Scholes, “资本资产定价模型：一些实证检验”，资本市场理论研究，Praeger Publishers Inc., 1972 年。

2 Chan, Fei Mei 和 Craig J. Lazzara, “低波动性异常是否普遍存在？”，标准普尔道琼斯指数，2015 年 4 月。

3 截至 2018 年 4 月，标普道琼斯指数提供的低波动性指数的完整列表请参阅附录中的图表 19。

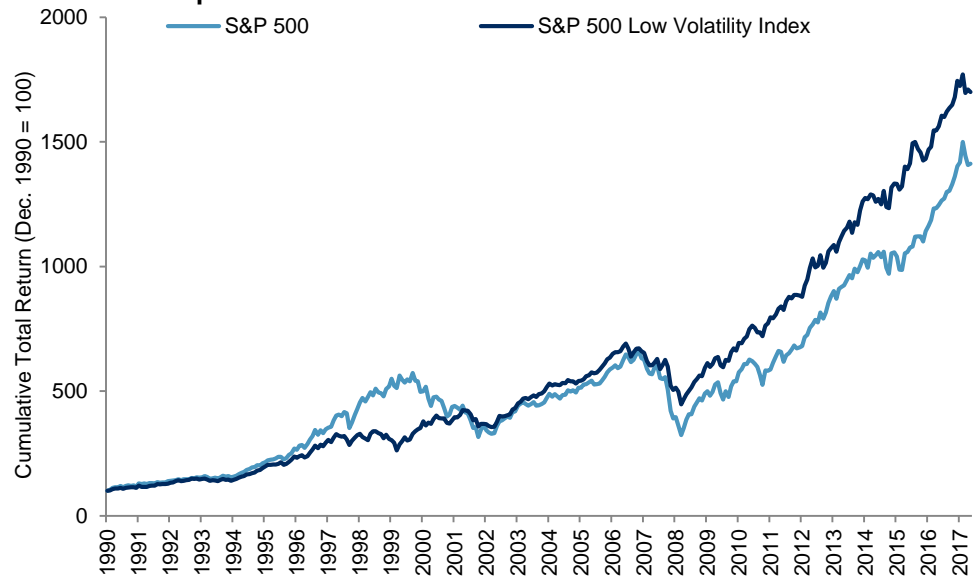
## THE CONSTRUCTION OF S&P DJI LOW VOLATILITY INDICES

Broadly speaking, S&P DJI's low volatility indices select a subset of lower volatility stocks from the available universe (typically the lowest 20% by rank) and form portfolios from such selections by weighting each constituent in inverse proportion to its volatility. The selections are made, and the index is rebalanced, on a regular schedule—typically once per quarter.<sup>4</sup>

Constituents are weighted in inverse proportion to their trailing price volatilities.

For example, at each quarterly rebalance of the S&P 500 Low Volatility Index, the price volatility of each S&P 500 constituent over the past 252 trading days is calculated. Once ranked, the 100 least volatile constituents are selected for inclusion in the index, with index weights determined in inverse proportion to volatility (and summing to 100%). Exhibit 2a shows the cumulative total return of the S&P 500 Low Volatility Index, and Exhibit 2b gives the summary performance statistics in comparison with the benchmark.

**Exhibit 2a: Comparison of Historical Cumulative Total Return**



Source: S&P Dow Jones Indices LLC. Data from December 1990 to April 2018. Index performance based on rebased monthly total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

<sup>4</sup> Practical considerations mean that the methodologies applied to produce low volatility indices can differ from one market to another. For example, buffers to limit turnover at rebalancing may be applied to low volatility indices operating in less liquid markets. Full details of each index's construction may be found in its methodology. For example, see the [S&P Low Volatility Indices Methodology](#).

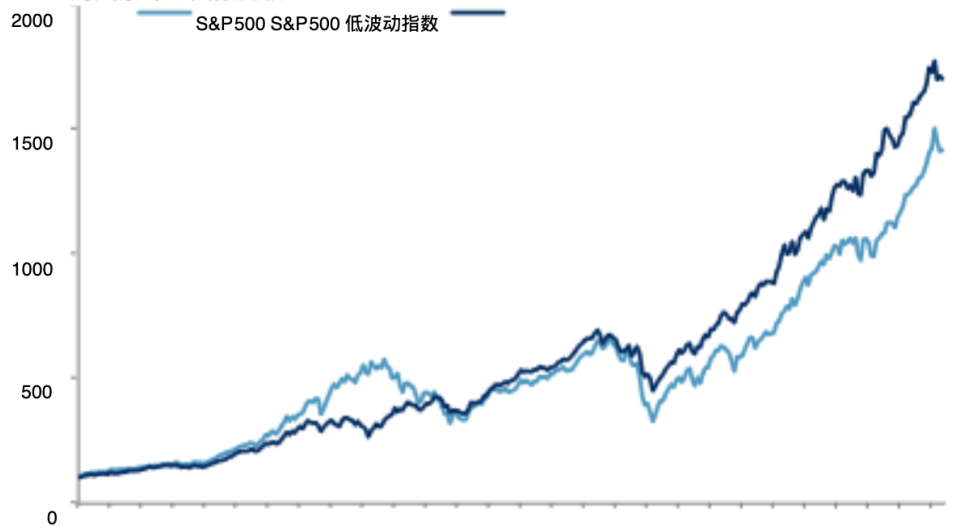
## 标普道琼斯低波动指数的构建

从广义上讲，标普道琼斯指数的低波动性指数从可用范围中选择波动性较低的股票子集（通常按排名最低的 20%），并通过按与波动性成反比的方式对每个成分进行加权来从这些选择中形成投资组合。定期进行选择并重新平衡指数——通常每季度一次。

成分股是  
倒数加权  
与其追踪价格波动成正比。

例如，在标准普尔 500 低波动性指数的每个季度重新调整时，都会计算过去 252 个交易日内每个标准普尔 500 指数成分股的价格波动性。排名完成后，将选择 100 个波动性最小的成分股纳入指数，指数权重按波动性反比确定（总和为 100%）。图表 2a 显示了标准普尔 500 低波动指数的累计总回报，图表 2b 给出了与基准相比的汇总绩效统计数据。

图表 2a：历史累计总回报比较



资料来源：标普道琼斯指数有限责任公司。1990 年 12 月至 2018 年 4 月的数据。指数表现基于重新调整的每月美元总回报率。过去的表现并不能保证将来的结果。图表仅供说明之用，反映假设的历史表现。请参阅本文档后面的性能披露，了解与回测性能相关的固有限制。

4 实际考虑意味着用于生成低波动性指数的方法可能因市场而异。例如，限制再平衡时换手率的缓冲可能适用于在流动性较低的市场中运行的低波动性指数。每个指数构建的完整细节可以在其方法中找到。例如，请参阅标准普尔低波动性指数方法。

**Exhibit 2b: Summary Statistics**

INDEX	RETURN (%)	VOLATILITY (%)	RETURN/RISK	TRACKING ERROR (%)	INFORMATION RATIO
S&P 500	10.14	14.04	0.72	-	-
S&P 500 Low Volatility Index	10.89	10.81	1.01	9.31	0.08

Source: S&P Dow Jones Indices LLC. Data from December 1990 to April 2018. Index performance based on annualized monthly total return in USD. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

Low volatility indices select stocks based on their *historical* volatilities.

### PERSISTENCE IN VOLATILITY RANKINGS

Since our low volatility indices select stocks based on their *historical* volatilities, it is natural to ask whether such a selection process is successful in identifying those stocks that will be less volatile *in the future*. In essence, the question relates to the persistence of volatility rankings among stocks over time.<sup>5</sup>

This has been an effective way of identifying those stocks that will be less volatile in the *future*.

Exhibit 3 illustrates the persistence of volatility rankings by quintile among S&P 500 constituents over a one-year time horizon. To construct Exhibit 3, we ranked year-end S&P 500 constituents between 1990 and 2017 according to their trailing one-year volatility, and sorted the results into quintiles (the lowest 20% by volatility that year, the next 20%, and so on). For those constituents that remained in the benchmark for two or more consecutive year-ends, **Exhibit 3 shows the resulting transition matrix**—the total percentages from each quintile that were ranked in the first, second, third, fourth, or fifth quintile at the subsequent annual ranking.

**Exhibit 3: S&P 500 Constituent Volatility Quintile Transition Matrix**

		QUINTILE IN SUBSEQUENT RANKING				
		1	2	3	4	5
INITIAL QUINTILE	1	67%	22%	8%	2%	1%
	2	25%	39%	23%	10%	2%
	3	7%	28%	36%	23%	6%
	4	1%	10%	28%	40%	21%
	5	0%	1%	6%	24%	69%

Source: S&P Dow Jones Indices LLC. Data from December 1990 to December 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

For example, the top left figure of 67% in Exhibit 3 represents the percentage of stocks in the lowest volatility quintile each year that remained in the lowest volatility quintile the next year. The figures along the leading diagonal—which represents those constituents that remained in the same quintile—are the largest in each row and column, and it is particularly clear

<sup>5</sup> Persistence in volatility levels in both absolute and relative terms over short- and medium-term time horizons is a well-known stylized fact. For more information, see Engle, Robert F. and Andrew J. Patton, "[What Good is a Volatility Model?](#)," *Quantitative Finance* Vol. 1, pp. 237-245 Jan. 29, 2001.

