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Dispersion: Measuring Market Opportunity

With apologies to Jane Austen, it is a truth universally acknowledged that a portfolio manager in control of a fortune must be in want of diversification. **But what does it mean to say that a particular index (or portfolio) is diversified?** Or more diversified than another, or more now than it was before? In order to speak meaningfully about the internal diversity of an index and its variation over time, quantitative metrics are required. The most commonly encountered is the correlation statistic, but correlations contain critical and unavoidable flaws.[1] It turns out that another measure—**asset dispersion**—has strong qualifications as a complementary tool.

In what follows, we'll show how dispersion can be used to examine the connection between active management performance and the idiosyncrasies present within underlying markets. We'll also demonstrate other interesting uses of dispersion, which is well-suited to address questions regarding the importance of various risk factors and exposures.

A DEFINITION OF DISPERSION

In seeking alternatives to correlation, a simple starting point is the degree of variation in the returns of a portfolio's components (measured, for example, by the cross-sectional standard deviation of asset performances during the relevant time period). This provides a direct measure of diversity by measuring how differently individual assets perform compared to the average. This is fine for an equal-weighted portfolio, but since most portfolios are not equal-weighted, we can obtain a more accurate measure of portfolio dispersion by weighting the summands in the standard deviation calculation:

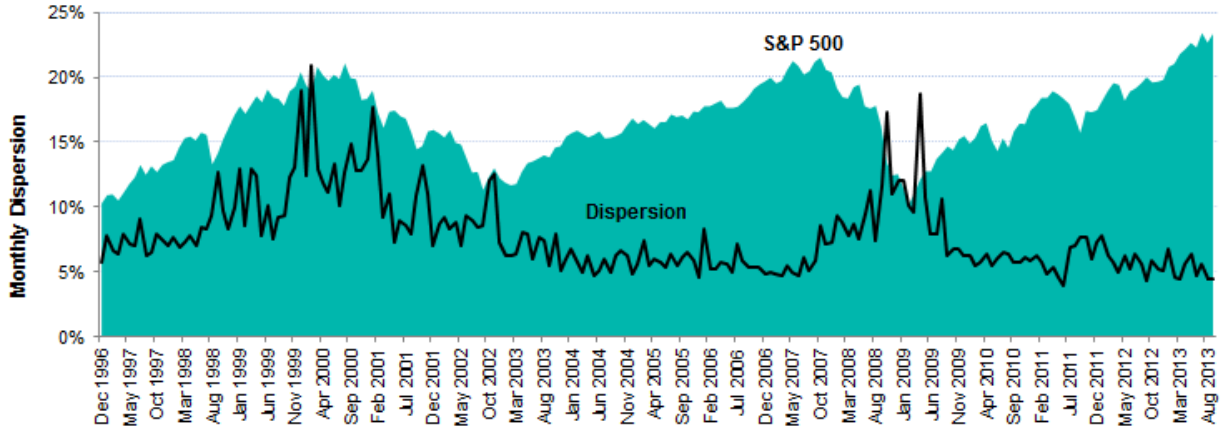
$$\textbf{Dispersion} = \sqrt{\sum_{i=1}^{n} w_i (r_i - P)^2}$$

where P is the portfolio return, each r_i is a component return and each w_i is the corresponding component weighting.

[1] See Appendix.

The result is sometimes called *cross-sectional portfolio volatility*; we prefer the more concise term *dispersion.*[2] Computing dispersion requires us to specify both the *time period* over which returns are to be measured, as well as the degree of *granularity* at which the calculation will be made.[3] For example, Exhibit 1 shows the dispersion of the S&P 500®, calculated with monthly returns at the stock level.

Exhibit 1: S&P 500 Monthly Dispersion, Dec. 1996 – Sept. 2013



Source: S&P Dow Jones Indices. Max S&P 500 = 1630.74. Data from Dec. 1996 to Sept. 2013. Graphs are provided for illustrative purposes.

The S&P 500 displays a few features of dispersion that are typical of equity indices:

- **Mean reversion within a limited range**. For the S&P 500, half of all readings fall between 6% and 9%. Levels below 4% and above 20% are so rare that the 4-20% range can be regarded as defining dispersion's practical limits for this index.

