S&P Dow Jones Indices

RESEARCH

CONTRIBUTORS

Fei Mei Chan
Director
Index Investment Strategy
feimei.chan@spglobal.com

Craig J. Lazzara, CFA
Managing Director
Index Investment Strategy
craig.lazzara@spglobal.com

S&P Global

The Dispersion-Correlation Map

"All happy families are alike; every unhappy family is unhappy in its own way"
– Tolstoy, *Anna Karenina*

EXECUTIVE SUMMARY

- In the past two decades, equities have gone through two major bear markets: the bursting of the technology bubble in 2000-2002 and the financial crisis of 2008.

- Although the two events seem superficially similar, the nature of the market's volatility was quite different in 2008 relative to 2000-2002.

- We introduce the dispersion-correlation map as a heuristic for understanding market volatility.

- All bear markets are unpleasant, but 2008 was especially so, given the very high correlations among equity securities.

- Today's environment shows no resemblance to either of the past two bear market episodes.

CONTEXT

Over the past 25 years, the S&P 500® has returned a cumulative 940% (10% annually). However, the market's climb was not a steady one (see Exhibit 1). Since 1991, equities have gone through two major bear markets: the bursting of the technology bubble in 2000-2002 and the financial crisis of 2007-2008. The S&P 500 declined 38% in calendar years 2000-2002 and 37% in 2008 alone.

**Exhibit 1: S&P 500 (TR) Performance**
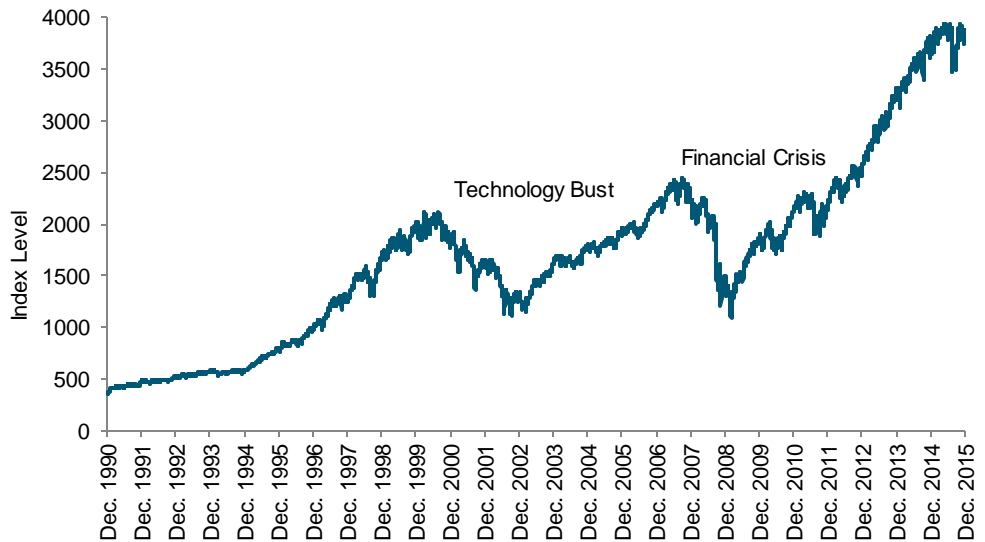
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1990, through Dec. 31, 2015. Index performance based on total return [USD]. Charts are provided for illustrative. It is not possible to invest directly in an index. Past performance is no guarantee of future results.

A future analyst might look back at the technology bust and the 2008 financial crisis and conclude they were essentially the same.

These two events seem superficially similar, starting with the magnitude of the decline. Both were major distresses following sustained gains in the S&P 500, and in both cases volatility rose (see Exhibit 2).[1] **It's not hard to imagine a young analyst, 50 years from now, looking at both episodes and concluding that they were essentially the same. But he would be wrong.**

