

# Emphasizing Low-Correlated Assets: The Volatility of Correlation

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This is the second article in a series on correlation. The first article, published in the February 2006 issue of the *Journal of Financial Planning*, focused on whether the correlation between the S&P 500 and 15 asset classes (in a 1 × 15 matrix) was consistent or inconsistent. The findings showed most relationships to the index were inconsistent.

This article adds two assets—global bonds and long-short—and extends the research to examine whether the correlation of 18 assets to each other (an 18 × 18 matrix) has been consistent or inconsistent. This article also evaluates whether real estate, international stocks, emerging markets, high-yield bonds, U.S. bonds, long-short, and blend style investing correlate closer to growth or value styles.

Table 1 shows the average correlations since 1970. But since averages don't tell us anything about the volatility within the average, Table 2 provides the standard deviation of correlation. Table 3 shows the range of correlations based on two standard deviations from the average correlation. Table 4 shows the consistency or inconsistency of correlations in a probability distribution. Tables 2, 3, and 4 should be interpreted as follows:

- Combining assets with consistently

## Executive Summary

- The fact that correlations change is well known. But the severity of change, and which relationships are subject to change, needs to be better understood because it has important implications for containing risk.
- This study evaluates the volatility of correlation among 18 asset classes to each other to determine the consistency or inconsistency of relationships. It provides not only the long-term correlations of the assets, but the standard deviation of correlation and the range of correlations based on two standard deviations from the average correlation. It also summarizes the correlations in a probability distribution.
- In the asset allocation process, some assets often are used together even though diversification benefits have been very low. For example, the correlations of the S&P 500 to large growth, mid-blend to mid-growth, small blend to small growth, and large value to mid-value, have been very strong.
- Several assets often are neglected in the asset allocation decision, even though their diversification benefits have been very high. Natural resources, global bonds, and long-short, for example, stand out as having consistently low correlations to all the other assets in this study.
- Growth and blend styles are highly correlated, and using them together does little to reduce risk.
- Real estate, high-yield bonds, U.S. bonds, and long-short are more closely linked to value investing than growth. Emerging markets are somewhat more connected to growth than value.
- The asset allocation decision should emphasize low-correlated assets that satisfy return objectives. Two sample portfolios for different style investors show how risk and return are improved by combining lower-correlated assets.

high correlations to each other has done little to reduce risk.

- Combining assets with correlations scattered from high to low have been inconsistent in reducing risk.
- Combining assets with consistently low correlations has consistently reduced risk.

The start date is either 1970 or the inception of an asset class index. The end date is 2004. Correlations were calculated using monthly returns. The article offers suggestions on how this information may be useful in making asset allocation decisions, including Tables 7 and 8, which show how combining assets with low cor-

**Table 1: Long-Term Correlations**

|               | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Mkts. | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
|---------------|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|--------------|-------------|------------|--------------|------|-------------|--------------|------------|
| S&P 500       |         | .96          | .92         | .86        | .93       | .87       | .79          | .79         | .78         | .55          | .59          | .50         | .23        | -.03         | .02  | .52         | .01          | -.01       |
| Large Growth  | .96     |              | .81         | .92        | .91       | .75       | .84          | .78         | .72         | .53          | .57          | .48         | .19        | -.03         | .00  | .45         | .00          | -.22       |
| Large Value   | .92     | .81          |             | .72        | .91       | .96       | .70          | .80         | .82         | .51          | .54          | .49         | .24        | -.05         | .03  | .60         | .05          | .30        |
| Mid-Growth    | .86     | .92          | .72         |            | .93       | .73       | .94          | .91         | .77         | .54          | .60          | .50         | .02        | -.04         | .00  | .40         | .04          | -.33       |
| Mid-Blend     | .93     | .91          | .91         | .93        |           | .93       | .91          | .93         | .91         | .55          | .63          | .54         | .20        | -.06         | .04  | .59         | .17          | -.04       |
| Mid-Value     | .87     | .75          | .96         | .73        | .93       |           | .70          | .79         | .89         | .51          | .54          | .52         | .11        | -.05         | -.03 | .63         | .07          | .29        |
| Small Growth  | .79     | .84          | .70         | .94        | .91       | .70       |              | .98         | .87         | .50          | .62          | .51         | .06        | -.08         | .00  | .52         | .19          | -.25       |
| Small Blend   | .79     | .78          | .80         | .91        | .93       | .79       | .98          |             | .95         | .47          | .63          | .55         | .15        | -.10         | .00  | .65         | .10          | .06        |
| Small Value   | .78     | .72          | .82         | .77        | .91       | .89       | .87          | .95         |             | .49          | .58          | .57         | .14        | -.12         | .02  | .71         | .19          | .15        |
| Int'l Stocks  | .55     | .53          | .51         | .54        | .55       | .51       | .50          | .47         | .49         |              | .56          | .34         | .13        | .44          | -.01 | .36         | .09          | -.02       |
| Emerging Mkts | .59     | .57          | .54         | .60        | .63       | .54       | .62          | .63         | .58         | .56          |              | .44         | -.06       | .00          | -.02 | .31         | .09          | -.05       |
| High Yields   | .50     | .48          | .49         | .50        | .54       | .52       | .51          | .55         | .57         | .34          | .44          |             | .28        | -.01         | .00  | .43         | -.04         | .08        |
| U.S. Bonds    | .23     | .19          | .24         | .02        | .20       | .11       | .06          | .15         | .14         | .13          | -.06         | .28         |            | .38          | .34  | .14         | -.14         | .06        |
| Global Bonds  | -.03    | -.03         | -.05        | -.04       | -.06      | -.05      | -.08         | -.10        | -.12        | .44          | .00          | -.01        | .38        |              | .03  | .03         | .13          | -.09       |
| Cash          | .02     | .00          | .03         | .00        | .04       | -.03      | .00          | .00         | .02         | -.01         | -.02         | .00         | .34        | .03          |      | -.02        | -.12         | .09        |
| Real Estate   | .52     | .45          | .60         | .40        | .59       | .63       | .52          | .65         | .71         | .36          | .31          | .43         | .14        | .03          | -.02 |             | .08          | .27        |
| Natural Res.  | .01     | .00          | .05         | .04        | .17       | .07       | .19          | .10         | .19         | .09          | .09          | -.04        | -.14       | .13          | -.12 | .08         |              | .05        |
| Long-Short    | -.01    | -.22         | .30         | -.33       | -.04      | .29       | -.25         | .06         | .15         | -.02         | -.05         | .08         | .06        | -.09         | .09  | .27         | .05          |            |

= .80 to .99     
 = .60 to .79     
 = .40 to .59     
 = .39 to Negative

relations can improve return and reduce risk more than many investors realize.

### Why the Volatility of Correlation Is Important

The relationship of international stocks to the S&P 500 averaged .48 from 1970 to 1997, and the correlation between emerging markets and the index averaged .41 from 1988 to 1997. But in the 2000 to 2002 bear market, international stocks (-44 percent) and emerging markets (-36 percent) fell in lock step with the S&P 500 (-38 percent), and did not reduce risk as planned for in the asset allocation decision. The fact that correlations change is well known, but the severity of change, and which relationships are subject to change, needs to be better understood because it has important implications for reducing risk.

Many correlations are erratic, but some have been consistent. Let's examine relationships that have been consistently strong, others that have been consistently weak, and others that have been inconsistent.

### High Correlations

These four relationships have been consistently strong:

1. The S&P 500 and large growth have had a long-term correlation of .96. Over rolling three-year periods, their correlations have been .90 or higher 100 percent of the time (Table 1 and Table 4, Panel 1).

2. Small blend and small growth have had a long-term correlation of .98. Over rolling three-year periods, their correlations have been .90 or higher 100 percent of the time (Table 1 and Table 4, Panel 8).

3. Large value and mid-value have had a long-term correlation of .96. Over rolling three-year periods, their correlations have been .90 or higher 100 percent of the time (Table 1 and Table 4, Panel 3).

4. Mid-blend and mid-growth have had a long-term correlation of .93. Over rolling three-year periods, their correlations have been .90 or higher 93 percent of the time (Table 1 and Table 4, Panel 5).

The author believes it is not helpful to invest in assets with similar return expectations and consistently strong correlations.

A better use of an investor's risk budget is to invest in assets with lower correlations that still meet return objectives.