图表 2b：统计摘要

指数回报率 (%)	波动率 (%)	回报/风险	追踪错误 (%)	信息比率			
S&P500 10.14	14.04	0.72	S&P500 低波动指数 10.89	10.81	1.01	9.31	0.08

资料来源：S&PDow JonesIndices LLC。1990 年 12 月至 2018 年 4 月的数据。指数表现基于年化月度总回报（以美元计）。过去的表现并不能保证将来的结果。表格仅供说明之用，反映了假设的历史表现。请参阅本文档后面的性能披露，了解与回测性能相关的固有限制。

低波动性指数选择股票的依据  
他们的历史波动性。

### 波动性排名持续存在

由于我们的低波动性指数根据历史波动性来选择股票，因此很自然地会问这样的选择过程是否能够成功地识别出那些未来波动性较小的股票。本质上，这个问题与股票波动性排名随时间的持续性有关。

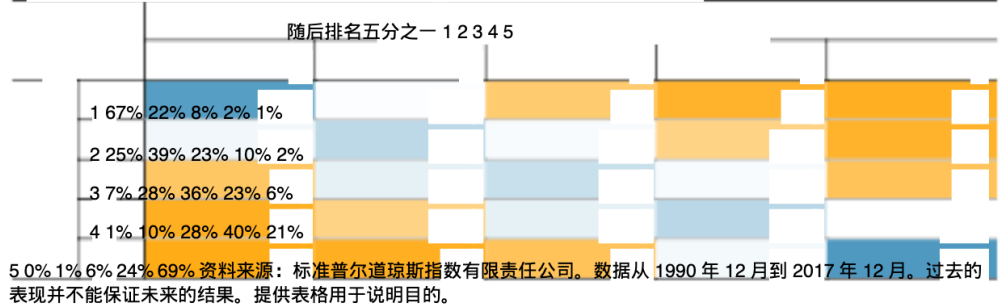
这已经是一个识别未来波动较小的股票的有效方法。

图表 3 显示了标准普尔 500 指数成分股在一年时间内按五分位排列的波动性排名的持续性。为了构建图表 3，我们根据过去一年的波动率对 1990 年至 2017 年年末标准普尔 500 指数成分股进行了排名，并将结果分为五分位数（当年波动率最低的 20%，接下来的 20%，依此类推）。对于那些在两个或两个以上的基准中保持不变的成分股

连续年底，图表 3 显示了最终的转换矩阵——

在随后的年度排名中，每个五分位数中排名第一、第二、第三、第四或第五五分位数的总百分比。

图表 3：S&P500 成分股波动率五分位转换矩阵



例如，图表 3 中左上角的数字 67% 代表每年处于波动性最低五分之一的股票在下一年仍处于波动性最低五分之一的股票的百分比。沿前导对角线的数字（代表保留在同一五分位中的那些成分）是每行和每列中最大的，并且特别清晰

5 在短期和中期时间范围内，绝对和相对波动水平的持续存在是一个众所周知的典型事实。欲了解更多信息，请参阅 Engle、Robert F. 和 Andrew J. Patton, “波动率模型有什么好处?”, 《量化金融》第 1 卷, 第 237245 页, 2001 年 1 月 29 日。

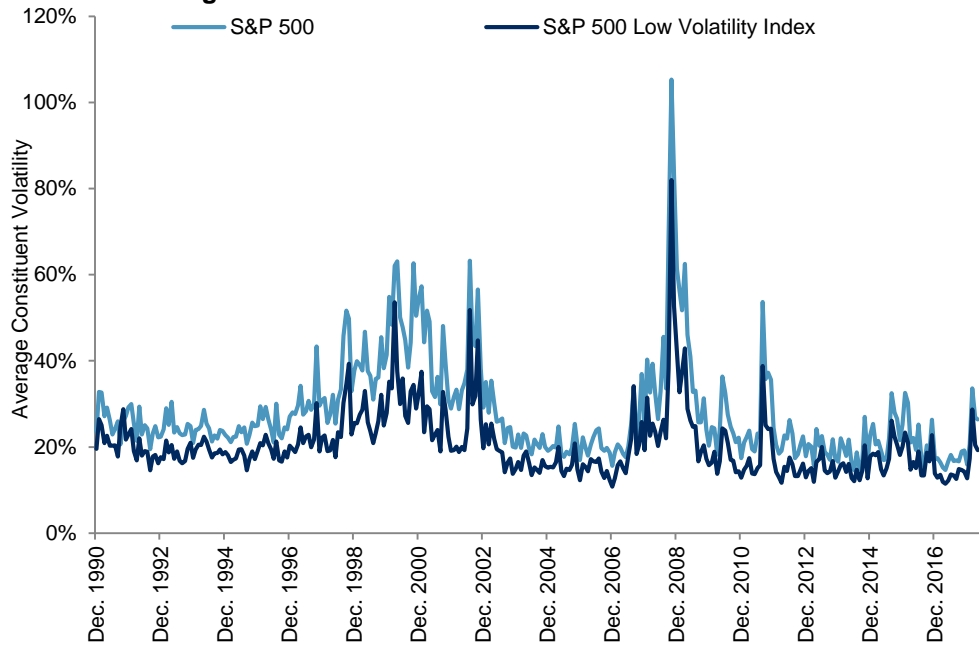


that **persistence in volatility ranks was highest for the most, and the least, volatile constituents**. Accordingly, Exhibit 3 provides a heuristic justification for selecting less volatile stocks based on trailing volatilities.

Less heuristically, Exhibit 4 provides explicit confirmation that **the index methodology was effective in selecting stocks that subsequently displayed lower volatility**. Exhibit 4 displays the lower historical (index-weighted) average volatility among S&P 500 Low Volatility Index constituents each month, compared with the equivalent average for the broader S&P 500. This reduction in average *constituent* volatility is a primary source for the lower *index* volatility shown in Exhibit 2b. In fact, over most time horizons, low volatility indices have nearly always proved less volatile than their benchmarks. Exhibit 20 in the Appendix provides a survey in the specific case of the S&P 500 Low Volatility Index.

Over most time horizons, low volatility indices were less volatile than their benchmarks.

**Exhibit 4: Average Constituent Volatilities Were Lower in the Low Vol Index**



Source: S&P Dow Jones Indices LLC. Data from December 1990 to April 2018. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

Less volatile single-period returns create the *potential* for higher multi-period returns, simply due to the non-linear impact that changes in volatility have on *compounded* return series.<sup>6</sup> In fact, **the historical performance of low volatility indices cannot be explained fully by such simple “geometric” effects.**<sup>7</sup> Instead, the key to their performance lies in the

<sup>6</sup> For example, an asset that rises 40% or falls 30% in alternative periods will eventually tend to zero value, while an asset that rises or falls by half as much in each period will grow indefinitely, despite the lower average return of the latter. This is essentially a consequence of the difference between arithmetic and geometric averages.

<sup>7</sup> See Chan, Fei Mei, and Craig J. Lazzara, “[In Search of the Low Volatility Anomaly: A Case Study](#),” S&P Dow Jones Indices, April 2016.

对于大多数人来说，波动性排名的持久性最高，并且最少的是挥发性成分。因此，图表 3 为根据跟踪波动率选择波动较小的股票提供了启发式理由。

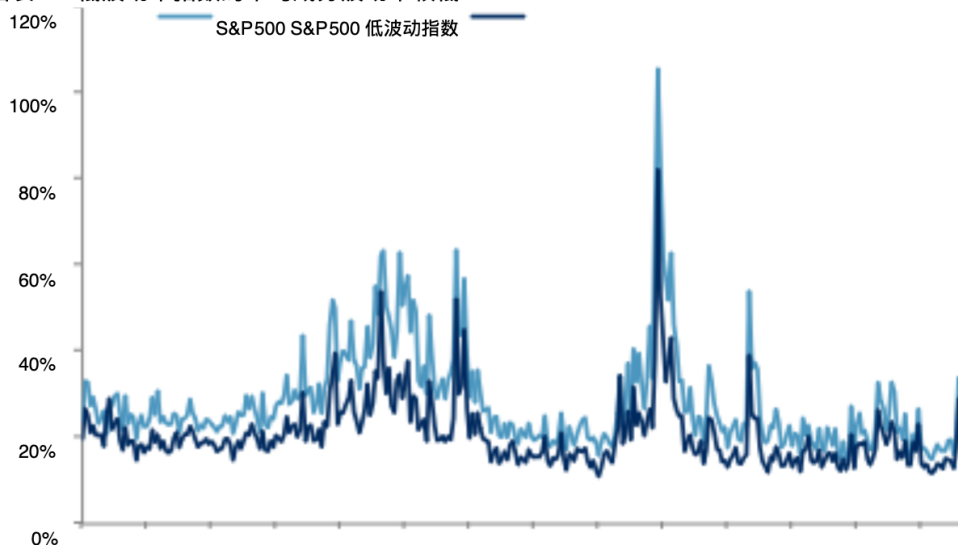
图表 4 明确地证实了该指数

该方法在选择股票方面是有效的

显示出较低的波动性。图表 4 显示，与更广泛的标准普尔 500 指数成分股的同等平均值相比，标准普尔 500 低波动性指数成分股每月的历史（指数加权）平均波动性较低。平均成分波动性的下降是图表中所示指数波动性较低的主要来源<sup>2b</sup>。事实上，在大多数时间范围内，低波动性指数几乎总是被证明其波动性低于其基准。附录中的图表 20 提供了针对 S&P500 低波动性指数具体情况的调查。

在大多数时间范围内，低波动性指数的波动性低于其基准。

图表 4：低波动率指数的平均成分波动率较低



资料来源：标普道琼斯指数有限责任公司。数据从 1990 年 12 月到 2018 年 4 月。过去的表现并不能保证未来的结果。图表仅供说明之用，反映假设的历史表现。请参阅本文档后面的性能披露，了解与回溯性能相关的固有限制。

波动性较小的单期回报创造了更高的多期回报的潜力，这仅仅是由于波动性变化对复合回报序列的非线性影响。事实上，低波动性指数的历史表现不能用这样简单的“相反，其性能的关键在于

6 例如，在不同时期上涨 40% 或下跌 30% 的资产最终将趋于零价值，而在每个时期上涨或下跌一半的资产将无限期增长，尽管后者的平均回报较低。这本质上是算术平均值和几何平均值之间差异的结果。

7 请参阅 Chan、Fei Mei 和 Craig J. Lazzara，“寻找低波动性异常：案例研究”，标普道琼斯指数，2016 年 4 月。

*difference* between the volatility reductions achieved during rising markets, compared with the volatility reductions achieved during declining markets. This aspect of low volatility indices is perhaps best approached via the concepts of “upside capture” and “downside capture” ratios—to which we now turn.