- Long periods of relatively high or low dispersion occur. In fact, **dispersion can be rather persistent**. Its monthly autocorrelation[4] during the time studied is 0.73, which suggests that current levels of dispersion may provide an accurate guide to the immediate future.

DISPERSION IN EQUITY PORTFOLIOS

We often hear (typically without the benefit of a precise definition) that we are in a "stock-picker's market." **Dispersion gives us a way to measure the potential value of stock selection ability.**

If stocks are acting largely in concert (i.e., have relatively low dispersion), an active investor will find it particularly difficult to construct an index-beating portfolio. In such circumstances, the case for passive investing is unusually compelling.

An investment landscape comprising more independent assets, on the other hand, should present a greater opportunity for the skillful (or lucky) investor to distinguish himself, especially in relative terms, as his deviations from benchmark weightings may create a more material impact. Of course, there is

[2] Note that the dispersion of an equal-weight portfolio is simply the standard deviation of asset returns over the period.

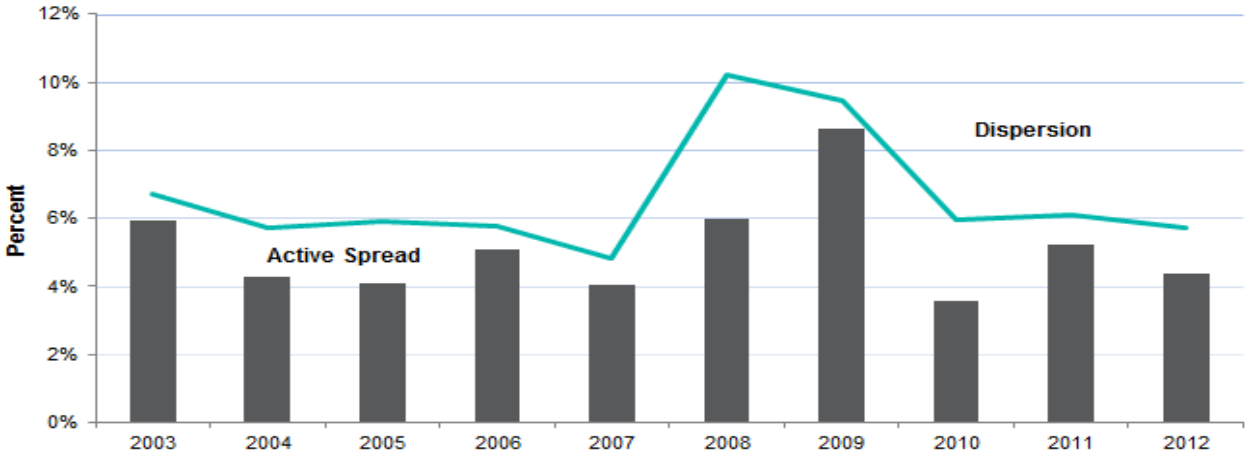
[3] Granularity tells us at what level of disaggregation the dispersion calculation is to be made. For example, we could measure the dispersion of an equity index at the stock level or the sector level; for an international index, dispersion can also be measured at the country level.

[4] Autocorrelation refers to the correlation between the series of monthly dispersion and the same series of dispersion offset by one month, i.e. the correlation of prior-month to current-month dispersion over the period.

simultaneously a greater opportunity for the less skillful (or unlucky) investor to embarrass himself. In a high dispersion environment, we should expect to see a relatively wide range of returns, while a low dispersion environment should yield a relatively tighter spread of active returns.

The evidence from our SPIVA Scorecards[5] confirms that there is a wider spread of active manager returns during periods of high dispersion. Exhibit 2 compares the average monthly dispersion for the S&P 500 during each calendar year with the interquartile spread of actively managed large-cap core U.S. equity funds.