### Low Correlations

Five assets have had low correlations to all the other assets in this study. Here is a summary of each:

1. Natural resources have had a correlation of less than .20 to all 17 other assets in this study, with the highest being just .19, for both small growth and small value. Natural resources have had the lowest average correlations—and the most consistently low correlations—to every asset in this study, including every category of stocks, bonds, and alternatives. Hence, natural resources have provided more diversification benefits than every other asset in this study. Of special note, natural resources have had a negative correlation 83 percent of the time to U.S. bonds, due to their inverse relationship to inflation.

2. Long-short has had an average correlation of .30 or less to all 17 other assets in this study, including negative correlations

**Table 2: Standard Deviation of Correlations**

|               | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Mkts. | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
|---------------|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|--------------|-------------|------------|--------------|------|-------------|--------------|------------|
| S&P 500       |         | .02          | .06         | .08        | .04       | .08       | .12          | .10         | .11         | .18          | .17          | .12         | .27        | .17          | .20  | .20         | .24          | .22        |
| Large Growth  | .02     |              | .11         | .03        | .04       | .16       | .08          | .09         | .14         | .18          | .15          | .12         | .25        | .16          | .22  | .23         | .26          | .25        |
| Large Value   | .06     | .11          |             | .19        | .09       | .01       | .21          | .17         | .11         | .17          | .17          | .15         | .28        | .16          | .16  | .17         | .20          | .20        |
| Mid-Growth    | .08     | .03          | .19         |            | .03       | .20       | .03          | .03         | .11         | .19          | .16          | .10         | .27        | .13          | .17  | .25         | .20          | .30        |
| Mid-Blend     | .04     | .04          | .09         | .03        |           | .10       | .05          | .04         | .05         | .19          | .17          | .09         | .28        | .14          | .16  | .19         | .23          | .22        |
| Mid-Value     | .08     | .16          | .01         | .20        | .10       |           | .23          | .20         | .09         | .18          | .17          | .15         | .32        | .15          | .17  | .16         | .20          | .08        |
| Small Growth  | .12     | .08          | .21         | .03        | .05       | .23       |              | .01         | .09         | .17          | .15          | .12         | .21        | .14          | .15  | .23         | .23          | .30        |
| Small Blend   | .10     | .09          | .17         | .03        | .04       | .20       | .01          |             | .05         | .18          | .15          | .10         | .21        | .13          | .14  | .19         | .21          | .33        |
| Small Value   | .11     | .14          | .11         | .11        | .05       | .09       | .09          | .05         |             | .17          | .12          | .09         | .23        | .13          | .16  | .12         | .2           | 1          |
| Int'l Stocks  | .18     | .18          | .17         | .19        | .19       | .18       | .17          | .18         | .17         |              | .19          | .14         | .21        | .18          | .18  | .17         | .26          | .19        |
| Emerging Mkts | .17     | .15          | .17         | .16        | .17       | .17       | .15          | .15         | .12         | .19          |              | .14         | .18        | .11          | .17  | .14         | .15          | .23        |
| High Yields   | .12     | .12          | .15         | .10        | .09       | .15       | .12          | .10         | .09         | .14          | .14          |             | .30        | .16          | .23  | .16         | .15          | .21        |
| U.S. Bonds    | .27     | .25          | .28         | .27        | .28       | .32       | .21          | .21         | .23         | .21          | .18          | .30         |            | .18          | .19  | .19         | .17          | .18        |
| Global Bonds  | .17     | .16          | .16         | .13        | .14       | .15       | .14          | .13         | .13         | .18          | .11          | .16         | .18        |              | .17  | .15         | .21          | .17        |
| Cash          | .20     | .22          | .16         | .17        | .16       | .17       | .15          | .14         | .16         | .18          | .17          | .23         | .19        | .17          |      | .15         | .20          | .22        |
| Real Estate   | .2      | 0            | .217        | .3         | .25       | .19       | .23          | .19         | .12         | .17          | .14          | .16         | .19        | .15          | .15  |             | .23          | .17        |
| Natural Res.  | .24     | .26          | .20         | .20        | .23       | .20       | .23          | .21         | .2          | 1            | .2           | .15         | .17        | .21          | .20  | .23         |              | .19        |
| Long-Short    | .22     | .25          | .20         | .30        | .22       | .08       | .30          | .33         | .21         | .19          | .23          | .21         | .18        | .17          | .22  | .17         | .19          |            |

= .01 to .09     
  = .10 to .19     
  = .20 and higher

to all three U.S. growth styles, ranging from  $-.22$  to  $-.33$ . Long-short has provided very strong risk-reduction benefits to all other assets, though it has had a mild association to value styles (high of  $.30$  to large value) and real estate ( $.27$ ).

3. U.S. bonds (the Lehman Brothers Government/Credit Index was used as the proxy for U.S. bonds) have had an average correlation of  $.30$  or less to 15 of the 17 assets in this study, with the exceptions being mild connections to global bonds ( $.38$ ) and cash ( $.34$ ). U.S. bonds have had a very low correlation to all nine U.S. equity styles (ranging from  $.02$  to  $.24$ ), international stocks ( $.13$ ), and emerging markets ( $-.06$ ). But the correlation of U.S. bonds to U.S. equities has been less consistent than investors might expect, which will be discussed later in the study.

4. Global bonds have had an average correlation of  $.30$  or less to 15 of the 17 assets in this study, with mild connections to international stocks ( $.44$ ) and U.S. bonds ( $.38$ ). Global bonds have had a negative relationship to all nine U.S. equity styles, with correlations ranging from  $-.03$  to

$-.12$ . Interestingly, global bonds have had lower correlations and lower standard deviations in their correlations to U.S. equities than U.S. bonds. *In other words, when mixed with U.S. equities, global bonds have provided more diversification benefits than U.S. bonds.*

5. Cash has had an average correlation of  $.30$  or less to 16 of the 17 assets in this study, with the exception being a mild relationship to U.S. bonds ( $.34$ ).

### Inconsistent Correlations

Correlations have been inconsistent in seven relationships.

**International stocks to U.S. equities.** International stocks have had an erratic relationship to all nine U.S. equity styles. For example, the correlation of international stocks to the S&P 500 has averaged just  $.55$ , but with a high standard deviation of  $.18$ . That means 95 percent of the time, the connection between international stocks and the index should range from  $.19$  to  $.91$ , which is a lot of uncertainty. This inconsistency is shown in Tables 2, 3, and 4, Panel 10.

### Emerging markets to U.S. equities.

Emerging markets have had a sporadic relationship to all nine U.S. equity styles. One example: the correlation of emerging markets to the S&P 500 has averaged just  $.59$ , but with a standard deviation of  $.17$ . That means 95 percent of the time, emerging markets' relationship to the S&P 500 should range between  $.25$  and  $.93$ , which is a lot of variability. This instability is shown in Tables 2, 3, and 4, Panel 11.

**Real estate to U.S. equities.** Real estate has had erratic correlations to eight of the nine U.S. equity styles, with the exception being a more consistent connection to small value, which will be discussed later. Real estate's correlation to large growth has averaged just  $.45$ , but its standard deviation of correlation has been very high at  $.23$ . That means 95 percent of the time, the correlation of real estate to large growth should range between  $-.01$  and  $.91$ , which is very erratic (see Tables 2, 3, and 4, Panel 16).