### UPSIDE AND DOWNSIDE CAPTURE RATIOS

Since they are composed of equities, low volatility indices typically rise when equity markets rise, and fall when equity markets fall.

Since they are composed of equities, low volatility indices typically rise when equity markets rise, and fall when equity markets fall, even if the lower volatility of their constituents means that their movements tend to be attenuated in both directions. However, **the extent to which low volatility indices participate in positive benchmark returns varies significantly from their typical participation in negative benchmark returns.** This lack of symmetry plays a significant role in the long-term performance of low volatility indices, and might also be said to provide a significant component of the investor interest in low volatility strategies more generally.

Exhibit 5 demonstrates the asymmetric nature of the relationship between the returns of the S&P 500 Low Volatility Index and the returns of the benchmark S&P 500 over various time horizons. Specifically, for each collection of non-overlapping intervals (days, weeks, months, etc.) in the period from December 1990 to April 2018, Exhibit 5 displays the average performance of the S&P 500, the average performance of the S&P 500 Low Volatility Index, and the ratio of the two, calculated on all the intervals where the S&P 500's returns were positive (upside capture) and, separately, on all the intervals where the S&P 500's returns were negative (downside capture).

Whether measured over days, weeks, months, quarters, or years, the S&P 500 Low Volatility Index displayed a higher upside capture ratio than downside capture ratio.

**Exhibit 5: Low Volatility Capture Ratios Across Various Time Horizons**

PERIOD	DURING WHICH S&P 500 RISES			DURING WHICH S&P 500 DECLINES		
	S&P 500	S&P 500 LOW VOLATILITY INDEX	UPSIDE CAPTURE	S&P 500	S&P 500 LOW VOLATILITY INDEX	DOWNSIDE CAPTURE
Trading Days (Total = 6,915)	0.73%	0.49%	<b>0.67</b>	-0.76%	-0.48%	<b>0.63</b>
Weeks (Total = 1,382)	1.60%	1.08%	<b>0.67</b>	-1.79%	-1.02%	<b>0.53</b>
Calendar Months (Total = 329)	3.10%	2.23%	<b>0.72</b>	-3.49%	-1.69%	<b>0.48</b>
Calendar Quarters (Total = 109)	6.14%	5.75%	<b>0.94</b>	-6.64%	-1.29%	<b>0.19</b>
Calendar Years (Total = 27)	17.38%	16.43%	<b>0.95</b>	-20.02%	2.32%	<b>-0.12</b>

Source: S&P Dow Jones Indices LLC. Data from December 1990 to December 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

For example, the third row of Exhibit 5 shows that the S&P 500 rose by an average of 3.10% in the months in which it gained, while the S&P 500 Low Volatility Index rose by an average of 2.23% in those months. The ratio of

市场上涨期间实现的波动性降低与市场下跌期间实现的波动性降低之间的差异。低波动性指数的这一方面也许最好通过我们现在转向的“上行捕获”和“下行捕获”比率的概念来解决。

### 上行和下行捕获比率

由于低波动性指数由股票组成，因此通常会在股市上涨时上涨，在股市下跌时下跌。

由于低波动性指数由股票组成，因此通常会在股市上涨时上涨，在股市下跌时下跌，即使其成分股的波动性较低意味着其走势往往会在两个方向上减弱。然而，低波动性指数参与正基准回报的程度与其典型参与负基准回报的程度有很大差异。这种缺乏对称性在低波动性指数的长期表现中发挥着重要作用，也可以说是投资者对低波动性策略兴趣的重要组成部分。

图表 5 显示了不同时间范围内标准普尔 500 低波动指数的回报与基准标准普尔 500 指数的回报之间关系的不对称性质。具体来说，对于 1990 年 12 月至 2018 年 4 月期间每个非重叠区间（天、周、月等）的集合，图表 5 显示了标普 500 指数的平均表现、标普 500 低波动率指数的平均表现指数以及两者的比率，根据标准普尔 500 指数回报为正的区间（上行捕获）以及标准普尔 500 指数回报为负的区间（下行捕获）分别计算。

是否测量  
在数日、数周、数月、季度或数年中，标普 500 低波动指数显示的上行捕获率高于下行捕获率。

图表 5：不同时间范围内的低波动率捕获率

时期	S&P500 上涨期间		S&P500 下跌		标准普尔 500 指数		标准普尔 500 指数						
	标准普尔 500 波动性	标准普尔 500 指数低位	标准普尔 500 指数低位	标准普尔 500 指数低位	标准普尔 500 指数	标准普尔 500 指数	标准普尔 500 指数	标准普尔 500 指数					
交易日 (总计 = 6,915)	0.73%	0.49%	0.67%	-0.76%	-0.48%	0.63	周 (总计 = 1,382)	1.60%	1.08%	0.67	-1.79%	-1.02%	0.53
日历月 (总计 = 329)	3.10%	2.23%	0.72	-3.49%	-1.69%	0.48	日历季度 (总计 = 109)	6.14%	5.75%	0.94	-6.64%	-1.29%	0.19
日历季 (总计 = 27)	17.38%	16.43%	0.95	-20.02%	2.32%	-0.12	资料来源：标普道琼斯指数有限责任公司。数据从 1990 年 12 月到 2017 年 12 月。过去的表现并不能保证未来的结果。表格仅供说明之用，反映了假设的历史表现。请参阅本文档后面的性能披露，了解与回测性能相关的固有限制。						

例如，图表 5 的第三行显示，标准普尔 500 指数在上涨的月份中平均上涨了 3.10%，而标准普尔 500 低波动指数在这些月份中平均上涨了 2.23%。的比例为

these two figures provides the monthly upside capture ratio of 0.72, which compares favorably with the monthly downside capture ratio, which was 0.48.

Higher dispersion in market declines may account for differences in capture ratios.

In fact, whether measured over days, weeks, months, quarters, or years, the S&P 500 Low Volatility Index displayed a **higher upside capture ratio than downside capture ratio**. Strikingly, **the difference increased with the length of the interval used for analysis**. In fact, over the four calendar years during which the S&P 500's total return was negative—an admittedly limited sample—the average total return of the S&P 500 Low Volatility Index was actually *positive*.

Rather than being specific to U.S. equities, **these characteristics extend universally to the global range of S&P Low Volatility Indices**. Exhibit 6 extends the analysis of Exhibit 5, focusing on the monthly capture ratios, to the collection of low volatility indices introduced earlier in Exhibit 1. For each index examined in Exhibit 6, the monthly upside capture ratio materially exceeded the downside capture ratio.

Part of what may be driving this result is the historical observation that **dispersion**<sup>8</sup>—interpreted as the difference, in magnitude, between relative winners and losers—**has generally been higher in months when the market fell**, compared with when it rose.<sup>9</sup> Since lower volatility stocks would naturally be expected to outperform during market declines, and to underperform during market gains, the difference in capture ratios may simply be a reflection of the proportionally larger relative rewards to outperforming in higher-dispersion markets.

<sup>8</sup> Edwards, Tim and Craig J. Lazzara, "[Dispersion: Measuring Market Opportunity](#)," S&P Dow Jones Indices, December 2013.

<sup>9</sup> Chan, Fei Mei and Craig J. Lazzara, "[The Best Offense: When Defensive Strategies Win](#)," S&P Dow Jones Indices, March 2015.

Other S&P Low Volatility Indices displayed a similar pattern of higher monthly upside capture ratios than downside capture ratios.

**Exhibit 6: Monthly Capture Ratios of Various S&P Low Volatility Indices**

INDEX	UPSIDE CAPTURE (MONTHLY)	DOWNSIDE CAPTURE (MONTHLY)
S&P Europe 350 Low Volatility Index	0.93	0.61
S&P Korea Low Volatility Index	0.87	0.58
S&P Pan Asia Low Volatility Index	0.74	0.51
S&P South Africa Low Volatility Index	0.84	0.46
S&P/ASX 200 Low Volatility Index	0.84	0.63
S&P/TSX Composite Low Volatility Index	0.71	0.31
S&P MidCap 400 Low Volatility Index	0.74	0.51
S&P SmallCap 600 Low Volatility Index	0.81	0.61
S&P Japan 500 Low Volatility Index	0.69	0.52
S&P BMI Emerging Markets Low Volatility Index	0.73	0.56

Source: S&P Dow Jones Indices LLC. Data based on monthly data from January 2001 to April 2018. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

Exhibit 6 offers a global perspective on the properties of low volatility indices; the broad similarity in their capture ratios may help to explain much of their long-term performance. However, not *all* practical aspects of low volatility index performance may be entirely explained through their capture ratios. Further insights may be gained through alternative perspectives; such as their sectoral exposures, their connections to macro factors like the interest rate environment, and their relationships to fundamental data, such as equity valuations. We begin with sectors.