Exhibit 2: S&P 500 Rolling 12-Month Average Volatility
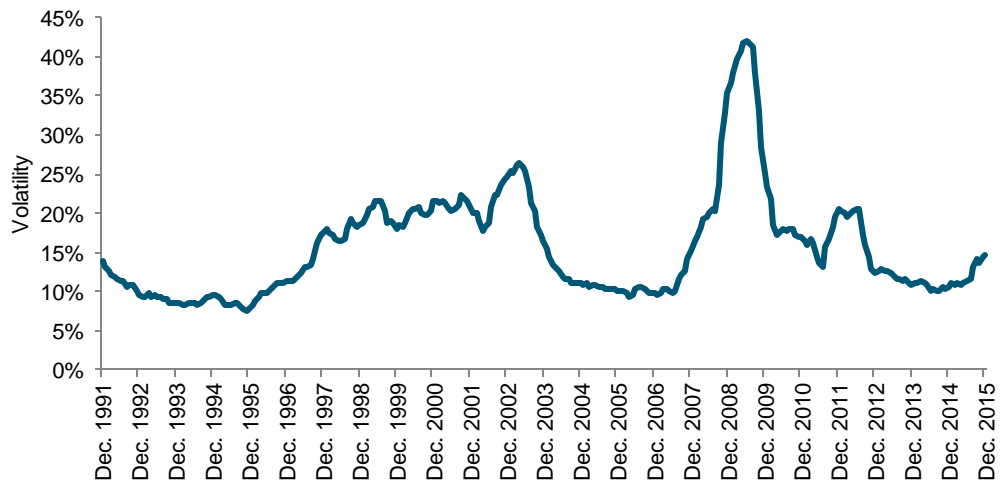
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1990, through Dec. 31, 2015. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

[1] Volatility and returns are inversely related, at least in the short run. See Edwards, Tim and Craig J. Lazzara, "The Landscape of Risk," December 2014.

A TALE OF TWO CRISES

What our putative analyst missed is that the *nature* of the market's volatility was quite different in 2008 compared with 2000-2002. More specifically, the deflation of the technology bubble was accompanied by the highest equity dispersion ever seen and below-average correlations. The 2008 global financial crisis saw above-average dispersion but with very high correlations.

Exhibit 3 illustrates the basic framework, which we call a dispersion-correlation map. Correlation is a measure of timing—it tells us whether the components of an index move in the same direction at the same time. Dispersion is a measure of magnitude. It tells us by how much the return of the average stock differs from the overall market's return.[2] If a market's tendency for co-movement (correlation) is constant, but the magnitude of individual stocks' fluctuations (dispersion) rises, market volatility will rise. Similarly, if the tendency for co-movement increases, then even with constant dispersion, market volatility will rise.[3]

> Correlation is a measure of timing and dispersion is a measure of magnitude.

Exhibit 3: Dispersion-Correlation Map
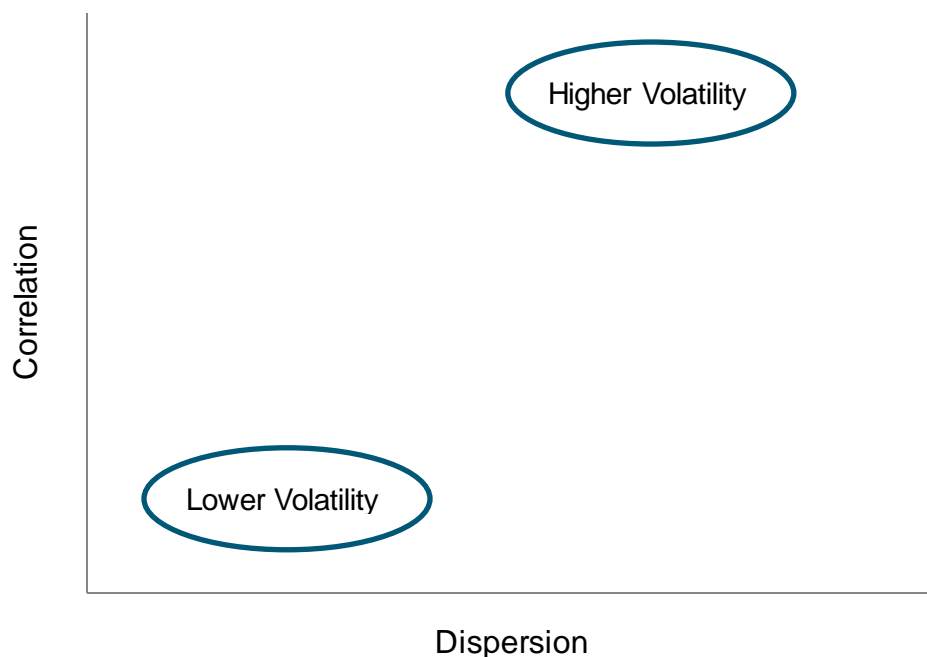
Source: S&P Dow Jones Indices. Chart is provided for illustrative purposes.

Whether correlation and dispersion are *sources* of volatility, or *manifestations* of volatility, is an interesting philosophical question.[4] What

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[2] Edwards, Tim and Craig J. Lazzara, "Dispersion: Measuring Market Opportunity," December 2013.