**International stocks to emerging markets.** The correlation of international stocks to emerging markets has been

**Table 3: Correlation Range: Two Standard Deviations from the Average Correlation**

|               | S&P 500     | Large Growth | Large Value | Mid-Growth  | Mid-Blend   | Mid-Value   | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Mkts. | High Yields | U.S. Bonds  | Global Bonds | Cash        | Real Estate | Natural Res. | Long-Short |
|---------------|-------------|--------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|--------------|--------------|-------------|-------------|--------------|-------------|-------------|--------------|------------|
| S&P 500       | .92 to 1.00 | .80 to 1.00  | .70 to 1.00 | .85 to 1.00 | .71 to 1.00 | .55 to 1.00 | .59 to .99   | .56 to 1.00 | .19 to .91  | .25 to .93   | .26 to .74   | -.31 to .77 | -.37 to .31 | -.38 to .42  | .12 to .92  | -.47 to .49 | -.45 to .43  |            |
| Large Growth  | .92 to 1.00 | .59 to 1.00  | .83 to .99  | .43 to 1.00 | .60 to .96  | .44 to 1.00 | .68 to 1.00  | .60 to 1.00 | .17 to .89  | .27 to .87   | .24 to .72   | -.31 to .69 | -.35 to .29 | -.44 to .44  | -.01 to .91 | -.52 to .52 | -.72 to .28  |            |
| Large Value   | .80 to 1.00 | .59 to 1.00  | .34 to 1.00 | .73 to 1.00 | .94 to 1.00 | .28 to 1.00 | .46 to 1.00  | .60 to 1.00 | .17 to .85  | .20 to .88   | .19 to .79   | -.32 to .80 | -.37 to .27 | -.29 to .35  | .26 to .94  | -.35 to .45 | -.10 to .70  |            |
| Mid-Growth    | .70 to 1.00 | .86 to .98   | .34 to 1.00 | .86 to 1.00 | .33 to 1.00 | .88 to 1.00 | .85 to .97   | .55 to .99  | .16 to .92  | .28 to .92   | .30 to .70   | -.52 to .56 | -.30 to .22 | -.34 to .34  | -.10 to .90 | -.36 to .44 | -.93 to .27  |            |
| Mid-Blend     | .85 to 1.00 | .83 to .99   | .73 to 1.00 | .86 to 1.00 | .73 to .93  | .81 to 1.00 | .85 to 1.00  | .81 to 1.00 | .17 to .93  | .29 to .97   | .36 to .72   | -.36 to .76 | -.34 to .22 | -.28 to .36  | .21 to .97  | -.29 to .63 | -.48 to .40  |            |
| Mid-Value     | .71 to 1.00 | .43 to 1.00  | .94 to 1.00 | .33 to 1.00 | .73 to .93  | .24 to 1.00 | .39 to 1.00  | .71 to 1.00 | .15 to .87  | .20 to .88   | .22 to .82   | -.53 to .75 | -.35 to .25 | -.37 to .31  | .31 to .95  | -.33 to .47 | .13 to .45   |            |
| Small Growth  | .55 to 1.00 | .68 to 1.00  | .28 to 1.00 | .88 to 1.00 | .24 to 1.00 | .96 to 1.00 | .69 to 1.00  | .69 to 1.00 | .16 to .84  | .32 to .92   | .27 to .75   | -.36 to .48 | -.36 to .20 | -.30 to .30  | .06 to .98  | -.27 to .65 | -.85 to .35  |            |
| Small Blend   | .59 to .99  | .60 to .96   | .46 to 1.00 | .85 to .97  | .85 to 1.00 | .39 to 1.00 | .96 to 1.00  | .85 to 1.00 | .11 to .83  | .33 to .93   | .35 to .75   | -.27 to .57 | -.36 to .16 | -.28 to .28  | .27 to 1.00 | -.32 to .52 | -.60 to .72  |            |
| Small Value   | .56 to 1.00 | .44 to 1.00  | .60 to 1.00 | .55 to .99  | .71 to 1.00 | .69 to 1.00 | .85 to 1.00  | .85 to 1.00 | .15 to .83  | .34 to .82   | .39 to .75   | -.32 to .60 | -.38 to .14 | -.30 to .34  | .47 to .95  | -.23 to .61 | -.27 to .57  |            |
| Int'l Stocks  | .19 to .91  | .17 to .85   | .17 to .85  | .16 to .92  | .17 to .93  | .15 to .87  | .16 to .84   | .11 to .83  | .15 to .83  | .18 to .94   | .06 to .62   | -.29 to .55 | .08 to .80  | -.37 to .35  | .02 to .70  | -.43 to .61 | -.40 to .36  |            |
| Emerging Mkts | .25 to .93  | .27 to .87   | .20 to .88  | .28 to .92  | .29 to .97  | .20 to .88  | .32 to .92   | .33 to .93  | .34 to .82  | .18 to .94   | .16 to .72   | -.42 to .30 | -.22 to .22 | -.36 to .32  | .03 to .59  | -.21 to .39 | -.51 to .41  |            |
| High Yields   | .26 to .74  | .24 to .72   | .19 to .79  | .30 to .70  | .36 to .72  | .22 to .82  | .27 to .75   | .35 to .75  | .39 to .75  | .06 to .62   | .16 to .72   | -.32 to .88 | -.33 to .31 | -.46 to .46  | .11 to .75  | -.34 to .26 | -.34 to .50  |            |
| U.S. Bonds    | -.31 to .77 | -.31 to .69  | -.32 to .80 | -.52 to .56 | -.36 to .76 | -.53 to .75 | -.36 to .48  | -.27 to .57 | -.32 to .60 | -.29 to .55  | -.42 to .30  | .02 to .74  | -.33 to .31 | -.04 to .72  | -.24 to .52 | -.48 to .20 | -.30 to .42  |            |
| Global Bonds  | -.37 to .31 | -.35 to .29  | -.37 to .27 | -.30 to .22 | -.34 to .22 | -.35 to .25 | -.36 to .20  | -.36 to .16 | -.38 to .14 | .08 to .80   | -.22 to .22  | .33 to .31  | .02 to .74  | -.31 to .37  | -.27 to .33 | -.29 to .55 | -.43 to .25  |            |
| Cash          | -.38 to .42 | -.44 to .44  | -.29 to .35 | -.34 to .34 | -.28 to .36 | -.37 to .31 | -.30 to .30  | -.28 to .28 | -.30 to .34 | -.37 to .35  | -.36 to .32  | -.46 to .46 | -.04 to .72 | -.31 to .37  | -.32 to .28 | -.52 to .28 | -.35 to .53  |            |
| Real Estate   | .12 to .92  | -.01 to .91  | .26 to .94  | -.10 to .90 | .21 to .97  | .31 to .95  | .06 to .98   | .27 to 1.00 | .47 to .95  | .02 to .70   | .03 to .59   | .11 to .75  | -.24 to .52 | -.27 to .33  | -.32 to .28 | -.38 to .54 | -.07 to .61  |            |
| Natural Res.  | -.47 to .49 | -.52 to .52  | -.35 to .45 | -.36 to .44 | -.29 to .63 | -.33 to .47 | -.27 to .65  | -.32 to .52 | -.23 to .61 | -.43 to .61  | -.21 to .39  | -.34 to .26 | -.48 to .20 | -.29 to .55  | -.52 to .28 | -.38 to .54 | -.33 to .43  |            |
| Long-Short    | -.45 to .43 | -.72 to .28  | -.10 to .70 | -.93 to .27 | -.48 to .40 | .13 to .45  | -.85 to .35  | -.60 to .72 | -.27 to .57 | -.40 to .36  | -.51 to .41  | -.34 to .50 | -.30 to .42 | -.43 to .25  | -.35 to .53 | -.07 to .61 | -.33 to .43  |            |



Correlation Range (Low to High)

.85 to 1.00  
.50 to 1.00  
-.50 to 1.00  
-1.00 to .69

modest over the long term (.56), which demonstrates they are different asset classes. But the standard deviation of correlation is high at .19, meaning that 95 percent of the time, their relationship should range between .18 and .94 (see Tables 2, 3, and 4, Panel 10).

**Correlation among U.S. equities depends on size and style.** Three observations stand out in the correlation of U.S. equity styles to each other. First, Table 1 shows the correlations among U.S. equities have generally been strong, with 44 percent of the relationships averaging .90 or higher, 67 percent averaging .80 or higher, and none less than .70. *Every asset in this study has had lower correlations to U.S. equity styles than U.S. equity styles have had to each other.*

Second, U.S. equities separated by just one style box tend to be highly correlated. The four strongest relationships noted earlier—the S&P 500 to large growth, large value to mid-value, small value to small growth, and mid-blend to mid-growth—are separated by just one style box. *When two assets have had consistently strong correlations, it means using them together has consistently done little to reduce risk.*

Third, *when U.S. equities are different in both size and style, lower correlations are evident.* For example, large growth to small value, large value to small growth, large value to mid-growth, and mid-value to small growth, have had the lowest correlations among U.S. equity styles, averaging .70 to .72. But their relationships are inconsistent, often proving strong, as shown in Table 5.

In short, when selecting a mix of U.S. equities, the best way to reduce risk has been to select assets that differ in both size and style. That said, investing in real estate, international stocks, emerging markets, or long-short is even more effective at reducing risk than diversifying into different U.S. equity styles because their correlations are lower and they still meet return objectives.