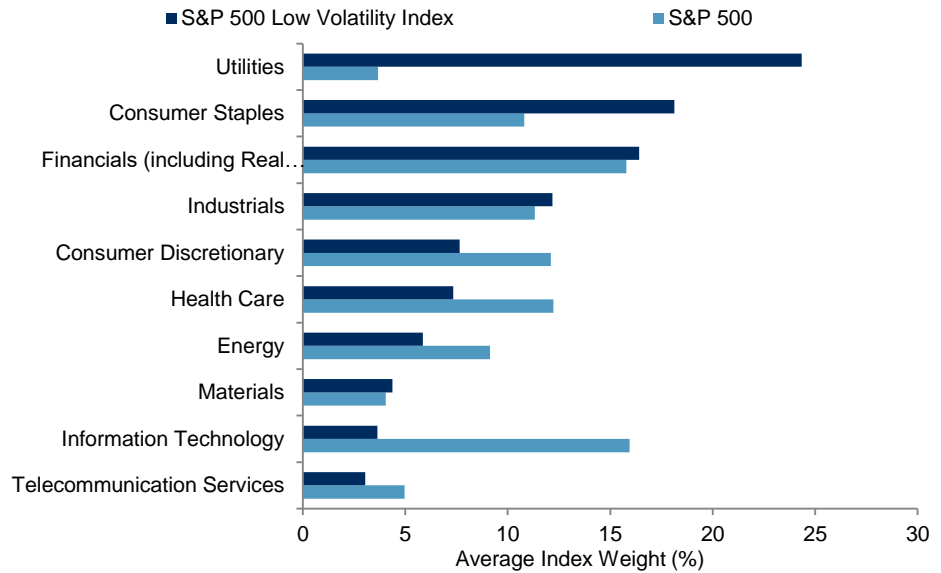
## LOW VOLATILITY AND SECTORS

S&P Low Volatility Indices can maintain significant sector tilts.

The constituent selections made at each rebalance of the S&P Low Volatility Indices are **unconstrained by sector**; the index allocates as much (or as little) to each sector as is determined by the overall ranks of the volatilities of the stocks in that sector. Since sectoral peers often display similar volatilities, and since **some sectors are typically less volatile than others**, the selection process is likely to result in **significant sector bets**, relative to a capitalization-weighted benchmark.

Exhibit 7 shows the average sector breakdown of the S&P 500 in comparison to that of the S&P 500 Low Volatility Index, averaged over calendar months in the period from December 1990 to April 2018. As might be expected, on average, the S&P 500 Low Volatility Index showed significant tilts toward utilities and consumer staples, and away from information technology.

**Exhibit 7: Comparing Average Sector Weights**

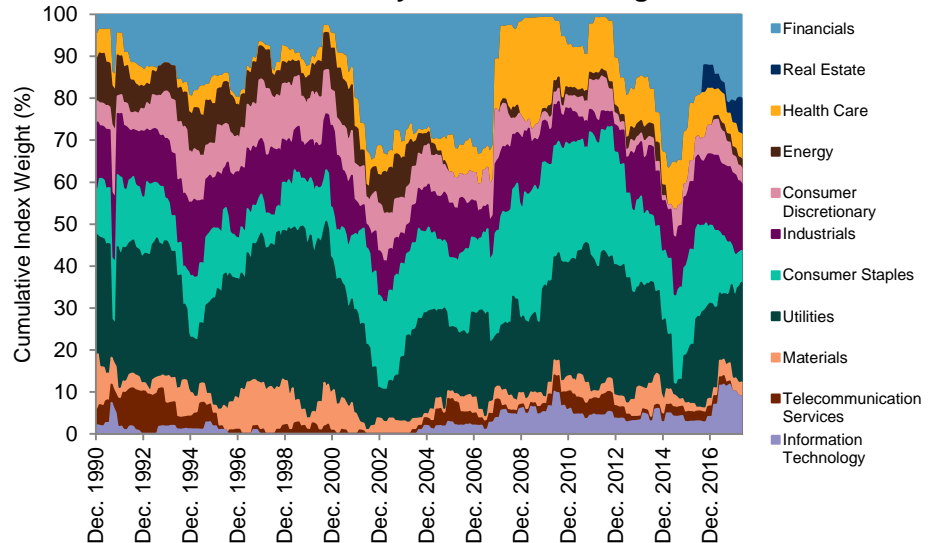


Source: S&P Dow Jones Indices LLC. Data based on monthly index weights from December 1990 to April 2018. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

The sector tilts of low volatility indices can vary significantly over time.

However, **the sector compositions (and tilts) of low volatility indices can vary significantly over time.** Exhibit 8 shows the sectoral breakdown of the S&P 500 Low Volatility Index for each month in the period from December 1990 to April 2018. Note the near-total reduction in the financials weight (top series) in the lead-up to the 2008 financial crisis, and the lack of any significant allocation to information technology (bottom series) in the lead-up to the “dotcom bubble”, and its aftermath.

**Exhibit 8: S&P 500 Low Volatility Index Sector Weights**



Source: S&P Dow Jones Indices LLC. Data based on monthly index weights from December 1990 to April 2018. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Real Estate became a GICS® sector in September 2016; it was included in Financials prior to this date. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

The high degree of variation in sector weights in the S&P 500 Low Volatility Index raises the question as to how much of the improvement in risk-adjusted returns comes from sectoral allocations. In order to answer this question, we apply the monthly returns of the (cap-weighted) S&P 500 sector indices to the respective historical sector weights in the S&P 500 Low Volatility Index to produce a hypothetical return series—referred to here as the “**Sector-Based Low Vol**” portfolio.<sup>10</sup> Comparing the returns and volatility of this hypothetical portfolio to the S&P 500 and S&P 500 Low Volatility Index provides an indication of **how much of the differential in their risk and return was generated through sectoral differences alone**. Exhibit 9 provides a summary.

INDEX	TOTAL RETURN (%)	VOLATILITY (%)	RETURN/RISK
S&P 500	15.27	17.64	0.87
Sector-Based Low Vol	15.01	14.87	1.01
S&P 500 Low Volatility Index	16.41	13.00	1.26
<b>Sector Contribution</b>	<b>-0.26</b>	<b>-2.77</b>	<b>0.14</b>
<b>Stock Contribution</b>	<b>1.39</b>	<b>-1.86</b>	<b>0.25</b>

The Sector-Based Low Vol portfolio is a hypothetical portfolio. Source: S&P Dow Jones Indices LLC. Data based on monthly index weights from December 1990 to April 2018. All figures are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

Over the full history, sector tilts accounted for most of the risk-reduction in the S&P 500 Low Volatility Index.

Between December 1990 and April 2018, the hypothetical portfolio representing the sector tilts of the S&P 500 Low Volatility Index displayed an annualized total return that was 0.26% lower than that of the S&P 500. However, its annualized volatility was 2.77% lower than that of the S&P 500; a proportionally greater reduction, resulting in an improved risk/return ratio.

Stock selection was more helpful for the low volatility index's returns.

Accordingly, we may conclude that both sector tilts and stock selection helped to improve the risk/return profile of the S&P 500 Low Volatility Index. Sector allocations contributed more significantly through risk reduction, while stock selection effects were responsible for the improvement in absolute returns. In fact, *all* of the historical return outperformance of the S&P 500 Low Volatility Index was generated by stock picks *within* each sector, rather than by sector selection itself.

<sup>10</sup> The process applied here is essentially equivalent to a so-called “Brinson” attribution; Brinson, Gary P., L. Randolph Hood, and Gilbert L. Beebower, “[Determinants of Portfolio Performance](#),” *Financial Analysts Journal*, 42(4), 39-44, July 1986. The idea is that the difference in performance between a portfolio and its benchmark can be separated into “timing” (in this case, sector allocation) and “security selection” (in this case, stock selection within each sector).

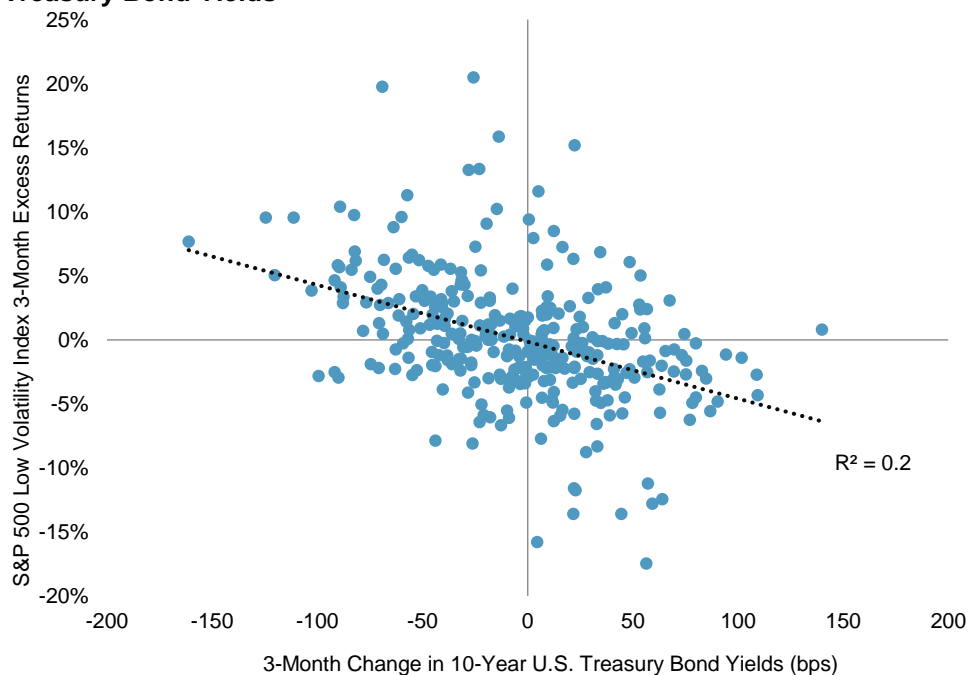


## LOW VOLATILITY AND INTEREST RATES

The relationship between low volatility indices and interest rates (or longer-dated bond yields) is of importance for two reasons. The first is that **the two are empirically, and naturally, related**. The second is that, during the period in which the performance of low volatility indices can be examined, there has been a global, multi-decade decline in interest rates. Accordingly, **the practitioner may ask whether the historically attractive performance of low volatility strategies might be attributed to multi-decade (and perhaps once-in-a-lifetime) changes in the fixed income environment**.