[3] Edwards, Tim and Craig J. Lazzara, "At the Intersection of Diversification, Volatility and Correlation," April 2014. Note that, for these purposes, correlation measures the average correlation of each stock in an index with every other stock in the index.

[4] In the same vein, are the sides of a right triangle the *source* of the hypotenuse or a *manifestation* of the hypotenuse (and its adjacent angles)? This is another philosophical question that need not detain us here.

is important for our purposes is to understand that in a dispersion-correlation map like Exhibit 3, **points close to the origin are associated with lower volatility, and points farther from the origin are associated with higher volatility**. One empirical confirmation of this relationship can be found in the cross-sectional volatility of the sectors of the S&P 500.[5]

We can also find evidence for this relationship by examining time series data. Exhibit 4 graphs dispersion and correlation for the S&P 500 on a rolling 12-month basis (corresponding to the graph of S&P 500 volatility in Exhibit 2). Notice that dispersion tends to run in a fairly narrow channel (between roughly 20% and 25% at annual rates) except during two significant exceptions around the time of the technology bubble and the financial crisis. Correlation tends to fluctuate more and appears to have drifted upward since the lows of the 1990s.

Exhibit 4: S&P 500 Dispersion and Correlation
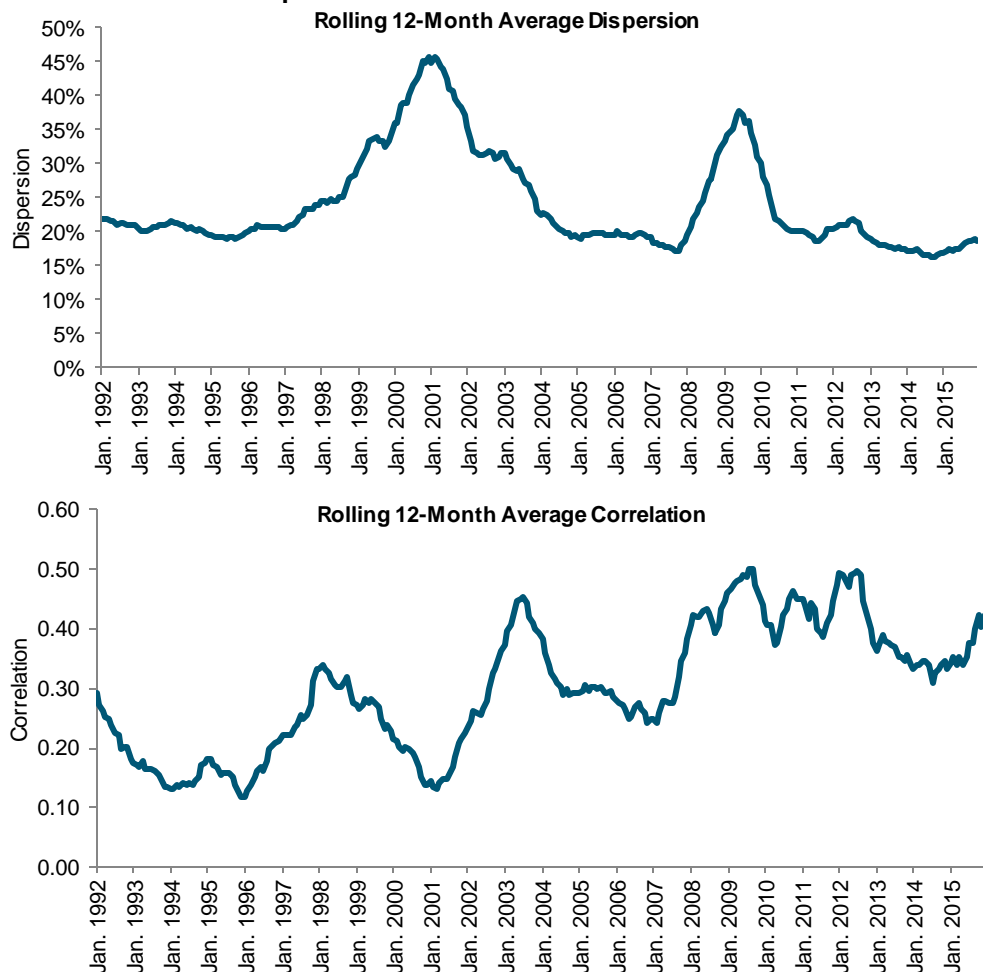
Correlation tends to fluctuate more and appears to have drifted upward since the lows of the 1990s.

Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1990, through Dec. 31, 2015. Past performance is no guarantee of future results. Charts are provided for illustrative. .