**U.S. bonds to U.S. equities.** U.S. bonds have had inconsistent relationships to U.S. equities, with a high standard deviation of correlation to all nine U.S. equity styles. For example, the correlation of U.S. bonds to large value has averaged just .24, but with a high standard deviation of .28, meaning 95 percent of the time their relationship should range between -.32 and .80. Tables 2, 3, and 4, Panel 13, confirm that U.S. bonds have had

**Table 4: Probability Distributions of Correlations**

| Panel 1 - Probability Distribution of the S&P 500 Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|--|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  |         | 100%         | 76%         | 44%        | 79%       | 45%       | 15%          | 16%         | 12%         |              |                |             |            |              |      |             |              |            |
| .70 to .89   |         |              | 24%         | 53%        | 21%       | 50%       | 53%          | 63%         | 64%         | 21%          | 43%            | 6%          |            |              |      | 27%         |              |            |
| .50 to .69   |         |              |             | 4%         |           | 6%        | 32%          | 21%         | 21%         | 30%          | 19%            | 68%         | 14%        |              |      | 33%         | 5%           | 1%         |
| .00 to .49   |         |              |             |            |           |           |              |             | 3%          | 49%          | 38%            | 26%         | 72%        | 53%          | 48%  | 40%         | 50%          | 63%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                |             | 14%        | 47%          | 52%  | 1%          | 45%          | 36%        |
| Avg. Corr.   |         | .96          | .92         | .86        | .93       | .87       | .79          | .79         | .78         | .55          | .59            | .50         | .23        | -.03         | .02  | .52         | .01          | -.01       |
| Std Dev.   |         | .02          | .06         | .08        | .04       | .08       | .12          | .10         | .11         | .18          | .17            | .12         | .27        | .17          | .20  | .20         | .24          | .22        |

| Panel 2 - Probability Distribution of Large Growth Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|---|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years   | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00   | 100%    |              | 34%         | 84%        | 68%       | 21%       | 35%          | 19%         | 13%         |              |                |             |            |              |      |             |              |            |
| .70 to .89  |         |              | 57%         | 16%        | 32%       | 56%       | 59%          | 69%         | 52%         | 18%          | 32%            | 1%          |            |              |      | 14%         |              |            |
| .50 to .69  |         |              | 7%          |            |           | 11%       | 6%           | 12%         | 27%         | 30%          | 33%            | 66%         | 9%         |              |      | 42%         | 7%           |            |
| .00 to .49  |         |              | 2%          |            |           | 12%       |              |             | 8%          | 51%          | 35%            | 33%         | 75%        | 49%          | 45%  | 42%         | 42%          | 36%        |
| Negative  |         |              |             |            |           |           |              |             |             |              |                |             | 16%        | 51%          | 55%  | 2%          | 51%          | 64%        |
| Avg. Corr.  | .96     |              | .81         | .92        | .91       | .75       | .84          | .78         | .72         | .53          | .57            | .48         | .19        | -.03         | .00  | .45         | .00          | -.22       |
| Std Dev.  | .02     |              | .11         | .03        | .04       | .16       | .08          | .09         | .14         | .18          | .15            | .12         | .25        | .16          | .22  | .23         | .26          | .25        |

| Panel 3 - Probability Distribution of Large Value Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|--|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  | 76%     | 34%          |             | 28%        | 73%       | 100%      | 10%          | 25%         | 16%         | 3%           |                |             |            |              |      |             |              |            |
| .70 to .89   | 24%     | 57%          |             | 49%        | 23%       |           | 54%          | 53%         | 69%         | 7%           | 22%            | 7%          | 3%         |              |      | 38%         |              | 3%         |
| .50 to .69   |         | 7%           |             | 5%         | 5%        |           | 21%          | 13%         | 11%         | 32%          | 27%            | 68%         | 12%        |              |      | 35%         | 2%           | 17%        |
| .00 to .49   |         | 2%           |             | 18%        |           |           | 14%          | 9%          | 4%          | 58%          | 51%            | 25%         | 72%        | 50%          | 54%  | 27%         | 62%          | 74%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                |             | 14%        | 50%          | 46%  |             | 36%          | 6%         |
| Avg. Corr.   | .92     | .81          |             | .72        | .91       | .96       | .70          | .80         | .82         | .51          | .54            | .49         | .24        | -.05         | .03  | .60         | .05          | .30        |
| Std Dev.   | .06     | .11          |             | .19        | .09       | .01       | .21          | .17         | .11         | .17          | .17            | .15         | .28        | .16          | .16  | .17         | .20          | .20        |

| Panel 4 - Probability Distribution of Mid-Growth Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|---|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years   | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00   | 44%     | 84%          | 28%         |            | 93%       | 32%       | 88%          | 80%         | 19%         |              |                |             |            |              |      |             |              |            |
| .70 to .89  | 53%     | 16%          | 49%         |            | 7%        | 47%       | 12%          | 20%         | 62%         | 32%          | 45%            | 1%          |            |              |      | 26%         |              |            |
| .50 to .69  | 4%      |              | 5%          |            |           | 3%        |              |             | 19%         | 22%          | 19%            | 69%         |            |              |      | 7%          |              |            |
| .00 to .49  |         |              | 18%         |            |           | 18%       |              |             |             | 46%          | 36%            | 30%         | 69%        | 50%          | 46%  | 65%         | 52%          | 37%        |
| Negative  |         |              |             |            |           |           |              |             |             |              |                |             | 31%        | 50%          | 54%  | 2%          | 48%          | 63%        |
| Avg. Corr.  | .86     | .92          | .72         |            | .93       | .73       | .94          | .91         | .77         | .54          | .60            | .50         | .02        | -.04         | .00  | .40         | .04          | -.33       |
| Std Dev.  | .08     | .03          | .19         |            | .03       | .20       | .03          | .03         | .11         | .19          | .16            | .10         | .27        | .13          | .17  | .25         | .20          | .30        |

| Panel 5 - Probability Distribution of Mid-Blend Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|--|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  | 79%     | 68%          | 73%         | 93%        |           | 79%       | 64%          | 67%         | 61%         | 1%           | 5%             |             |            |              |      |             |              |            |
| .70 to .89   | 21%     | 32%          | 23%         | 7%         |           | 15%       | 36%          | 33%         | 39%         | 23%          | 41%            | 2%          |            |              |      | 31%         |              |            |
| .50 to .69   |         |              | 5%          |            |           | 6%        |              |             |             | 2            | 22%            | 82%         | 6%         |              |      | 34%         | 5%           |            |
| .00 to .49   |         |              |             |            |           |           |              |             |             | 54%          | 33%            | 16%         | 77%        | 45%          | 42%  | 35%         | 61%          | 60%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                |             | 18%        | 55%          | 58%  |             | 34%          | 40%        |
| Avg. Corr.   | .93     | .91          | .91         | .93        |           | .93       | .91          | .93         | .91         | .55          | .63            | .54         | .20        | -.06         | .04  | .59         | .17          | -.04       |
| Std Dev.   | .04     | .04          | .09         | .03        |           | .10       | .05          | .04         | .05         | .19          | .17            | .09         | .28        | .14          | .16  | .19         | .2           | .3         |

| Panel 6 - Probability Distribution of Mid-Value Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|--|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  | 45%     | 21%          | 100%        | 32%        | 79%       |           | 25%          | 36%         | 47%         | 3%           | 5%             |             |            |              |      | 5%          |              |            |
| .70 to .89   | 50%     | 56%          |             | 47%        | 15%       |           | 36%          | 45%         | 46%         | 11%          | 16%            | 5%          |            |              |      | 25%         |              |            |
| .50 to .69   | 6%      | 11%          |             | 3%         | 6%        |           | 20%          | 2%          | 7%          | 33%          | 34%            | 68%         | 18%        |              |      | 44%         |              | 8%         |
| .00 to .49   |         | 12%          |             | 18%        |           |           | 19%          | 17%         |             | 53%          | 45%            | 27%         | 58%        | 46%          | 50%  | 26%         | 65%          | 92%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                |             | 25%        | 54%          | 50%  |             | 35%          |            |
| Avg. Corr.   | .87     | .75          | .96         | .73        | .93       |           | .70          | .79         | .89         | .51          | .54            | .52         | .11        | -.05         | -.03 | .63         | .07          | .29        |
| Std Dev.   | .08     | .16          | .01         | .20        | .10       |           | .23          | .20         | .09         | .18          | .17            | .15         | .32        | .15          | .17  | .16         | .20          | .08        |