Exhibit 10 plots the historical relationship between the rolling three-month relative performance of the S&P 500 Low Volatility Index, compared with the contemporaneous change in the benchmark 10-year U.S. Treasury Bond yields. A negative association is clearly visible.

**Exhibit 10: S&P 500 Low Volatility Index Relative Returns and 10-Year U.S. Treasury Bond Yields**



When the equity market crashes, U.S. Treasury Bond yields tend to fall amid a “flight to safety”.

Source: S&P Dow Jones Indices LLC. Data based on monthly total return index levels and yield to maturities from November 1990 to April 2018. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

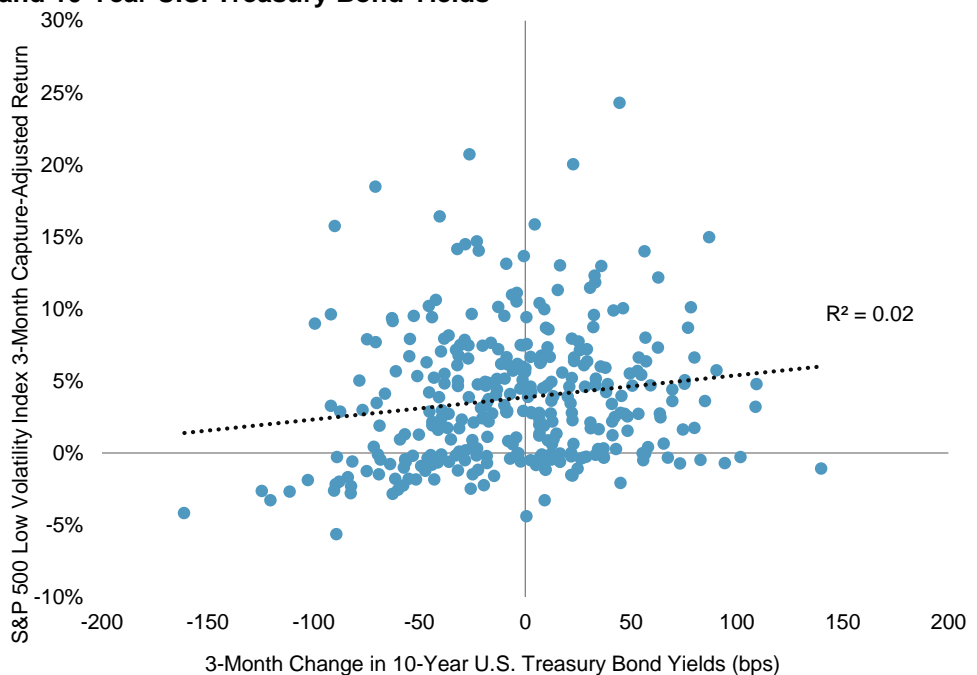
The relationship highlighted by Exhibit 10 depends on a further variable: the S&P 500's returns in the period. When the equity market crashes, U.S. Treasury Bond yields—especially the yields of highly rated bonds—tend to fall amid a “flight to safety”. Conversely, U.S. Treasury Bond yields tend to rise in strong equity bull markets. Since low volatility indices tend to lag in bull markets and outperform in bear markets, it's entirely possible that the

relationship shown in Exhibit 10 is **simply a manifestation of their shared association to the overall equity market's direction**. In fact, this appears to be the case.

To demonstrate this, we first computed a “capture-adjusted” excess return for the S&P 500 Low Volatility Index equal to *the return in excess of what might be expected, given the benchmark's returns and the expected capture ratio*. The capture-adjusted excess return is calculated as the difference between (i) the S&P 500 Low Volatility Index's returns, and (ii) the product of S&P 500's returns and the appropriate upside or downside capture ratio for a three-month period (see Exhibit 5). **If the only relationship between bond yields and S&P 500 Low Volatility Index performance came from the equity market environment, we should expect to find no correlation between bond yields and the capture-adjusted excess returns**. Exhibit 11 confirms that this is the case; the trend line changes sign, while **the correlation effectively falls to zero**.

**Exhibit 11: Capture-Adjusted S&P 500 Low Volatility Index Relative Returns and 10-Year U.S. Treasury Bond Yields**

The performance of low volatility equity strategies is far more dependent on the direction of the equity market than on that of the bond market.



Source: S&P Dow Jones Indices LLC. Data based on monthly total return index levels and yield to maturities from November 1990 to April 2018. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

Accordingly, taken together, Exhibits 10 and 11 demonstrate that the performance of low volatility equity strategies is far more dependent on the direction of the equity market than on that of the bond market.<sup>11</sup>

<sup>11</sup> This point has been raised before. See Chan, Fei Mei, “[Rising Rates Arrive](#)”, March 23, 2017.

## LOW VOLATILITY AND VALUATIONS

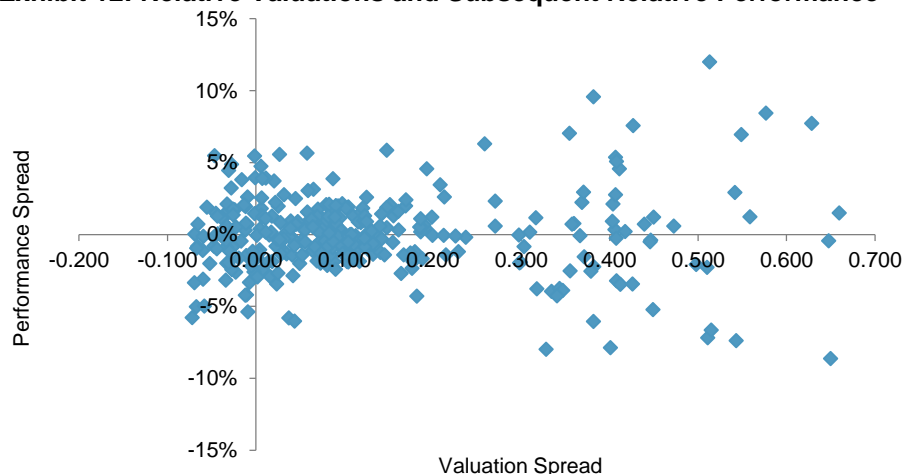
While so-called “quant” hedge funds and related institutions have been offering and implementing low volatility equity strategies for several decades, low-cost index funds and ETFs tracking low volatility indices are a more recent phenomena. The increasing popularity of such index-linked products has led some to query whether the more recent performance of low volatility indices may be explained *precisely by their growing popularity*.

So, is low volatility suffering from a form of “crowding”? The question has clear merit when examining *any* non-capitalization-weighted strategy, the continued attractiveness of which necessarily relies on the inability or disinclination of a sufficiently large base of investment capital to diminish future returns by adopting those strategies themselves. In other words, investment flows into low volatility strategies—if they are to be informative—must be compared with the magnitude and motivations of investors “taking the other side” and underweighting low volatility stocks.

We shall consider this question again in the context of the causes, and putative persistence, of the low volatility “anomaly”. Returning to present concerns, we consider the related question: whether the performance of low volatility strategies in fact arose because lower volatility equities were once “cheap”, and are now “expensive”. In other words, **the practitioner may ask whether low volatility is essentially a disguised form of “value” investing**. Exhibit 12 highlights the results of an earlier study examining the relationship between relative valuations and the performance of low volatility strategies.<sup>12</sup>

Valuations cannot “explain away” the historical returns of low volatility.

**Exhibit 12: Relative Valuations and Subsequent Relative Performance**



Source: S&P Dow Jones Indices LLC, “The Valuation of Low Volatility,” November 2016. Data from Dec. 31, 1990, to June 30, 2016. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the back of this document regarding the inherent limitations associated with back-tested performance.

<sup>12</sup> Chan, Fei Mei and Craig J. Lazzara, “[The Valuation of Low Volatility](#),” S&P Dow Jones Indices, November 2016.

Exhibit 12 compares the relative valuation of the S&P 500 Low Volatility Index against its relative performance in the subsequent month (both measures are relative to the S&P 500).<sup>13</sup> **If a causal link exists between relative valuations and relative performance, it is very difficult to see:** there has been substantial variation in relative returns following similar relative valuations. Other researchers have found similar results.<sup>14</sup> Suffice to say, **valuations do not appear to “explain away” the historical returns of low volatility.**

Although we shall return to the topic of whether the performance characteristics of low volatility indices might persist, this completes our review of the key drivers and aspects of their historical performance. We turn now to portfolio applications.

## LOW VOLATILITY IN MULTI-FACTOR PORTFOLIOS

Although the downside protection associated with low volatility indices may be attractive for turbulent times, many managers (and asset owners) also wish to participate fully in market gains. In other words, a commitment to low volatility strategies can become challenging to maintain during extended bull markets.

A commitment to low volatility can be challenging to maintain in bull markets.

One way to manage the tracking error implicit in low volatility strategies is to combine them with other investments exhibiting complementary characteristics. An example is provided by momentum (or relative strength) strategies, which typically outperform in extended periods of strong market gains. For example, the upside capture ratio of the [S&P 500 Momentum](#) between September 1994 and April 2018 was 1.06.<sup>15</sup>

One way to manage this is to combine low volatility with strategies that demonstrate complementary characteristics.