[5] Bennett, Chris and Craig J. Lazzara, "Some Implications of Sector Dispersion," April 2015.

Exhibit 5 gathers the data of Exhibit 4 into annual averages to form a dispersion-correlation map. Each point on the map represents the average of 12 monthly dispersion and correlation observations for the year in question. (The dotted lines simply show us the median levels of dispersion and correlation.) Given what we observed in Exhibit 4, it's not surprising that dispersion in most years hovers around 20%. However, there are two major exceptions to this tendency.

In the lower right quadrant of Exhibit 5, we find 1998, 1999, 2000, and 2001: the center of the inflation and deflation of the technology bubble. Dispersion in those years was extremely high, but correlation was well below average. In the upper right quadrant is 2008: a period of well-above average dispersion and very high correlations.

Exhibit 5: S&P 500 Dispersion-Correlation Map
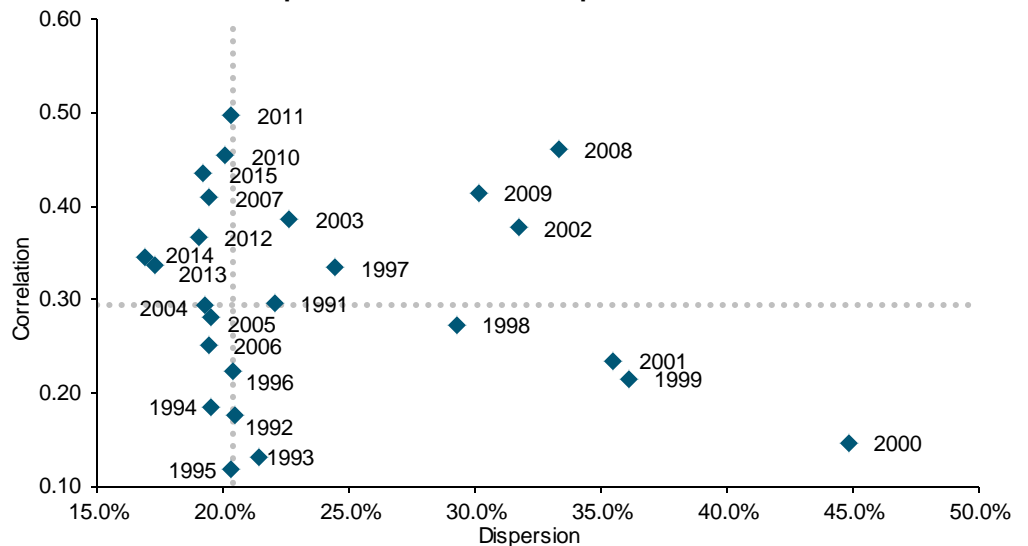
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1990, through Dec. 31, 2015. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

WHY THIS MATTERS

All bear markets are unpleasant, but those of the 2008 variety are especially so. The difficulty comes from 2008's elevated correlations, which tell us that there was considerable co-movement among S&P 500 components. In 2000-2002, in contrast, correlations were dramatically lower, suggesting a below-average tendency toward co-movement. Furthermore, 2000-2002's elevated dispersion tells us that there was a large gap between the best and the worst performers.

In a bear market of the 2000-2002 type, there are potentially places for an investor to hide. Below-average co-movement suggests that not all stocks were declining, and very high dispersion tells us that there was considerable room to add value relative to the market's average performance. **In 2008, the degree of co-movement left less latitude for defensive strategies to succeed.**

All bear markets are unpleasant, but those of the 2008 variety are especially so.

Exhibit 6a, which compares the results of several such strategies during both periods, illustrates this point. In 2000-2002, despite the S&P 500's -38% decline, at least some strategies achieved a positive total return. In 2008, on the other hand, the tendency for all stocks to move together (in this case, downward together) was much stronger. The higher dispersion in the earlier period means that the spread between defensive strategy returns and those of the S&P 500 was much greater than during the 2008 crisis (see Exhibit 6b).[6]

The spread between defensive strategy returns and those of the S&P 500 was much greater in 2000-2002 than during the 2008 financial crisis.