**Table 4: Probability Distributions of Correlations, continued**

| Panel 7 - Probability Distribution of Small Growth Correlations to Other Assets          |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|--|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  | 15%     | 35%          | 10%         | 88%        | 64%       | 25%       |              | 100%        | 57%         |              |                |             |            |              |      |             |              |            |
| .70 to .89   | 53%     | 59%          | 54%         | 12%        | 36%       | 36%       |              |             | 35%         | 15%          | 30%            | 1%          |            |              |      | 29%         |              |            |
| .50 to .69   | 32%     | 6%           | 21%         |            |           | 20%       |              |             | 8%          | 27%          | 41%            | 69%         |            |              |      | 2           | 67%          |            |
| .00 to .49   |         |              | 14%         |            |           | 19%       |              |             |             | 58%          | 28%            | 30%         | 62%        | 32%          | 28%  | 46%         | 55%          | 33%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                |             | 38%        | 68%          | 72%  |             | 38%          | 67%        |
| Avg. Corr.   | .79     | .84          | .70         | .94        | .91       | .70       |              | .98         | .87         | .50          | .62            | .51         | .06        | -.08         | .00  | .52         | .19          | -.25       |
| Std Dev.   | .12     | .08          | .21         | .03        | .05       | .2        |              | 3           | .01         | .09          | .17            | .15         | .12        | .21          | .14  | .15         | .23          | .30        |
| Panel 8 - Probability Distribution of Small Blend Correlations to Other Assets           |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  | 16%     | 19%          | 25%         | 80%        | 67%       | 36%       | 100%         |             | 87%         |              |                |             |            |              |      | 2%          |              |            |
| .70 to .89   | 63%     | 69%          | 53%         | 20%        | 33%       | 45%       |              |             | 13%         | 9%           | 36%            | 8%          |            |              |      | 47%         |              | 1%         |
| .50 to .69   | 21%     | 12%          | 13%         |            |           | 2%        |              |             |             | 34%          | 38%            | 70%         | 1%         |              |      | 27%         | 6%           | 21%        |
| .00 to .49   |         |              | 9%          |            |           | 17%       |              |             |             | 57%          | 26%            | 23%         | 73%        | 29%          | 39%  | 24%         | 57%          | 43%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                |             | 26%        | 71%          | 61%  |             | 37%          | 35%        |
| Avg. Corr.   | .79     | .78          | .80         | .91        | .93       | .79       | .98          |             | .95         | .47          | .63            | .55         | .15        | -.10         | .00  | .65         | .10          | .06        |
| Std Dev.   | .10     | .09          | .17         | .03        | .04       | .20       | .01          |             | .05         | .18          | .15            | .10         | .21        | .13          | .14  | .19         | .21          | .33        |
| Panel 9 - Probability Distribution of Small Value Correlations to Other Assets           |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  | 12%     | 13%          | 16%         | 19%        | 61%       | 47%       | 57%          | 87%         |             |              |                |             |            |              |      | 5%          |              |            |
| .70 to .89   | 64%     | 52%          | 69%         | 62%        | 39%       | 46%       | 35%          | 13%         |             | 12%          | 20%            | 16%         |            |              |      | 44%         |              |            |
| .50 to .69   | 21%     | 27%          | 11%         | 19%        |           | 7%        | 8%           |             |             | 37%          | 54%            | 73%         | 1%         |              |      | 46%         | 6%           | 7%         |
| .00 to .49   | 3%      | 8%           | 4%          |            |           |           |              |             |             | 51%          | 27%            | 12%         | 71%        | 22%          | 35%  | 5%          | 63%          | 69%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                |             | 2          | 73%          | 65%  |             | 31%          | 24%        |
| Avg. Corr.   | .78     | .72          | .82         | .77        | .91       | .89       | .87          | .95         |             | .49          | .58            | .57         | .14        | -.12         | .02  | .71         | .19          | .15        |
| Std Dev.   | .11     | .14          | .11         | .11        | .05       | .09       | .09          | .05         |             | .17          | .12            | .09         | .23        | .13          | .16  | .12         | .2           | 1          |
| Panel 10 - Probability Distribution of International Stocks Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  |         |              | 3%          |            | 1%        | 3%        |              |             |             |              |                |             |            |              |      |             |              |            |
| .70 to .89   | 21%     | 18%          | 7%          | 32%        | 23%       | 11%       | 15%          | 9%          | 12%         |              | 46%            |             |            |              |      |             |              |            |
| .50 to .69   | 30%     | 30%          | 32%         | 22%        | 22%       | 33%       | 27%          | 34%         | 37%         |              | 15%            | 17%         |            | 22%          |      | 26%         | 1%           |            |
| .00 to .49   | 49%     | 51%          | 57%         | 46%        | 54%       | 53%       | 58%          | 57%         | 51%         |              | 40%            | 80%         | 72%        | 77%          | 32%  | 73%         | 73%          | 64%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                | 2%          | 28%        |              | 68%  | 1%          | 26%          | 36%        |
| Avg. Corr.   | .55     | .53          | .51         | .54        | .55       | .51       | .50          | .47         | .49         |              | .56            | .34         | .13        | .44          | -.01 | .36         | .09          | -.02       |
| Std Dev.   | .18     | .18          | .17         | .19        | .19       | .18       | .17          | .18         | .17         |              | .19            | .14         | .21        | .18          | .18  | .17         | .26          | .19        |
| Panel 11 - Probability Distribution of Emerging Markets Correlations to Other Assets     |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  |         |              |             |            | 5%        | 5%        |              |             |             |              |                |             |            |              |      |             |              |            |
| .70 to .89   | 43%     | 32%          | 22%         | 45%        | 41%       | 16%       | 30%          | 36%         | 20%         | 46%          |                | 2%          |            |              |      | 9%          |              |            |
| .50 to .69   | 19%     | 33%          | 27%         | 19%        | 22%       | 34%       | 41%          | 38%         | 54%         | 15%          |                | 39%         |            |              |      |             |              |            |
| .00 to .49   | 38%     | 35%          | 51%         | 36%        | 33%       | 45%       | 28%          | 26%         | 27%         | 40%          |                | 59%         | 39%        | 22%          | 24%  | 91%         | 65%          | 66%        |
| Negative   |         |              |             |            |           |           |              |             |             |              |                |             | 61%        | 78%          | 76%  |             | 35%          | 34%        |
| Avg. Corr.   | .59     | .57          | .54         | .60        | .63       | .54       | .62          | .63         | .58         | .56          |                | .44         | -.06       | .00          | -.02 | .31         | .09          | -.05       |
| Std Dev.   | .17     | .15          | .17         | .16        | .17       | .17       | .15          | .15         | .12         | .19          |                | .14         | .18        | .11          | .17  | .14         | .15          | .23        |
| Panel 12 - Probability Distribution of High Yield Bonds Correlations to Other Assets     |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| .70 to .89   | 6%      | 1%           | 7%          | 1%         | 2%        | 5%        | 1%           | 8%          | 16%         |              | 2%             |             | 19%        |              |      | 8%          |              |            |
| .50 to .69   | 68%     | 66%          | 68%         | 69%        | 82%       | 68%       | 69%          | 70%         | 73%         | 17%          | 39%            |             | 12%        |              | 3%   | 37%         |              | 6%         |
| .00 to .49   | 26%     | 33%          | 25%         | 30%        | 16%       | 27%       | 30%          | 23%         | 12%         | 80%          | 59%            |             | 53%        | 42%          | 47%  | 55%         | 40%          | 71%        |
| Negative   |         |              |             |            |           |           |              |             |             | 2%           |                |             | 17%        | 58%          | 50%  |             | 60%          | 23%        |
| Avg. Corr.   | .50     | .48          | .49         | .50        | .54       | .52       | .51          | .55         | .57         | .34          | .44            |             | .28        | -.01         | .00  | .43         | -.04         | .08        |
| Std Dev.   | .12     | .12          | .15         | .10        | .09       | .15       | .12          | .10         | .09         | .14          | .14            |             | .30        | .16          | .23  | .16         | .15          | .21        |

**Table 4: Probability Distributions of Correlations, *continued***

| Panel 13 - Probability Distribution of U.S. Intermediate Bonds Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|---|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years   | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00   |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| .70 to .89  |         |              | 3%          |            |           |           |              |             |             |              |                | 19%         |            | 2%           | 6%   |             |              |            |
| .50 to .69  | 14%     | 9%           | 12%         |            | 6%        | 18%       |              | 1%          | 1%          |              |                | 12%         |            | 26%          | 28%  | 1%          |              | 2%         |
| .00 to .49  | 72%     | 75%          | 72%         | 69%        | 77%       | 58%       | 62%          | 73%         | 71%         | 72%          | 39%            | 53%         |            | 72%          | 64%  | 86%         | 17%          | 65%        |
| Negative  | 14%     | 16%          | 14%         | 31%        | 18%       | 25%       | 38%          | 26%         | 29%         | 28%          | 61%            | 17%         |            |              | 1%   | 13%         | 83%          | 33%        |
| Avg. Corr.  | .23     | .19          | .24         | .02        | .20       | .11       | .06          | .15         | .14         | .13          | -.06           | .28         |            | .38          | .34  | .14         | -.14         | .06        |
| Std Dev.  | .27     | .2           | .5          | .2         | .27       | .32       | .21          | .21         | .23         | .21          | .18            | .30         |            | .18          | .19  | .19         | .17          | .18        |