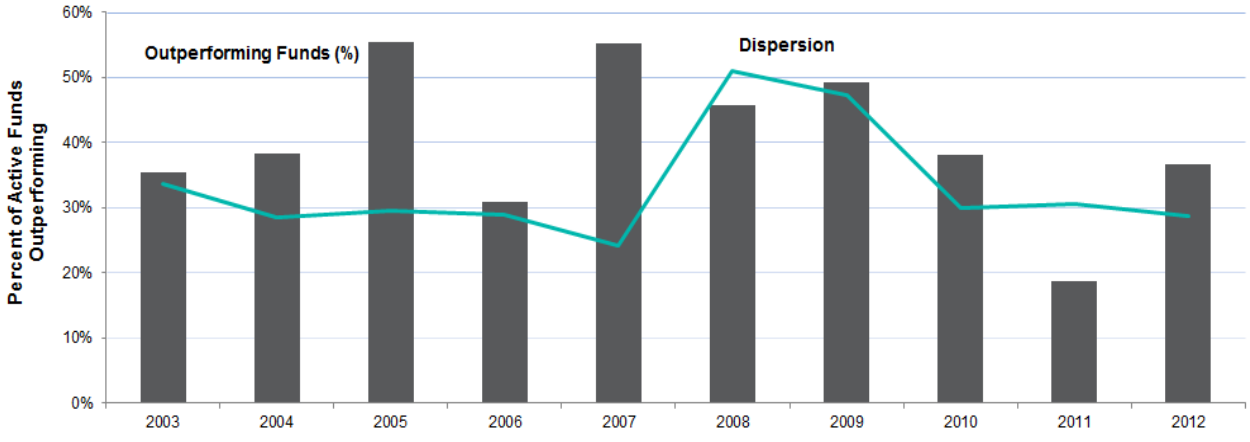
Exhibit 2: Interquartile Range of Active Funds vs. S&P 500 Average Monthly Dispersion



Source: S&P Dow Jones Indices. Data for 2007 are to March end; all other years are full calendar years. Charts are provided for illustrative purposes. Past performance is no guarantee of future results.

Dispersion provides a useful way to gauge the spread of active returns. At the very least, it may be interpreted as a gauge of how much tracking error to expect from individual active strategies. But do active managers tend to outperform in higher dispersion environments? Exhibit 3 suggests they do not.

Exhibit 3: Percentage of Outperforming Active Funds and Dispersion of the S&P 500



Source: S&P Dow Jones Indices. Dispersion max = 10.19%. Data for 2007 is to March end; all other years are full calendar years. Charts are provided for illustrative purposes. Past performance is no guarantee of future results.

[5] See www.spindices.com/resource-center/thought-leadership/spiva/.

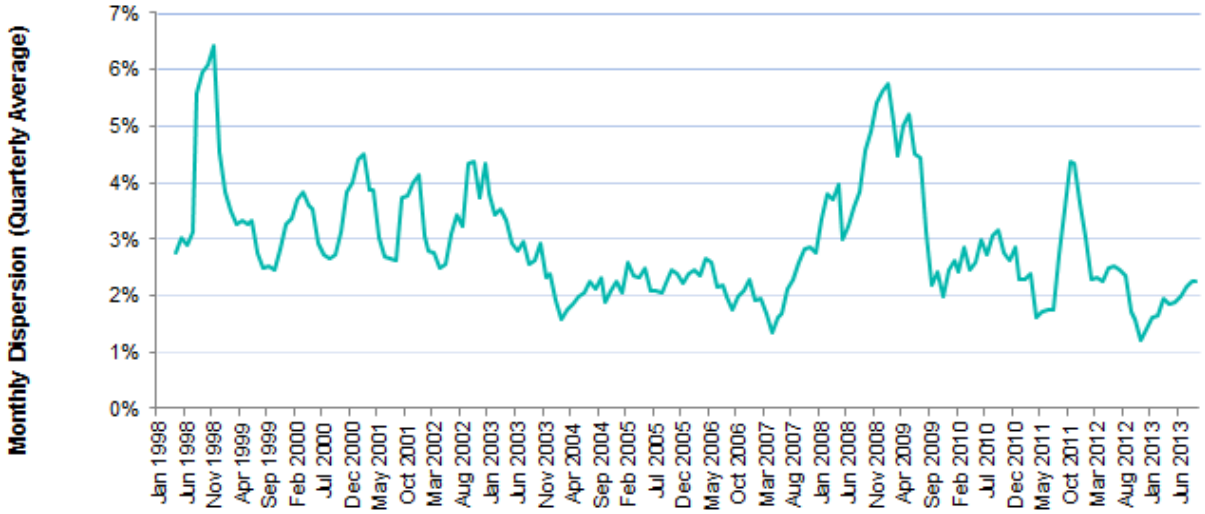
The evidence shows that higher dispersion does *not* increase the likelihood of outperformance by active managers within the large-cap U.S. market. And with a September 2013 dispersion level of 4.5%, it appears that **current opportunities for stock pickers to outperform (or underperform) the S&P 500 may not be especially significant**.