Exhibit 6a: Performance of the S&P 500 and S&P 500 Strategy Indices
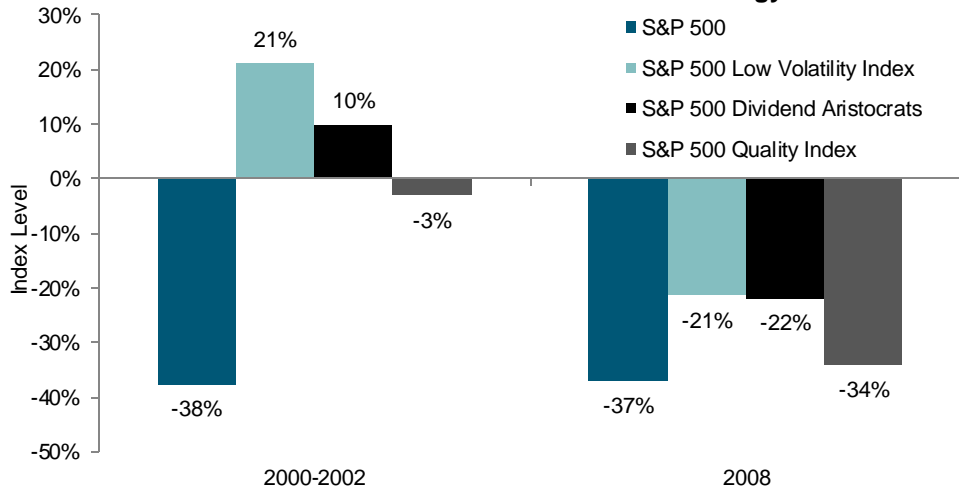
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1999, through Dec. 31, 2002, and Dec. 31, 2007, through Dec. 31, 2008. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of the document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 6b: Performance Differentials
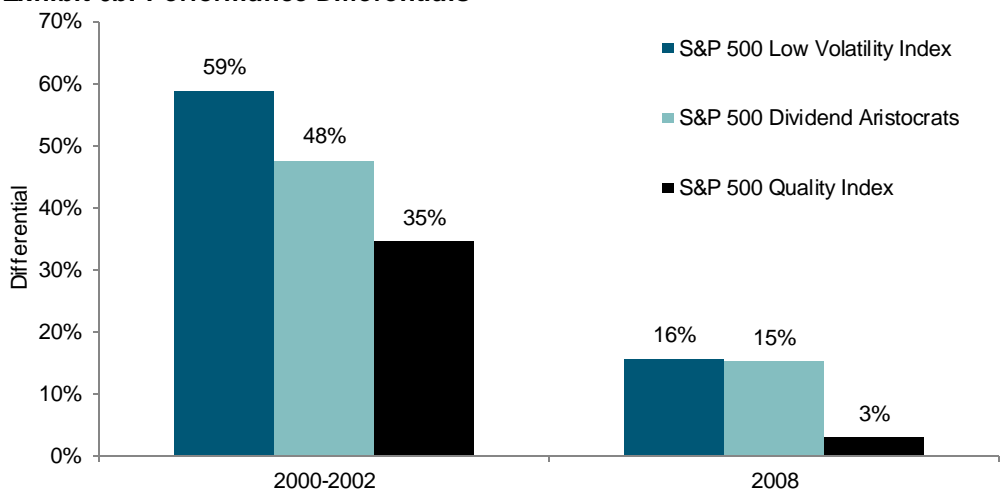
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1999, through Dec. 31, 2002, and Dec. 31, 2007, through Dec. 31, 2008. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of the document for more information regarding the inherent limitations associated with back-tested performance.

[6] Chan, Fei Mei and Craig J. Lazzara, "Gauging Differential Returns," January 2014.

Importantly, we can observe similar effects in equity markets outside the U.S. Exhibit 7 plots dispersion and correlation for the S&P Europe 350 (albeit for a shorter period). Although not identical to the U.S. pattern, 2000-2002 was a period of below-average correlation and very high dispersion; 2008 showed much higher correlations.