  

| Panel 14 - Probability Distribution of Global Bonds Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|--|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| .70 to .89   |         |              |             |            |           |           |              |             |             |              |                |             |            | 2%           |      |             |              |            |
| .50 to .69   |         |              |             |            |           |           |              |             |             | 22%          |                |             |            | 26%          |      |             |              |            |
| .00 to .49   | 53%     | 49%          | 50%         | 50%        | 45%       | 46%       | 32%          | 29%         | 22%         | 77%          | 22%            | 42%         | 72%        |              | 67%  | 39%         | 60%          | 20%        |
| Negative   | 47%     | 51%          | 50%         | 50%        | 55%       | 54%       | 68%          | 71%         | 78%         |              | 78%            | 58%         |            |              | 33%  | 61%         | 40%          | 80%        |
| Avg. Corr.   | -.03    | -.03         | -.05        | -.04       | -.06      | -.05      | -.08         | -.10        | -.12        | .44          | .00            | -.01        | .38        |              | .03  | .03         | .13          | -.09       |
| Std Dev.   | .17     | .16          | .16         | .13        | .14       | .15       | .14          | .13         | .13         | .18          | .11            | .16         | .18        |              | .17  | .15         | .21          | .17        |

  

| Panel 15 - Probability Distribution of Cash Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|--|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| .70 to .89   |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| .50 to .69   |         |              |             |            |           |           |              |             |             |              |                |             | 6%         |              |      |             |              |            |
| .00 to .49   | 48%     | 45%          | 54%         | 46%        | 42%       | 50%       | 28%          | 39%         | 35%         | 32%          | 24%            | 47%         | 64%        | 67%          |      | 42%         | 32%          | 59%        |
| Negative   | 52%     | 55%          | 46%         | 54%        | 58%       | 50%       | 72%          | 61%         | 65%         | 68%          | 76%            | 50%         | 1%         | 33%          |      | 58%         | 68%          | 37%        |
| Avg. Corr.   | .02     | .00          | .03         | .00        | .04       | -.03      | .00          | .00         | .02         | -.01         | -.02           | .00         | .34        | .03          |      | -.02        | -.12         | .09        |
| Std Dev.   | .2      | 0            | .2          | .17        | .16       | .17       | .15          | .14         | .16         | .18          | .17            | .23         | .19        | .17          |      | .15         | .20          | .22        |

  

| Panel 16 - Probability Distribution of Real Estate Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|---|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years   | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00   |         |              |             |            |           | 5%        |              | 2%          | 5%          |              |                |             |            |              |      |             |              |            |
| .70 to .89  | 27%     | 14%          | 38%         | 26%        | 31%       | 25%       | 29%          | 47%         | 44%         |              |                | 8%          |            |              |      |             |              | 1%         |
| .50 to .69  | 33%     | 42%          | 35%         | 7%         | 34%       | 44%       | 26%          | 27%         | 46%         | 26%          | 9%             | 37%         | 1%         |              |      |             | 5%           | 12%        |
| .00 to .49  | 40%     | 42%          | 27%         | 65%        | 35%       | 26%       | 45%          | 24%         | 5%          | 73%          | 91%            | 55%         | 86%        | 39%          | 42%  |             | 58%          | 81%        |
| Negative  | 1%      | 2%           |             | 2%         |           |           |              |             |             | 1%           |                |             | 13%        | 61%          | 58%  |             | 37%          | 7%         |
| Avg. Corr.  | .52     | .45          | .60         | .40        | .59       | .63       | .52          | .65         | .71         | .36          | .31            | .43         | .14        | .03          | -.02 |             | .08          | .27        |
| Std Dev.  | .2      | 0            | .2          | .17        | .19       | .16       | .23          | .19         | .12         | .17          | .14            | .16         | .19        | .15          | .15  |             | .23          | .17        |

  

| Panel 17 - Probability Distribution of Natural Resources Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|---|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years   | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00   |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| .70 to .89  |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| .50 to .69  | 5%      | 7%           | 2%          |            | 5%        |           | 7%           | 6%          | 6%          | 1%           |                |             |            |              |      | 5%          |              |            |
| .00 to .49  | 50%     | 42%          | 62%         | 52%        | 61%       | 65%       | 55%          | 57%         | 63%         | 73%          | 65%            | 40%         | 17%        | 60%          | 32%  | 58%         |              | 75%        |
| Negative  | 45%     | 51%          | 36%         | 48%        | 34%       | 35%       | 38%          | 37%         | 31%         | 26%          | 35%            | 60%         | 83%        | 40%          | 68%  | 37%         |              | 25%        |
| Avg. Corr.  | .01     | .00          | .05         | .04        | .17       | .07       | .19          | .10         | .19         | .09          | .09            | -.04        | -.14       | .13          | -.12 | .08         |              | .05        |
| Std Dev.  | .24     | .2           | .6          | .2         | .20       | .23       | .23          | .21         | .21         | .26          | .15            | .15         | .17        | .21          | .20  | .23         |              | .19        |

  

| Panel 18 - Probability Distribution of Long-Short Correlations to Other Assets |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
|--|---------|--------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|--------------|----------------|-------------|------------|--------------|------|-------------|--------------|------------|
| 3 Years  | S&P 500 | Large Growth | Large Value | Mid-Growth | Mid-Blend | Mid-Value | Small Growth | Small Blend | Small Value | Int'l Stocks | Emerg. Markets | High Yields | U.S. Bonds | Global Bonds | Cash | Real Estate | Natural Res. | Long-Short |
| .90 to 1.00  |         |              |             |            |           |           |              |             |             |              |                |             |            |              |      |             |              |            |
| .70 to .89   |         |              | 3%          |            |           |           |              | 1%          |             |              |                |             |            |              |      | 1%          |              |            |
| .50 to .69   | 1%      |              | 17%         |            |           | 8%        |              | 21%         | 7%          |              |                | 6%          | 2%         |              | 3%   | 12%         |              |            |
| .00 to .49   | 63%     | 36%          | 74%         | 37%        | 60%       | 92%       | 33%          | 43%         | 69%         | 64%          | 66%            | 71%         | 65%        | 20%          | 59%  | 81%         | 75%          |            |
| Negative   | 36%     | 64%          | 6%          | 63%        | 40%       |           | 67%          | 35%         | 24%         | 36%          | 34%            | 23%         | 33%        | 80%          | 37%  | 7%          | 25%          |            |
| Avg. Corr.   | -.01    | -.22         | .30         | -.33       | -.04      | .29       | -.25         | .06         | .15         | -.02         | -.05           | .08         | .06        | -.09         | .09  | .27         | .05          |            |
| Std Dev.   | .22     | .25          | .20         | .30        | .22       | .08       | .30          | .33         | .21         | .19          | .2             | 3           | .2         | .18          | .17  | .22         | .17          | .19        |

**Table 5: Lowest Correlations Among U.S. Equity Styles**

| Assets                      | .90-1.00 | .80-.89 | .70-.79 | .60-.69 | .50-.59 | > .50 | Average |
|-----------------------------|----------|---------|---------|---------|---------|-------|---------|
| Large Growth to Small Value | 13%      | 25%     | 27%     | 20%     | 8%      | 8%    | 0.72    |
| Large Value to Small Growth | 10%      | 33%     | 21%     | 7%      | 14%     | 15%   | 0.70    |
| Large Value to Mid-Growth   | 28%      | 23%     | 26%     | 4%      | 1%      | 18%   | 0.72    |
| Mid-Value to Small Growth   | 25%      | 19%     | 18%     | 19%     | 1%      | 18%   | 0.70    |

**Table 6: Blend and Growth Appear to Be the Same Thing**

| Correlations                | .90-1.00 | .80-.89 | .70-.79 | > .70 |
|-----------------------------|----------|---------|---------|-------|
| S&P 500 to Large Growth     | 100%     |         |         |       |
| S&P 500 to Large Value      | 76%      | 21%     | 3%      |       |
| Mid-Blend to Mid-Growth     | 93%      | 7%      |         |       |
| Mid-Blend to Mid-Value      | 79%      | 4%      | 11%     | 6%    |
| Small Blend to Small Growth | 100%     |         |         |       |
| Small Blend to Small Value  | 87%      | 10%     | 3%      |       |

inconsistent relationships to all nine U.S. equity styles.