Exhibit 13 illustrates the cumulative excess returns of the S&P 500 Low Volatility Index and the S&P 500 Momentum,<sup>16</sup> the latter chosen to be representative of momentum strategies in large-cap U.S. equities. A rise in either line means the corresponding index outperformed the S&P 500 that month. Generally—although not always—if one outperformed, the other underperformed (more precisely, the correlation of their excess monthly returns was -0.24).

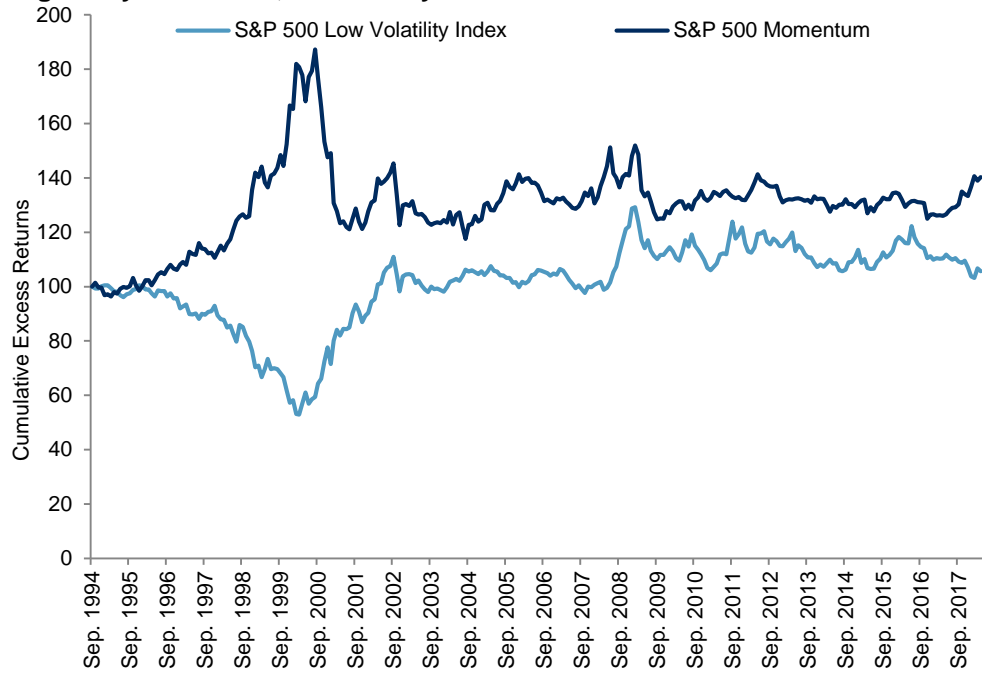
<sup>13</sup> Ibid.

<sup>14</sup> See Blitz, David, “[The Value of Low Volatility](#),” *The Journal of Portfolio Management*, Feb. 10, 2016.

<sup>15</sup> The upside capture ratio is based on monthly total return levels.

<sup>16</sup> For more information on momentum and S&P DJI's momentum methodology, see Preston, Hamish, “[Momentum: A Practitioner's Guide](#),” S&P Dow Jones Indices, January 2017.

**Exhibit 13: Excess Returns to Low Volatility and Momentum Have Been Negatively Correlated, Historically**



The hypothetical Blended portfolio displayed a greater participation in bull markets.

Source: S&P Dow Jones Indices LLC. Data based on monthly total return index levels from September 1994 to April 2018. Excess returns calculated by subtracting S&P 500 total returns. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

To illustrate the potential benefits of combining low volatility and momentum strategies, we constructed a hypothetical “Blended” portfolio containing both. Our hypothetical blend allocates 75% to the S&P 500 Low Volatility Index and 25% to the S&P 500 Momentum, assuming a quarterly rebalance. (The annualized volatility of this blend is approximately equal to that of the S&P 500 Low Volatility Index.) Exhibit 14 provides summary statistics for the period between September 1994 and April 2018.

**Exhibit 14: Hypothetical Blend Versus the S&P 500 Low Volatility Index and S&P 500 Momentum**

INDEX	RETURNS (% ANN.)	VOLATILITY (% ANN.)	RETURN/RISK	UPSIDE CAPTURE (MONTHLY)	DOWNSIDE CAPTURE (MONTHLY)	TRACKING ERROR (% ANN.)
Blended	11.36	11.00	1.03	0.80	0.58	7.19
S&P 500 Low Volatility Index	11.01	11.06	1.00	0.71	0.45	9.83
S&P 500 Momentum	11.36	16.67	0.68	1.06	0.98	8.82
S&P 500	9.74	14.50	0.67	-	-	-

The Blended portfolio is a hypothetical portfolio.

Source: S&P Dow Jones Indices LLC. Data from September 1994 to April 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

As we might have expected, the hypothetical Blended portfolio displayed a greater participation in bull markets than the S&P 500 Low Volatility Index;

the upside capture ratio was 0.80 compared with 0.71 for the S&P 500 Low Volatility Index. Naturally, the downside capture ratio also rose. However, a diversification benefit also arose from the combination, as evidenced by the higher return/risk ratio. The Blended portfolio's lower tracking error to the S&P 500, combined with its outperformance, also meant that the information ratio would have increased.

Of course, we have only scratched the surface of combining low volatility with other factors, or indeed combining factors more generally. We note in passing that in addition to momentum, **growth and equal-weight strategies may also offer attractive diversification characteristics** to low volatility, and highlight the growing literature on their combinations.<sup>17</sup>

## LOW VOLATILITY IN MULTI-ASSET PORTFOLIOS

Equity allocations are frequently part of a broader multi-asset mix.

The previous section considered practical applications of low volatility within equity portfolios. Of course, equity allocations are frequently part of a broader multi-asset mix; **including other components that already offer a degree of downside protection**, such as fixed income. This section illustrates—somewhat stylistically—how **low volatility equity indices can provide practitioners with an expanded toolkit** for multi-asset portfolio construction.

We shall offer two examples of multi-asset applications: first, showing how a simple equity/bond mix might be improved with the addition of a low volatility sleeve; and second, illustrating how low volatility strategies may be used to gain access to more volatile markets without significant sacrifices to risk management.

To begin, we consider three highly simplified equity/bond portfolios, constructed to represent stylized “conservative”, “moderate” and “growth” objectives. These “traditional” portfolios each comprise static, rebalanced combinations of the S&P 500 and the [S&P U.S. Treasury Bond Index](#). The conservative portfolio allocates 50% to both the equity and fixed income index, the moderate portfolio represents a 60% equity/40% bond mix, while the growth portfolio reflects a 70% equity/30% bond combination.

We also form “alternative” hypothetical portfolios, also rebalanced monthly to fixed allocations, which employ the S&P 500 Low Volatility Index as an additional option, occupying the middle ground between the lower-risk fixed income and higher-risk equity allocations. Providing the allocations in the form S&P U.S. Treasury Bond Index/S&P 500/S&P 500 Low Volatility Index, the “conservative” version holds a 40%/30%/30% split; the

<sup>17</sup> See Chan, Fei Mei and Craig J. Lazzara, “[The Sum of the Parts](#),” May 2017 and also “[Outperformance in Equal Weight Indices](#),” January 2018, pp. 23.

“moderate” version holds 30%/40%/30% allocations; and the final “growth” portfolio holds a 20%/50%/30% mix.<sup>18</sup>

Exhibit 15 provides pro forma summary statistics of the various traditional and alternative combinations. In each case, the alternative portfolios experienced higher returns without a commensurate increase in risk. This is primarily because **the inclusion of the S&P 500 Low Volatility Index allowed the alternative portfolios to have less exposure to bonds (and more to equities) at the same level of portfolio risk.**

Incorporating low volatility within a traditional equity/bond allocation could have delivered higher returns without a commensurate increase in risk.

**Exhibit 15: Summary Statistics**

CATEGORY	CONSERVATIVE		MODERATE		GROWTH	
	TRAD	ALT	TRAD	ALT	TRAD	ALT
Return (%)	7.8	8.6	8.4	9.1	8.8	9.6
Excess Return (% Ann.)	-	0.7	-	0.7	-	0.7
Return Volatility (% Ann.)	7.0	7.1	8.4	8.3	9.7	9.7
Return/Risk (Ann.)	1.12	1.21	1.00	1.09	0.91	0.99

All portfolios are hypothetical. Trad represents the traditional portfolio. Alt represents the alternative portfolio.  
 Source: S&P Dow Jones Indices LLC. Data based on monthly total return index levels from December 1990 to April 2018. All volatility and return figures are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Thus, the option of incorporating low volatility equity strategies within a multi-asset portfolio may offer the potential for a more calibrated approach to risk management and can improve long-term, or risk-adjusted, returns.

Turning to our second illustrative example, consider the position of a hypothetical asset owner originally following the “traditional” and “moderate” 60/40 allocation described above. Suppose this asset owner wished to gain exposure to emerging market equities, yet was concerned about the potential volatility such an allocation may entail. How might low volatility help?

To illustrate the problem and one potential solution, we consider three simple portfolios. The “U.S.” portfolio maintains 60% in the S&P 500 and 40% in the S&P U.S. Treasury Bond Index, and is recognizable as the moderate, traditional option above. The “U.S. + EM” portfolio holds 40% in each of the S&P 500 and the Treasury Bond Index, as well as 20% in the [S&P Emerging BMI](#). Finally, the “U.S. + Low Vol EM” portfolio replaces the S&P Emerging BMI in the U.S. + EM portfolio with the [S&P BMI Emerging Market Low Volatility Index](#).

<sup>18</sup> The allocations were set such that the volatility of each alternative portfolio was similar to that of its traditional counterpart over the entire period, provided that the low volatility allocation was set at 30%.