DISPERSION IN MULTI-ASSET PORTFOLIOS

A wide variety of portfolio tools exists to convert a set of forecasted returns, volatilities and correlations into optimized allocations in a multi-asset context. Nearly all such models are united in their attempt to replace an existing portfolio with one that captures more completely the benefits of diversification. Less frequently examined is the temporal drift in the diversification of fixed-weight portfolios. Dispersion can support this analysis at a security, factor, index or even asset-class level.

In order to frame the discussion, Exhibit 4 shows the dispersion of an equal-weighted portfolio comprising 10 commonly-referenced benchmark indices.[6] The interpretation of dispersion here is the same as in our earlier example of the S&P 500's dispersion: relatively high levels of dispersion indicate relatively greater opportunity to add (or lose) value by changing allocations among the 10 asset classes.[7]

Exhibit 4: Multi-Asset Dispersion, Dec. 1997 – Sept. 2013



Source: S&P Dow Jones Indices, Barclays, HFR, J.P. Morgan. Data from Dec. 1997 to Sept. 2013. Charts are provided for illustrative purposes.

Two important conclusions emerge from Exhibit 4:

- We are currently (as of September 2013) in a relatively low-dispersion environment, meaning that the performance differences among the 10 asset classes are relatively small. This implies that **opportunities for asset allocators will probably not be especially attractive in the immediate future**.

[6] The asset classes and representative indices are: large-cap U.S. stocks (S&P 500), small-cap U.S. stocks, (S&P SmallCap 600®), European equities (S&P Europe 350®), emerging market equities (S&P Emerging Markets BMI), U.S. Treasuries (S&P/BG Cantor 7-10 year), high-yield bonds (Barclays U.S. Corporate High Yield),emerging market bonds (J.P. Morgan EMBI Global Core), hedge funds (HFRX Global Hedge Fund), currencies (DXY U.S. Dollar), and commodities (Dow Jones UBS Commodity Index).

[7] Importantly, we are *not* proposing that these 10 asset classes are all appropriate in all circumstances, or that equal-weighting is the correct way to combine them.

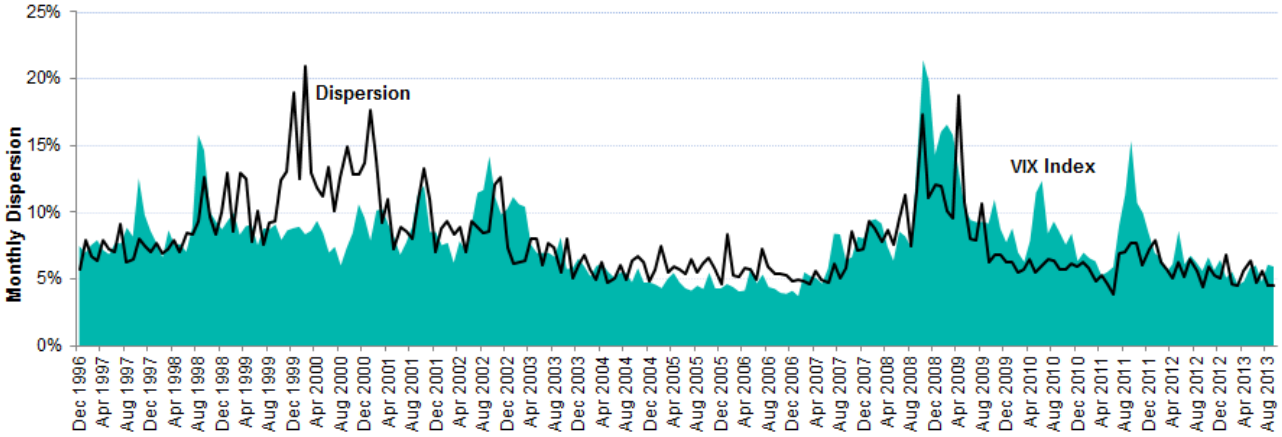
- This has important consequences in terms of risk: the level of portfolio diversification that was easily achieved in the late 1990s **is no longer available** within our 10-asset-class menu. One may need to incorporate additional, otherwise esoteric, investments such as frontier markets, or VIX futures, in order to achieve the portfolio's former level of diversification. (Alternatively, one might look for more effective ways to diversify within individual asset classes.)