**High-yield bonds to U.S. bonds.** The correlation between high-yield bonds and U.S. bonds has averaged just .28, but has an inconsistent relationship because of a high standard deviation of .30. That means 95 percent of the time, their correlation should range from  $-.32$  to  $.88$ . Tables 2, 3, and 4, Panel 12, confirm the relationship has been very erratic.

How should investors use assets with inconsistent correlations, such as the seven relationships listed in this section? It makes sense to have a meaningful allocation to assets that have moderate to low long-term correlations that also meet return objectives. But investors should not rely too heavily on assets with inconsistent correlations to reduce risk because sometimes diversification won't work.

### Assets that Behave Closer to Growth or Value Styles

The author believes it is helpful to evaluate connections between asset classes that may not be readily evident. In this section seven assets are evaluated to determine if they correlate closer to value or growth style investing.

**Blend and growth styles appear to be the same thing.** Very strong correlations

were observed between growth and blend styles of the same size. Large blend and large growth, mid-blend and mid-growth, and small blend and small growth have all moved in lock step with each other. Comparatively, value and blend more frequently de-link, as shown in Table 6.

The consistently strong correlations between growth and blend styles may be due to index construction. The service and information sectors are growing faster than the U.S. economy as a whole, and the S&P 500 has 70 percent in the service and information sectors. The S&P 500 is classified as a blend index, but it overweights growth segments, so it behaves a lot like growth-style investing.

To be considered a separate asset class, the author believes the asset must behave differently than all other assets. The consistently strong correlations between growth and blend of the same size (such as the S&P 500 and large growth) suggests they are essentially the same thing. Since the reduction in risk has been so low, it does not appear necessary to invest in both growth and blend styles of the same size. A better use of an investor's risk budget is to select blend or growth, then allocate to other assets with lower correlations that still satisfy return objectives.

**Real estate behaves more like value investing.** Real estate investment trusts

(REITs) were used as the proxy for real estate. REITs have been more closely connected to value styles (.65) than growth (.49). There are several possible explanations. First, REITs and value stocks have higher dividend yields. Second, value companies typically have more debt than growth companies; hence, value firms generally have more sensitivity to interest rates than growth companies, and REITs are also sensitive to interest rates.

Interestingly, REITs and small value tend to simultaneously outperform or underperform the S&P 500. From 1972 to 2004, REITs outperformed the index in 20 years, and small value outperformed in 16 of those years. In the 13 years REITs lagged the S&P 500, small value lagged in 11 of those years.

REITs and small value have had an extra connection (a correlation of .71) for two reasons. First, small stocks are more sensitive to interest rates than large stocks, and REITs also have an extra sensitivity to interest rates. Second, the small value index has 12 percent in REITs, while the large growth index has less than 1 percent. In short, investors should know that investing in REITs may be increasing their exposure to risk factors that also affect value investing, particularly small value.

**Emerging markets behave somewhat more like growth styles.** Emerging markets have had a somewhat closer connection to small growth (.62) than large value (.54). When risk appetites are rising, emerging markets and small growth tend to outperform, while large value usually lags; when investors become risk averse, however, large value tends to decline less than the broader market, while small growth and emerging markets tend to decline more. Emerging markets appear to increase an investor's exposure to risk factors that affect growth style investing more than value.

**High-yield bonds behave more like stocks (particularly value stocks) than bonds.** High-yield bonds have had stronger correlations to all nine U.S. equity styles (averaging .52) than U.S. bonds (.28).

**Table 7: 100% Equity Investor****Time Period: 1972 to 2004****Portfolio #1: 100% U.S. Stocks****Portfolio #2: 85% U.S. Stocks, 15% Int'l Stocks****Low-Correlation Portfolio: 35% U.S. Stocks/30% International Stocks/35% Alternatives (1)**

|                         | Portfolio #1 | Portfolio #2 | Lower-Correlated Portfolio |
|-------------------------|--------------|--------------|----------------------------|
| S&P 500                 | 25.0%        | 25.0%        | 10.0%                      |
| Large Growth            | 25.0%        | 20.0%        |                            |
| Large Value             | 25.0%        | 20.0%        | 10.0%                      |
| Small Blend             | 25.0%        | 20.0%        | 7.5%                       |
| Small Value             |              |              | 7.5%                       |
| International           |              | 10.0%        | 20.0%                      |
| Emerging Markets        |              | 5.0%         | 10.0%                      |
| Real Estate (1)         |              |              | 15.0%                      |
| Natural Resources (1)   |              |              | 10.0%                      |
| Long-Short (1)          |              |              | 10.0%                      |
|                         | 100.0%       | 100.0%       | 100.0%                     |
| Annualized Return       | 12.25%       | 12.17%       | 13.70%                     |
| Growth of \$100,000     | \$4,530,540  | \$4,425,691  | \$6,923,813                |
| Standard Deviation      | 17.2%        | 16.2%        | 12.1%                      |
| Change vs. Portfolio 1: |              |              |                            |
| Increase in wealth      |              |              | 52.8%                      |
| Decrease in volatility  |              |              | -29.7%                     |
| Change vs. Portfolio 2: |              |              |                            |
| Increase in wealth      |              |              | 56.4%                      |
| Decrease in volatility  |              |              | -25.3%                     |

1. The start date of the portfolios is 1972, which is the inception of the NAREIT Index. The end date is 2004.

2. Allocations to emerging markets begin in 1988, when the MSCI Emerging Markets Index began. Prior to 1988, additional allocations were made to international stocks.

High-yield bonds have also behaved more like other equity assets—real estate (.43), emerging market stocks (.44), and international stocks (.34)—than U.S. bonds (.28). Since high-yield bonds have higher correlations to stocks, they should be viewed more like stocks than bonds.

High-yield bonds have had somewhat closer correlations to value investing (.57 to small value) than growth (.49 to large growth). The extra connection between high yields and value investing may be due to higher debt ratios, a greater sensitivity to interest rates, and higher dividend yields.

**U.S. bonds behave more like value investing.** U.S. bonds have had stronger correlations to value stocks (.24 to large value) than growth styles (.02 to mid-growth and .06 to small growth), which may be due to risk appetites. When investors seek more risk, small and mid-

cap growth stocks tend to outperform, while value stocks and bonds tend to lag; but when investors become risk averse, large value stocks and bonds tend to hold up reasonably well, while growth stocks usually suffer most.

**Long-short may behave more like value investing.** The long-short product<sup>1</sup> used in this study has had negative correlations to all three growth styles (averaging -.27), but a positive relationship to value styles (.25). Systematic and unique risks vary considerably among long-short products, but investors should be aware if their long-short products are increasing their exposure to risk factors that affect value investing more than growth.

As of December 31, 2006, there were 125 long-short mutual funds in Morningstar's database, mostly with minimums in the \$500–\$2,500 range. Long-short products are also widely available through

hedge funds, but the minimum required investment is usually high. The author expects long-short will become widely used in the next decade, and plans to evaluate these strategies in a future article.

**International stocks behave similarly to growth and value styles.** International stocks have had similar correlations to growth styles (averaging .52) and value investing (.50). But more recently international stocks have correlated somewhat closer to value. In a future article, the author will examine the correlation of international equities in different market conditions.

### The Asset Allocation Decision

This section examines how risk and return are affected by better emphasizing low-correlated assets for two types of investors. Table 7 shows three asset allocations for a 100 percent equity investor.