Exhibit 16 provides summary statistics for these hypothetical portfolios, assuming, as before, a monthly rebalance to static weights. (Note that the figures for the U.S. portfolio differ from those of Exhibit 15 due to the shorter history available for the emerging market indices.)

The addition of an emerging market-based low volatility strategy might have provided a way to access the higher returns of those markets, but without a significant increase in risk.

**Exhibit 16: Summary Statistics**

CATEGORY	U.S.	U.S. + EM	U.S. + LOW VOL EM
Return (%)	6.23	6.53	6.72
Risk (%)	8.53	9.54	8.20
Return/Risk	0.73	0.68	0.82

All portfolios are hypothetical.  
 Source: S&P Dow Jones Indices LLC. Data based on monthly total return index levels from January 2001 to April 2018. All figures are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

As Exhibit 16 shows, replacing some U.S. equity exposure with a capitalization-weighted emerging market exposure might have delivered higher returns, but at a substantially higher level of overall risk. In contrast, the addition of an emerging market-based low volatility strategy might have provided a way to access the higher returns of those developing markets, but without a significant increase in risk. In fact, diversification effects might have allowed for an overall risk reduction.

These examples of potential applications of low volatility indices in a portfolio context are predicated on the assumption that the historical performance of low volatility will persist. **It is critical, therefore, to ask whether low volatility indices might display similarly higher risk-adjusted returns in the next few decades, as they displayed in the past.** While we cannot hope to answer this question definitively, the next section aims to provide the grounds on which optimism—or pessimism—might be founded.

It is critical to ask whether low volatility indices will offer improved risk-adjusted returns in the future.

### PERSISTENCE OF THE LOW VOLATILITY ANOMALY

Explanations for the low volatility "anomaly" typically approach the problem from the opposite angle: offering behavioral or structural theories as to **why higher volatility stocks might underperform**. From this perspective, the low volatility anomaly arises because investors "overpay" for riskier stocks compared to more pedestrian alternatives.

On the behavioral side, the "**preference for lotteries**" theory argues that the price of higher volatility stocks is elevated by a phenomenon analogous to the demand for—and purchase of—lottery tickets. Buyers of volatile stocks may well appreciate that, *on average*, they are likely to be disappointed but **they are willing to make a purchase, simply because of the possibility of extreme gains**. To the extent that some (or many)



investors continue to value extreme gains more highly than would be strictly proportional, the low volatility anomaly has the potential to persist.<sup>19</sup>

On the structural side, one can question the very premise that expected returns (in excess over a risk-free rate) should be commensurate with risk. This premise arises from the belief that market participants will arbitrage away any discrepancies—for example, by selling higher volatility stocks in favor of leveraged positions in less volatile stocks. In practice however, for many investors, the use of leverage is restricted by policy or incurs significant additional costs beyond a risk-free rate. In other words, **there may simply not be enough “arbitrageurs”** who are willing and able to exploit such tactics. **This creates the *potential* for lower-risk stocks to offer higher risk-adjusted returns.**<sup>20</sup>

Behavioral and structural reasons may be important in explaining the performance of low volatility indices.

This argument continues by noting that many institutional portfolios and funds maintain a non-zero allocation to cash equivalents in their equity portfolios, in order, for example, to meet operational needs or as a consequence of trading activity.<sup>21</sup> Of course, **unless it is biased towards stocks with a higher-than-average participation in market movements (or employs leverage) any equity portfolio with a significant cash allocation will likely lag the market when it rises.** Since many equity managers target one-to-one participation in the market's gains, they are obliged to bias their portfolios towards higher-risk stocks. Thus—the argument concludes—the disproportionate demand from institutional investors for higher-risk stocks provides the initial source of the low volatility anomaly, while the limited availability of low-cost leverage explains the inability of arbitrageurs to diminish it.<sup>22</sup>

In practice, a combination of structural and behavioral effects may be important in determining the performance of low volatility strategies.<sup>23</sup> While we cannot say whether they will continue, Exhibit 17 illustrates that the S&P 500 Low Volatility Index—one of the most widely followed of its kind—typically offered an improvement in risk-adjusted returns, and this has not visibly diminished since its launch in 2011. Historically, only around the “dotcom bubble” did the S&P 500 Low Volatility Index endure an extended period of underperformance—unsurprisingly, given the roaring

<sup>19</sup> Bali, Turan G., Stephen Brown, Scott Murray, and Yi Tang, “[A Lottery Demand-Based Explanation of the Beta Anomaly](#),” *Journal of Financial and Quantitative Analysis*, 52(6), 2369-2397, Dec. 1, 2016.

<sup>20</sup> Baker, Malcom, Brendan Bradley, and Jeffrey Wurgler, “[Benchmarks as Limits to Arbitrage: Understanding the Low-Volatility Anomaly](#),” *Financial Analysts Journal*, Vol. 67, No. 1, pp. 40-54, Jan. 21, 2011.

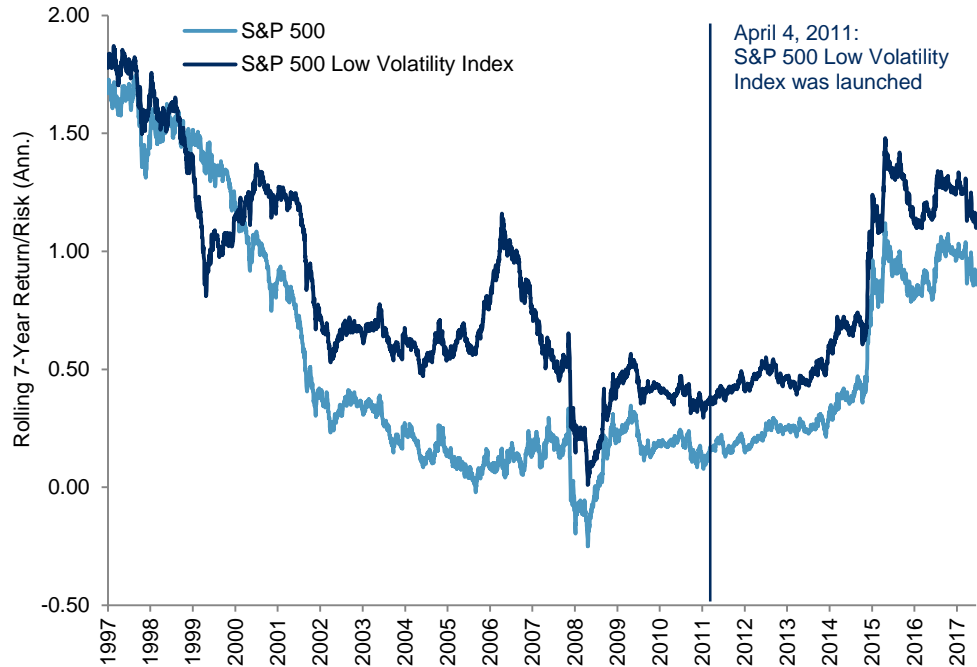
<sup>21</sup> See Edwards, Tim, Craig J. Lazzara, and Luca Ramotti, “[The Volatility of Active Management](#),” S&P Dow Jones Indices, August 2016, for empirical evidence that actively managed U.S. equity mutual funds appear to display a structural preference for higher-beta stocks in generating higher-risk portfolios, but prefer cash allocations in de-risking.

<sup>22</sup> See also Frazzini, Andrea and Lasse Heje Pedersen, “[Betting Against Beta](#),” *Journal of Financial Economics*, Vol. 111, Issue 1, January 2014. For an examination of the persistence of the low volatility anomaly, see Edwards, Tim, Craig J. Lazzara, and Hamish Preston, “[The Persistence of Smart Beta](#),” S&P Dow Jones Indices, pp. 13-15, October 2015.

<sup>23</sup> For an overview of academic literature on the low volatility anomaly, see Soe, Aye, “[The Low-Volatility Effect: A Comprehensive Look](#),” S&P Dow Jones Indices, August 2012.

bull market of the time and low volatility's propensity to underperform during market gains.

**Exhibit 17: Return/Risk Ratio Has Not Diminished Since 2011**



The S&P Low Volatility Index was launched on April 4, 2011.

The improvement in risk-adjusted returns has not visibly diminished since then.

Source: S&P Dow Jones Indices LLC. Data based on daily total return index levels from Nov. 16, 1990, to April 30, 2018. All figures are annualized. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

### LOW VOLATILITY OR MINIMUM VOLATILITY INDICES?

We conclude by offering a summary of the differences between low volatility indices (as discussed so far) and the similar, yet importantly different, concept of *minimum* volatility indices.<sup>24</sup>

At a basic level, low volatility indices form portfolios from the *least volatile* stocks out of a given universe. In contrast, minimum volatility indices aim to select *the least volatile portfolio* of stocks from all possible portfolios of stocks. Consequently, **a minimum volatility index might well contain some stocks with relatively high volatilities, if their correlation with the rest of the portfolio is low enough to provide a diversification benefit.**

In part because the universe of all possible portfolios is a *lot* bigger than the universe of possible portfolio constituents, minimum volatility indices require greater sophistication in both selection and weighting. Typically, an optimization procedure is applied to find the particular combination of