Exhibit 7: S&P Europe 350 Dispersion-Correlation Map
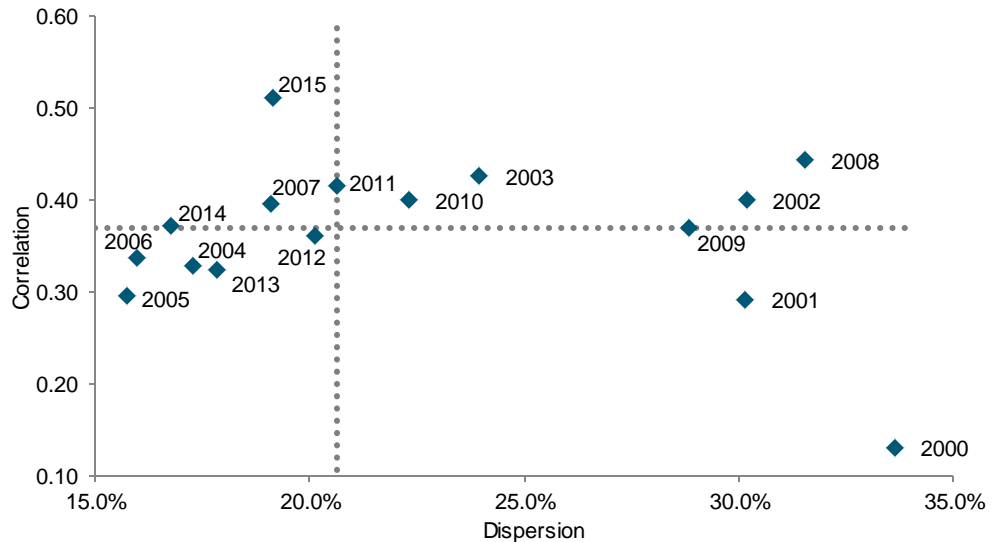
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1999, through Dec. 31, 2015. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

The correlation-dispersion map of the S&P 500 provides historical context for today's market dynamics.

We see similar patterns in Canada as well as Asia (see Appendix). The Asian narrative, however, also includes the regional financial crisis of 1997-1998. The average correlation in Asia for 1998 was even higher than in 2008.

WHERE ARE WE NOW?

This analysis may be of more than just historical interest. Market volatility is unavoidable, but understanding how dispersion and correlation have interacted can sometimes provide actionable current insight. Specifically, we have seen what the historical dispersion-correlation profiles of bear markets look like. What happens when we compare contemporary data to those profiles?

As of May 2016, correlations had dropped and dispersion had declined significantly in comparison with January 2016.

Exhibit 8 shows that at the beginning of 2016, U.S. equity correlations were very high, with dispersion at about median level. Historically, we have seen that high correlation can be worrisome; even without elevated dispersion, the S&P 500 looked potentially fragile at the beginning of this year. That fragility was manifested in January 2016's 5% decline for the S&P 500. Since that decline, however, the index's internal dynamics have shifted considerably. As of May 31, 2016, correlations had dropped dramatically and stood only slightly above their median level, and dispersion had also declined significantly.

Exhibit 8: S&P 500 Dispersion-Correlation Map
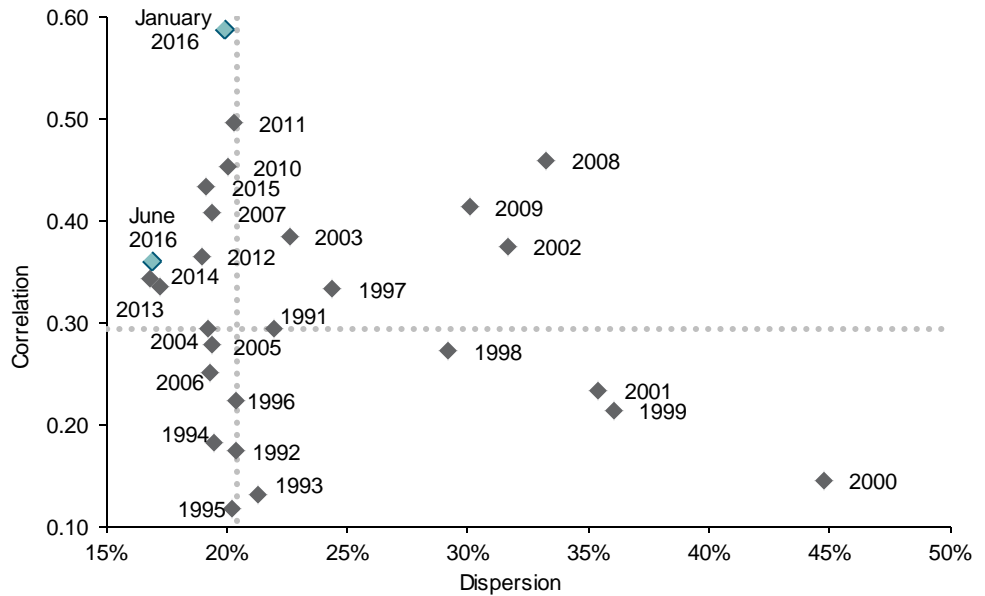
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1990, through May 31, 2016. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

We make no claims of market timing prescience based on the dispersion-correlation map, but Exhibit 8 does provide historical context for the market's current dynamics. January 2016's 5% decline *might* have signaled the start of an extended market decline. If that had occurred, and if historical precedents had prevailed, the index would have moved to the right on the dispersion-correlation map.