1. Portfolio 1 is composed of 100 percent U.S. equities.
2. Portfolio 2 is composed of 85 percent U.S. equities and 15 percent international equities.
3. Portfolio 3 consists of lower correlated assets that are approximately equally weighted:
  - 35 percent U.S. equities (20 percent large stocks and 15 percent small stocks)
  - 30 percent international stocks (20 percent developed and 10 percent emerging markets)
  - 35 percent alternatives (15 percent real estate, 10 percent natural resources, and 10 percent long-short)

It should be noted that large and small stocks are more equally weighted than typical practice because small stocks have lower correlations to large stocks while still meeting return objectives. The allocation to value and blend styles is equal. Growth styles were not included because this study observed that growth and blend styles are essentially the same thing. The allocations to international stocks, emerging markets, real estate, natural resources,

**Table 8: Balanced Investor**

|   | Portfolio #1 | Portfolio #2 | Lower-Correlated Portfolio |
|---|--------------|--------------|----------------------------|
| <b>Time Period: 1972 to 2004</b>  |              |              |                            |
| <b>Portfolio #1: 60% U.S. Stocks, 40% U.S. Bonds</b>  |              |              |                            |
| <b>Portfolio #2: 50% U.S. Stocks, 10% Int'l Stocks, 40% U.S. Bonds</b>                                    |              |              |                            |
| <b>Low-Correlation Portfolio: 25% U.S. Stocks/20% International Stocks/25% Alternatives (1)/30% Bonds</b> |              |              |                            |
| S&P 500   | 15.0%        | 20.0%        | 7.5%                       |
| Large Growth  | 15.0%        | 10.0%        |                            |
| Large Value   | 15.0%        | 10.0%        | 7.5%                       |
| Small Blend   | 15.0%        | 10.0%        | 5.0%                       |
| Small Value   |              |              | 5.0%                       |
| International   |              | 10.0%        | 13.0%                      |
| Emerging Markets  |              |              | 7.0%                       |
| Real Estate (1)   |              |              | 11.0%                      |
| Natural Resources (1)   |              |              | 7.0%                       |
| Long-Short (1)  |              |              | 7.0%                       |
| U.S. Bonds  | 40.0%        | 40.0%        | 15.0%                      |
| Global Bonds  |              |              | 15.0%                      |
|   | 100.0%       | 100.0%       | 100.0%                     |
| Annualized Return   | 10.97%       | 10.82%       | 12.53%                     |
| Growth of \$100,000   | \$3,103,020  | \$2,969,803  | \$4,911,815                |
| Standard Deviation  | 10.8%        | 10.1%        | 8.9%                       |
| Change vs. Portfolio 1:   |              |              |                            |
| Increase in wealth  |              |              | 58.3%                      |
| Decrease in volatility  |              |              | -17.6%                     |
| Change vs. Portfolio 2:   |              |              |                            |
| Increase in wealth  |              |              | 65.4%                      |
| Decrease in volatility  |              |              | -11.9%                     |

1. The start date of the portfolios is 1972, which is the inception of the NAREIT Index. The end date is 2004.

2. Allocations to emerging markets begin in 1988, when the MSCI Emerging Markets Index began. Prior to 1988, additional allocations were made to international stocks.

3. Allocations to global bonds begin in 1985, when the Citigroup World Global Bond Index (ex-U.S. and unhedged) began. Prior to 1985, additional allocations were made to U.S. bonds.

and long-short are also greater than typical practice because they all have lower correlations to U.S. equities while still meeting return objectives.

The results for the equity investor (Table 7) show the portfolio with lower-correlated assets earned 1.45 percent more a year than Portfolio 1 and 1.53 percent more a year than Portfolio 2. Over 30 years this resulted in 53 percent more wealth than Portfolio 1 and 56 percent more than Portfolio 2. The portfolio of lower correlated assets also had 30 percent less volatility than Portfolio 1 and 25 percent less volatility than Portfolio 2.

Table 8 also shows three asset allocations, this time for a balanced investor.

1. Portfolio 1 is composed of 60 percent U.S. equities and 40 percent U.S. bonds.

2. Portfolio 2 is composed of 50 percent U.S. equities, 10 percent international stocks, and 40 percent U.S. bonds.

3. Portfolio 3 consists of lower-correlated assets that are approximately equally weighted:

- 25 percent U.S. stocks (15 percent large and 10 percent small)
- 20 percent international stocks (13 percent developed and 7 percent emerging markets)
- 25 percent alternatives (11 percent real estate, 7 percent natural resources, and 7 percent long-short)
- 30 percent bonds (15 percent U.S. bonds and 15 percent global bonds)

The asset allocation principles described in Table 7 for the 100 percent equity investor are repeated for the balanced

investor. In addition, U.S. bonds and global bonds are equally weighted. The allocation to global bonds is greater than typical practice because global bonds have lower correlations to U.S. equities.

The results for the balanced investor (Table 8) show the portfolio of lower-correlated assets earned 1.56 percent more a year than Portfolio 1 and 1.71 percent more a year than Portfolio 2. Over 30 years this resulted in 58 percent more wealth than Portfolio 1 and 65 percent more than Portfolio 2. The portfolio of lower correlated assets also had 18 percent less volatility than Portfolio 1 and 12 percent less volatility than Portfolio 2.

## Conclusion

To optimize the risk/return relationship, the asset allocation decision should emphasize low-correlated assets that still meet return objectives. Here are several ideas on how to ensure a portfolio includes low correlated assets rather than just a lot of asset classes:

- When two assets have similar return expectations, investors can use the consistency or inconsistency of relationships reflected in Tables 1 through 5 to make better asset allocation decisions by

1. Limiting the inclusion of assets with consistently strong correlations
2. Emphasizing assets with consistently low correlations that still meet return objectives
3. Relying on assets with correlations that range from low to high means that sometimes diversification won't work. To maximize diversification, emphasize a mix of assets with consistently lower correlations that still meet return objectives.

- Do not rely solely on average correlations. Averages don't tell us anything about the volatility of the average. Barry Bonds and I have averaged 378 home runs, but the dispersion within the average is that Barry Bonds has hit 756 home runs and I have hit none. Evaluate the volatility of averages.

- Using both growth and blend styles of the same size has done very little to reduce

## Sources of Monthly Returns

- S&P 500: Standard & Poor's
- Large growth: Russell 1000 Growth, 1979–2004; Fama & French, 1970–1978
- Large value: Russell 1000 Value, 1979–2004; Fama & French, 1970–1978
- Mid-growth: Russell Mid-Cap Growth, 1986–2004
- Mid-blend: Russell Mid-Cap, 1979–2004
- Mid-value: Russell Mid-Cap Value, 1986–2004
- Small growth: Russell 2000 Growth, 1979–2004; Ibbotson, 1970–1978
- Small blend: Russell 2000, 1979–2004; Ibbotson, 1970–1978
- Small value: Russell 2000 Value, 1979–2004; Ibbotson, 1970–1978
- International stocks: Morgan Stanley Europe, Australia, Far East (EAFE), 1970–2004
- Emerging markets: Morgan Stanley Emerging Markets Index, 1988–2004
- High-yield bonds: Lehman Brothers High Yield Index, June 1983–2004
- U.S. bonds: Lehman Brothers Government/Credit Bond Index, 1970–2004
- Global bonds: Citigroup World Global Bond Index, ex-U.S., unhedged, 1985–2004
- Cash: Lipper Money Market Index, 1990–2004; U.S. Three-Month Treasury Bill 1970–1989
- Real estate: National Association of Real Estate Investment Trusts (NAREIT), 1972–2004
- Natural resources: Goldman Sachs Commodity Index, 1970–2004
- Long-short: Rob Arnott Fundamental Index, Long-Short, 1970–2004 (simulated results)

risk. Instead of using both styles, a better use of an investor's risk budget is to choose blend or growth, then allocate to other assets with lower correlations that still satisfy return objectives.

“Instead of using both styles, a better use of an investor's risk budget is to choose blend or growth, then allocate to other assets with lower correlations that still satisfy return objectives.”

- View assets according to how they behave in relation to each other, not their traditional classifications. High-yield bonds should be viewed closer to stocks because they behave more like stocks. Growth and blend styles of the same size should be viewed as essentially the same thing

because their correlations are consistently very strong.

- Evaluate how asset classes may share similar risk exposures, and thus behave more closely. Real estate, high-yield

bonds, U.S. bonds, and long-short behave more like value style investing than growth. Allocations to these assets may be increasing an investor's exposure to risk factors that affect value investing more than

growth. Emerging markets behave somewhat closer to growth styles, and may be increasing an investor's exposure to risk factors that affect growth style investing more than value.

- Natural resources, long-short, U.S. bonds, global bonds, and cash have had

consistently low correlations to all to the other assets in this study. The diversification benefits of U.S. bonds and cash are well known, but the author believes that natural resources, global bonds, and long-short are under-used and should have higher allocations than standard practice. The author also believes that real estate, international stocks, and emerging markets should be used more than the typical practice because they have lower correlations than U.S. equities and still satisfy return objectives.

In the asset allocation decision, the mantra the author wishes to convey is that investors can improve return and reduce risk by better emphasizing low-correlated assets that still meet return objectives.



### Endnote

1. The betas and correlations among long-short products vary substantially, which made using a long-short index useless as representative of an investment strategy. Hence, the author used a single long-short product (a hedged equity strategy that invests \$100 long and \$100 short, but which is not a market-neutral strategy because its sector weights and beta may differ from zero) in this study.