Dispersion can inform the process of asset allocation and guide expectations for results.

DISPERSION AND VOLATILITY

As seen in Exhibit 1, higher dispersion can accompany both bull and bear markets. This observation is counterintuitive; given the negative correlation between volatility and market performance, one might expect high dispersion (suggestive of high volatility) to be unambiguously bearish. In fact, while strongly positive historical correlations exist between volatility and dispersion, periods where they differ can highlight important market dynamics, as shown in Exhibit 5.

Exhibit 5: S&P 500 Monthly Dispersion and the VIX®, Dec. 1996 – Sept. 2013



Source: S&P Dow Jones Indices, CBOE. Max VIX = 59.89. Data from Dec. 1996 to Sept. 2013. Charts are provided for illustrative purposes.

We can draw the following conclusions from Exhibit 5:

- The period between April 1999 and January 2001 showed a marked increase in dispersion, driven by the deeply idiosyncratic behavior of the technology sector. But index volatility did not rise, as sectors other than technology performed more normally. Thus, **dispersion can better capture periods where only a portion of the market either bubbles or crashes**.

- Volatility spikes during the summers of 2010 and 2011 were not accompanied by a commensurate rise in dispersion; individual stocks displayed relatively similar performances as market participants reacted in an indiscriminate manner to events such as the European debt crisis and the downgrade of U.S. government debt.

DISPERSION AND FACTOR IMPORTANCE

In an accurate description of risk, the importance of certain factor exposures is often in question. For example, the problem of whether international equity allocations are more suitably calibrated by country or sector has historically received much professional attention. Together with increased adoption of a wide variety of factor models, the question of determining the degree of independence and explanatory

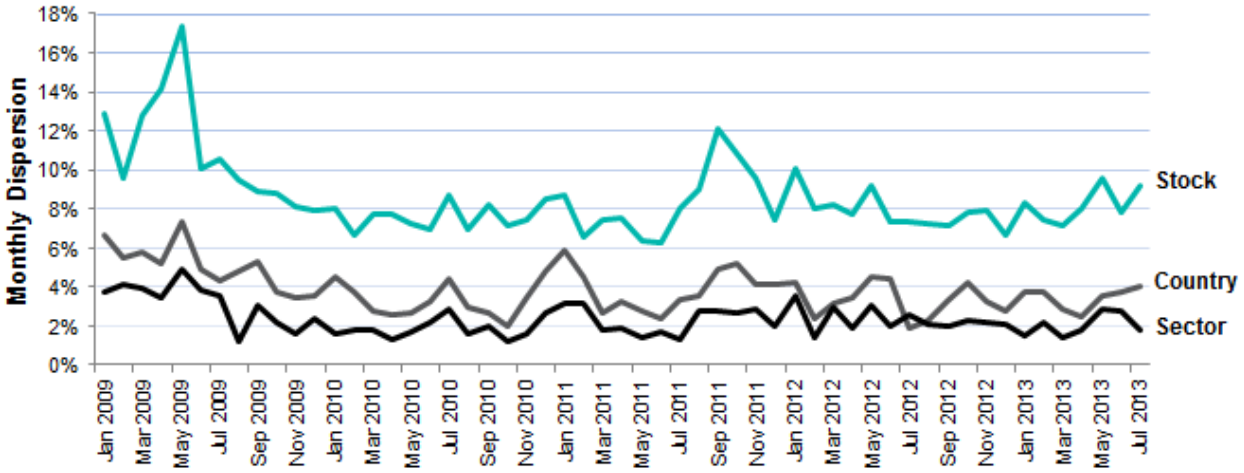
power for a set of factors has taken a prominent role. Dispersion can be used as a tool to address such questions by measuring the percentage of overall stock-level dispersion that is captured by considering only the dispersion caused by different factors. By computing dispersion not at the stock level, but rather at sector or country levels (for example), **we can measure the relative importance of sector and country factors**.