But it didn't. **The market's volatility was resolved in a relatively benign way**—correlations fell, dispersion declined, and six months later we find the index in a very different position on the dispersion-correlation map. In that sense, this analysis may provide some comfort to nervous investors.

APPENDIX

Exhibit 9: S&P/TSX Composite Dispersion-Correlation Map
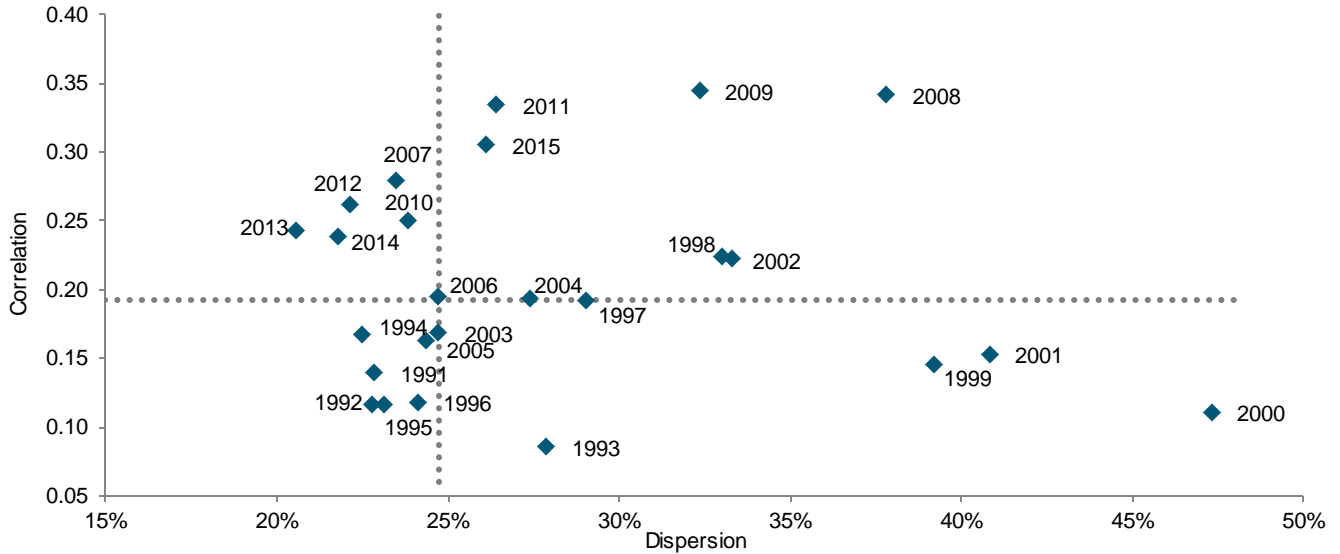
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1990, through Dec. 31, 2015. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

Exhibit 10: S&P Pan Asia BMI Dispersion-Correlation Map
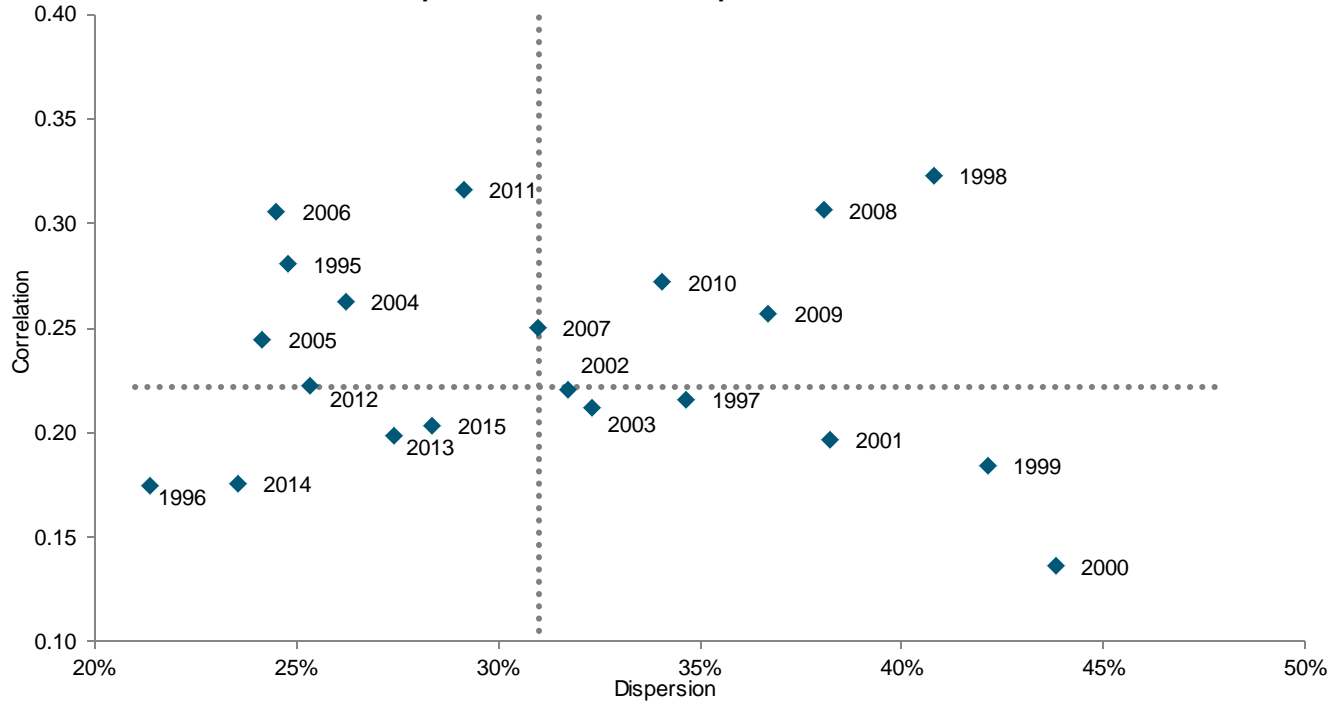
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, through Dec. 31, 2015. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