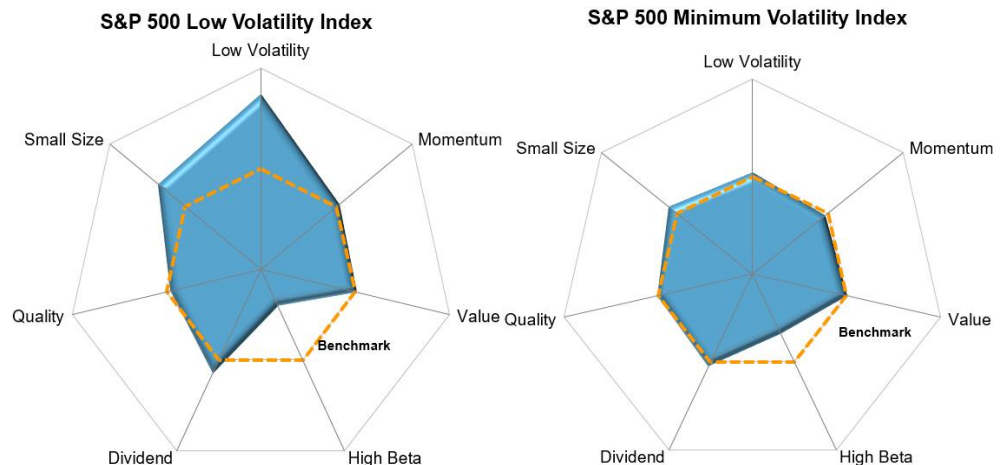
<sup>24</sup> For a full comparison of low and minimum volatility indices, please see Brzenk, Phillip and Aye Soe, "[Inside Low Volatility Indices](#)," S&P Dow Jones Indices, January 2017.

stocks that results in the least volatile portfolio. Minimum volatility indices also employ constraints at a sector and factor level, limiting the extent to which the final combination deviates from its benchmark and limiting the potential turnover at each rebalance.<sup>25</sup>

One way to demonstrate the impact of these differences in methodology is to consider the factor exposure of the two indices, as summarized in S&P DJI's quarterly S&P 500 Factor Dashboard.<sup>26</sup> Exhibit 18 shows the factor exposures of the S&P 500 Low Volatility Index and the [S&P 500 Minimum Volatility Index](#) as of Q1 2018. The central dotted line represents the (neutral by definition) factor exposures of the benchmark S&P 500, the outer line (inner line) represents the factor exposure for a portfolio owning the single S&P 500 stock with the highest (lowest) factor score. A point halfway from the benchmark to the outer edge would indicate a portfolio with the same average exposure to low volatility stocks as a cap-weighted portfolio containing half the capitalization of the S&P 500, selected from the lowest-ranked stocks by volatility (or momentum, or value, and so on).<sup>27</sup>

**Exhibit 18: Low Volatility and Minimum Volatility Indices Can Have Different Factor Exposures**

Minimum volatility indices are different to low volatility indices. Their factor exposures illustrate differences in their construction.



Source: S&P Dow Jones Indices LLC. S&P 500 Factor Dashboard Q1 2018. Data as of March 29, 2018. Past performance is no guarantee of future results. Charts are provided for illustrative purposes.

As Exhibit 18 illustrates, **minimum volatility indices do not necessarily maintain a significant bias towards lower volatility stocks.** This may help to explain why the S&P 500 Minimum Volatility Index has typically provided more volatile returns than the S&P 500 Low Volatility Index. For example, computing rolling 12-month trailing volatilities in each index between December 1991 and April 2018 shows that the S&P 500 Low Volatility Index offered less volatile returns in 67% of the 317 months. On the other hand, due to their unconstrained design, low volatility indices can

<sup>25</sup> See the [S&P 500 Minimum Volatility Index Methodology](#).

<sup>26</sup> For more information, please see the [S&P 500 Factor Dashboard](#) as of Q1 2018.

<sup>27</sup> A more detailed explanation of factor diagrams is offered in Lazzara, Craig, "[Visualizing Factor Exposures](#)," Jan. 3, 2017.

maintain a higher tracking error to their benchmark, and may also require higher levels of turnover to replicate.

## CONCLUSIONS

S&P Dow Jones Indices publishes a range of low volatility equity indices, offered in various markets as the basis for benchmarks or investment products. These indices operate by selecting stocks that have historically displayed lower volatility than their peers, a process that has resulted in the indices typically selecting stocks that were less volatile in the future.

Over extended time periods, many of these indices have displayed relatively attractive investment characteristics in comparison with their parent benchmarks—nearly always displaying less risk, often displaying an improved risk/return ratio and, in several cases, even offering an improvement in total returns.

The performance of low volatility indices may be understood through their different upside and downside capture ratios, a feature that helps to explain how these indices relate to, and may outperform, their benchmarks over the market cycle. Further perspectives may be offered by their sectoral allocations, which typically differ significantly from those of their benchmark.

When combined with other factor-based equity indices, or when used within a multi-asset context, low volatility indices can provide tools suitable to a more calibrated approach to risk management and return generation.

Low volatility indices can provide tools suitable to a more calibrated approach to risk management and return generation.

## APPENDIX

Exhibit 19: SPDJI Low Volatility Indices		
LOW VOLATILITY INDEX	PARENT INDEX	LAUNCH DATE
S&P 500 Low Volatility Index	S&P 500	April 4, 2011
S&P BMI International Developed Low Volatility Index	S&P Developed BMI Ex-U.S. & Korea LargeMidCap	December 5, 2011
S&P BMI Emerging Markets Low Volatility Index	S&P Emerging Plus LargeMidCap	December 5, 2011
S&P 500 Low Volatility Index CAD Hedged	S&P 500	January 24, 2012
S&P Europe 350 Low Volatility Index	S&P Europe 350	July 9, 2012
S&P MidCap 400 Low Volatility Index	S&P MidCap 400	September 24, 2012
S&P SmallCap 600 Low Volatility Index	S&P SmallCap 600	September 24, 2012
S&P Pan Asia Low Volatility Index	S&P Pan Asia Ex-NZ LargeMidCap	November 19, 2012
S&P Korea Low Volatility Index	S&P Korea BMI	May 8, 2013
S&P Nordic Low Volatility Index	S&P Nordic BMI	May 17, 2013
S&P South Africa Low Volatility Index	S&P South Africa Composite	January 29, 2014
S&P Southern Europe Low Volatility Index	S&P Italy BMI, S&P Portugal BMI, S&P Spain BMI	February 28, 2014
S&P Emerging Markets Low Volatility Select Index	S&P Emerging Plus LargeMidCap	November 13, 2014
S&P Eurozone Low Volatility Index	S&P Eurozone BMI	March 30, 2015
S&P Eurozone Low Volatility USD Hedged Index	S&P Eurozone BMI	March 30, 2015
S&P Developed Asia Low Volatility	S&P Asia Pacific LargeMidCap	August 5, 2015
S&P EPAC Ex-Korea Low Volatility	S&P EPAC Ex-Korea LargeMidCap	May 25, 2015
S&P EPAC Ex-Korea Low Volatility USD Hedged Index	S&P EPAC Ex-Korea LargeMidCap	May 25, 2015
S&P Japan 500 Low Volatility Index	S&P Japan 500	June 8, 2015
S&P Japan 500 Low Volatility USD Hedged Index	S&P Japan 500	June 8, 2015
S&P Europe 350 Carbon Efficient Select Low Volatility Index	S&P Europe 350 Carbon Efficient Select Index	January 18, 2016
S&P Global Low Volatility Index	S&P Global LargeMidCap	April 11, 2016
S&P Developed Low Volatility Index	S&P Developed LargeMidCap	April 11, 2016
S&P/ASX 200 Low Volatility Index	S&P/ASX 200	October 17, 2017

Source: S&P Dow Jones Indices LLC. Data as of April 2018. Table is provided for illustrative purposes.

## APPENDIX B

**Exhibit 20: S&P 500 and the S&P 500 Low Volatility Index**

PERIOD	ANNUALIZED RETURN (%)		ANNUALIZED VOLATILITY (%)		RETURN/RISK		12-MONTH MAXIMUM DRAWDOWNS (%)	
	S&P 500	S&P 500 LOW VOLATILITY INDEX	S&P 500	S&P 500 LOW VOLATILITY INDEX	S&P 500	S&P 500 LOW VOLATILITY INDEX	S&P 500	S&P 500 LOW VOLATILITY INDEX
1	13.27	8.81	8.50	7.39	1.56	1.19	6.13	4.24
3	10.57	10.52	10.26	9.04	1.03	1.16	8.36	5.29
5	12.96	10.49	9.86	9.08	1.31	1.16	8.36	5.29
7	12.30	12.44	10.98	8.82	1.12	1.41	16.26	5.50
10	9.02	10.69	14.99	11.00	0.60	0.97	46.41	28.96
15	9.55	10.57	13.22	9.86	0.72	1.07	46.41	28.96
20	6.42	8.69	14.86	11.15	0.43	0.78	46.41	28.96
25	9.59	10.52	14.24	10.93	0.67	0.96	46.41	28.96

Source: S&P Dow Jones Indices LLC. Figures based on monthly data as of April 2018. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

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The S&P 500 Low Volatility Index was launched on April 4, 2011. The S&P Europe 350 Low Volatility Index was launched on July 9, 2012. The S&P Korea Low Volatility Index was launched on May 8, 2013. The S&P Pan Asia Low Volatility Index was launched on November 19, 2012. The S&P South Africa Low Volatility Index was launched on January 29, 2014. The S&P/ASX 200 Low Volatility Index was launched on October 17, 2017. The S&P/TSX Composite Low Volatility Index was launched on April 10, 2012. The S&P MidCap 400 Low Volatility Index was launched on September 24, 2012. The S&P SmallCap 600 Low Volatility Index was launched on September 4, 2012. The S&P Japan 500 Low Volatility Index was launched on June 8, 2015. The S&P BMI Emerging Markets Low Volatility Index was launched on December 5, 2011. The S&P 500 Momentum was launched on November 18, 2014. The S&P 500 Minimum Volatility Index was launched on November 9, 2012. All information presented prior to an index's Launch Date is hypothetical (back-tested), not actual performance. The back-test calculations are based on the same methodology that was in effect on the index Launch Date. Complete index methodology details are available at [www.spdji.com](http://www.spdji.com).

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