The concept of dispersion extends naturally to subindices—such as sectors—by considering each sector to be an individual component, with the weighted combination equal to the original index.[8] The level of subindex dispersion depends on whether the classification into subindices "reduces" stock-level dispersion by collecting together and averaging out a wide range of returns, or "retains" stock-level dispersion by collecting together only stocks with similar performance characteristics.[9]

AN EXAMPLE: COUNTRY VERSUS SECTOR WITHIN EMERGING MARKET EQUITIES

Exhibit 6 shows the overall stock-level dispersion within the S&P Emerging Markets BMI, a broad measure of equity markets in developing nations, and the corresponding subindex dispersions produced by considering sector and country subindices.

Exhibit 6: Stock, Country and Sector Dispersion in Emerging Market Equity, Dec. 2008 – Jul. 2013



Source: S&P Dow Jones Indices. Data from Dec. 2008 to Jul. 2013. Graphs are provided for illustrative purposes.

It is interesting to note that sector dispersion was almost invariably lower than country dispersion during this period (although perhaps unsurprising, since this result is consistent with academic approaches published elsewhere). Otherwise said, **the value of perfect foresight about country returns is greater than the value of perfect foresight about sector returns.**[10]

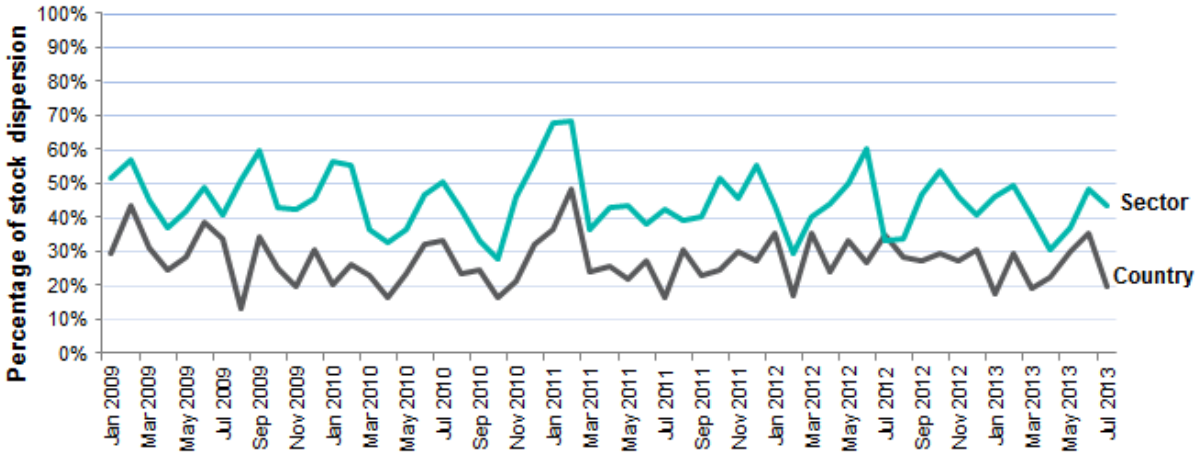
[8] Some common sense is required: each constituent component of the original index should be included in one and only one subindex if such comparisons are to be made. Note with caution the difference between "subindex dispersion" as defined here (with reference to the difference among various subindex performances) and the dispersion calculated using the individual stocks *within* a specified subindex; the latter will not play a part in what follows.

[9] Note that the subindex dispersion will always be *less than or equal to* stock dispersion, with equality only in the unlikely case that each subindex comprises identically performing components.