ABOUT S&P DOW JONES INDICES

S&P Dow Jones Indices LLC, a division of S&P Global, is the w orld's largest, global resource for index-based concepts, data and research. Home to iconic financial market indicators, such as the S&P 500® and the Dow Jones Industrial Average™, S&P Dow Jones Indices LLC has over 115 years of experience constructing innovative and transparent solutions that fulfill the needs of institutional and retail investors. More assets are invested in products based upon our indices than any other provider in the w orld. With over 1,000,000 indices covering a w ide range of assets classes across the globe, S&P Dow Jones Indices LLC defines the w ay investors measure and trade the markets. To learn more about our company, please visit w ww.spdji.com.

PERFORMANCE DISCLOSURE

The S&P 500 Low Volatility Index w as launched April 4, 2011. The S&P 500 Dividend Aristocrats was launched May 2, 2005. The S&P 500 Quality Index w as launched July 8, 2014. 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 w as in effect on the index Launch Date. Complete index methodology details are available at www.spdji.com.

S&P Dow Jones Indices defines various dates to assist our clients in providing transparency. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at w hich the Index is set at a fixed value for calculation purposes. The Launch Date designates the date upon w hich the values of an index are first considered live: index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P Dow Jones Indices defines the Launch Date as the date by w hich the values of an index are know n to have been released to the public, for example via the company's public w ebsite or its datafeed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (w hich prior to May 31, 2013, w as termed "Date of introduction") is set at a date upon w hich no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

Past performance of the Index is not an indication of future results. Prospective application of the methodology used to construct the Index may not result in performance commensurate w ith the back-test returns shown. The back-test period does not necessarily correspond to the entire available history of the Index. Please refer to the methodology paper for the Index, available at www.spdji.com for more details about the index, including the manner in w hich it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as w ell as all index calculations.

Another limitation of using back-tested information is that the back-tested calculation is generally prepared w ith the benefit of hindsight. Back-tested information reflects the application of the index methodology and selection of index constituents in hindsight. No hypothetical record can completely account for the impact of financial risk in actual trading. For example, there are numerous factors related to the equities, fixed income, or commodities markets in general w hich cannot be, and have not been accounted for in the preparation of the index information set forth, all of w hich can affect actual performance.

The Index returns show n do not represent the results of actual trading of investable assets/securities. S&P Dow Jones Indices LLC maintains the Index and calculates the Index levels and performance shown or discussed, but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be low er than the Index performance shown. As a simple example, if an index returned 10% on a US $100,000 investment for a 12-month period (or US $10,000) and an actual asset-based fee of 1.5% w as imposed at the end of the period on the investment plus accrued interest (or US $1,650), the net return w ould be 8.35% (or US $8,350) for the year. Over a three year period, an annual 1.5% fee taken at year end w ith an assumed 10% return per year w ould result in a cumulative gross return of 33.10%, a total fee of US $5,375, and a cumulative net return of 27.2% (or US $27,200).

GENERAL DISCLAIMER

INDEX INVESTMENT STRATEGY