[10] One may object that the dispersion among the 31 countries is greater than among the 10 sectors simply by virtue of greater granularity as opposed to factor importance. While greater granularity tautologically provides greater explanatory power, in fact, granularity is not the key here. The chart is remarkably similar when only accounting for the top 10 countries; albeit reducing the country dispersion by 10%, it remains on average 40% higher than sector dispersion.

Comparisons of subindex dispersions can be made across markets by considering the ratio of subindex dispersion to overall dispersion. Exhibit 7 normalizes Exhibit 6 in such a manner and shows the monthly percentage contribution to stock-level dispersion from each categorization.

Exhibit 7: Country and Sector Dispersion in Emerging Market Equity, Dec. 2008 – Jul. 2013



Source: S&P Dow Jones Indices. Data from Dec. 2008 to Jul. 2013. Graphs are provided for illustrative purposes.

In this way, subindex dispersion can become a powerful tool for quantifying the explanatory power of style or factor groupings within an unfamiliar market. It can also relate this explanatory power to the equivalent importance of classifications in known and well-understood markets. For example, the relative importance of countries (which accounts for approximately 50% of total variation over the period shown in Exhibit 7) within the S&P Emerging BMI can be meaningfully compared to the 40% of S&P 500 stock dispersion that can be accounted for by sector groupings.[11]

CONCLUSIONS

Correlations—the fundamental metric of multi-asset diversification—capture only part of the behavior of historical returns. **A well-qualified complementary input is provided by dispersion, which quantifies the extent of idiosyncrasy in component performance.** Dispersion can help us to:

- Quantify the opportunities available from stock selection as well as from factor and asset allocation.
- Understand market dynamics, in conjunction with standard volatility measures.
- Ascertain the component drivers of performance on a historical basis.

[11] Comparing S&P 500 stock dispersion with the subindex dispersion that arises from the 10 GICS® sectors.

APPENDIX: WHAT'S WRONG WITH CORRELATION?

While remarkably useful as an input to various asset-allocation models and an overall measure of diversity in a portfolio context, correlation suffers from several key disadvantages:

- **Fooled by complexity:** A correlation of one indicates a perfect, straight-line relationship. However, a correlation of zero does *not* imply independence; it means that *if there is a relationship, it is not captured by a straight line.* In this way, correlation systematically understates many relationships.[12]

- **Confused in crowds:** Correlation itself is defined for a single pair of assets. For three or more return streams, correlation can miss important dependencies between *combinations* of assets. For a stylized example, consider a portfolio comprising equal weights in two uncorrelated stocks, A and B, plus an ETF C that owns 50% A and 50% B. Then the average correlation among all three assets is 1/3, which is reasonably low. But this overstates the true diversity of the opportunity set: C is perfectly correlated to the overall portfolio, while A and B correlate to the overall portfolio with a measure of 0.5.

- **Beta blocker:** Correlation does not distinguish between assets that have similar drivers of return but differing sensitivities, such as market beta, underestimating the likely realized spread of returns. Otherwise said, a pair of highly-correlated assets tends to go up and down at the same time—but not necessarily by the same amount.

- **Unreliable estimation:** For an index such the S&P 500, with 500 component stocks, there are 124,750 different pairwise correlations, each of which must be estimated over a sufficiently long time period. Computational effort aside, a robust estimate for monthly correlation might include the prior two or three year's returns,[13] a suspect measure for rapidly evolving markets.

Of these disadvantages, the first suggests a genuine and real difficulty. The second can in theory be managed via techniques such as principal component analysis. The third is possibly acceptable provided a degree of common sense is applied. However, given the sensitivity of most portfolio allocations that require correlation to be used as an input, or to be contemporary and accurate, the fourth is fatal.

[12] For an example of non-linear relationships: the price of crude oil tends to rise in bull markets (positive correlation) as both oil and stock prices reflect greater economic confidence. Yet exaggerated oil price spikes, such as those of the 1970s, have triggered stock market crashes. Many derivatives have similar subtleties; call and put options have a price sensitivity ("delta") that changes according to the price of the underlying.

[13] The solution of taking 30 days instead of 30 months to estimate correlation is problematic if a monthly correlation is required, as short-term correlations are often markedly different from longer-term equivalents.

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