Dynamic correlations: The implications for portfolio construction

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Executive summary. It's common to hear of the value of diversification during uncertain or volatile markets. Indeed, a broadly diversified, balanced portfolio is unlikely to perform as poorly as a portfolio focused entirely on stocks, if stocks enter a bear market or experience seemingly abnormal volatility. Perhaps this is a primary reason the market environment since the recent global financial crisis has spawned such disappointment and a perception that diversification no longer works. For instance, since 2008, most risky asset classes have seemingly moved in lockstep, with correlations to U.S. equities over the past three years ranging from 0.6 (for commodities) to 0.93 (for developed international markets). Indeed, only U.S. Treasury bonds have proven to be a true diversifier, correlating at –0.3 to U.S. equities.

Although carefully examining correlation is critical to the process of portfolio construction, great care must be exercised in using correlation as the *foundation* for a portfolio's construction. Correlation is a statistical measure, subject to estimation error, and correlations among assets can

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vary both over time and in different circumstances. And, as the recent market environment has shown, many risky assets can and do perform similarly during periods characterized by risk aversion and a general flight to quality.

So what can investors do with this information? How can they ensure that a portfolio is properly diversified? This updated version of our 2009 paper discusses what correlation does and does not mean for diversification, the implications of dynamic (that is, changing) correlations, the risk of relying on historical correlations during a flight to quality, and the benefit of focusing on fixed income instruments as a source of consistent diversification benefit to mitigate the near-term risk of the equity markets.[1]

Correlation is a measure of the tendency of the returns of one asset to move in tandem with those of another asset. In other words, two assets that are "uncorrelated" could be expected to show no systematic, linear relationship between their returns over time. By combining uncorrelated assets, the movements of one asset can be expected to at least partially mitigate the movements of the second asset, reducing the average volatility of a portfolio. The first half of this paper examines the impact of correlations on portfolio construction and examines how correlations can change over time.

Although most investors have long-term investment goals, they are particularly averse to large losses, even over the short term. The second half of our analysis thus looks closely at what happens to correlations and, ultimately, diversification during periods of severe market stress. At such times, diversification benefits can seem to vanish among some assets with low long-term correlation, while the diversification benefits of other assets may become more apparent.

Notes on risk: All investments are subject to risk. Past performance is no guarantee of future results. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index. Visit vanguard.com for updated Vanguard fund performance. Diversification does not ensure a profit or protect against a loss in a declining market. Investments in bonds are subject to interest rate, credit, and inflation risk. Funds that concentrate on a relatively narrow market sector face the risk of higher share-price volatility. Because high-yield bonds are considered speculative, investors should be prepared to assume a substantially greater level of credit risk than with other types of bonds. Foreign investing involves additional risks, including currency fluctuations and political uncertainty. Stocks of companies in emerging markets are generally more risky than stocks of companies in developed countries. Prices of mid- and small-cap stocks often fluctuate more than those of large-company stocks.

Investors must buy or sell ETF shares in the secondary market with the assistance of a stockbroker. In doing so, the investor may incur brokerage commissions and may pay more than net asset value when buying and receive less than net asset value when selling.

1 During periods of severe equity market stress, cash has historically been the most consistent diversifier for risky assets such as stocks. However, cash is more generally associated with short-term needs than investing with the goal of increasing the real value of a long-term investment portfolio. For this reason, we have chosen not to focus on cash in this paper.

Setting the baseline: What does correlation tell us?

Correlation is a statistical measurement used to convey the strength and direction of a linear relationship between two random variables. In finance, these variables can be anything from an individual security to an entire asset class. Increasingly positive (negative) correlation indicates an increasingly strong (inverse) relationship between the two variables, up to 1 (–1), which indicates a perfectly positive (inverse) relationship. In other words, two stocks with perfect correlation would be expected to move up and down in fixed proportion over a given period of time. Of course, because distinct investments are by definition influenced differently by the same factors, perfect positive correlation is extremely rare. For example, for the period from January 1, 2000, through December 31, 2011, the returns of ExxonMobil and Chevron, two very similar oil services firms, correlated at 0.85 on a daily basis, and 0.74 on a monthly basis (Source: Thomson Reuters Datastream). Although the two companies moved in the same direction on 2,541 days, they moved in opposite directions on 589 days.

Even in the case of a preannounced stock-for-stock merger of two corporations (in which the equity of one entity will be converted into equity of another in fixed proportion at a given future date), correlations can be less than 1.0. And while correlation conveys information about tendencies in the direction of the change in value of two investments, the statistic itself conveys very little information about the absolute level of change in value of the assets. For example, over the same period, ExxonMobil posted a 110% cumulative return while Chevron notched a more impressive 146% cumulative return. So despite the companies' high correlation, investing in one was not "just as good" as investing in the other. In fact, investors must be equally aware of the things that correlation does not tell them.

Role of correlation in portfolio construction

Correlation is one of the primary building blocks of portfolio construction, along with expected returns and expected volatility. Because correlation summarizes the historical relationship between two assets, investors often focus on correlation to frame expectations for how a portfolio may perform over time. Specifically, by combining imperfectly correlated assets, a portfolio's expected volatility may be reduced, often without a significant affect on returns.[2] As **Figure 1**, on page 5, illustrates, from January 1, 1926, through December 31, 2011, adding a 10% bond allocation[3] to a U.S. stock portfolio[4] would have reduced volatility from 22.96% to 20.81%, but would have only reduced annualized returns from 10.17% to 9.95%. It's clear that the low average correlation between the U.S. stock market and the U.S. bond market (historically, 0.25), combined with significantly lower overall volatility for U.S. bonds, has produced a significant diversification benefit. This is particularly true in equity-heavy portfolios, where an addition of bonds has led to

2 Correlation has been widely used when constructing investment portfolios ever since Harry M. Markowitz first developed the theory of mean-variance analysis in the 1950s. The basic premise of mean-variance analysis is that investors face a trade-off between risk and expected return. In mean-variance analysis, risky assets can be combined in a portfolio in an attempt to minimize the total portfolio risk at any desired level of expected return. Markowitz discovered that portfolio standard deviation is a function not only of the standard deviations of all the individual assets in a portfolio but also of the covariance between the rates of return for all the assets in the portfolio. Optimal mean-variance combinations lie along the efficient frontier—a set of portfolios that has the maximum expected return for a given level of risk and the minimum risk for a given level of expected return. According to the theory, any risk–return combination that does not lie along the efficient frontier would be suboptimal. All rational investors would therefore wish to be positioned at some point along the efficient frontier commensurate with their return expectations and risk tolerance.

3 Throughout this analysis, references to "bonds" or "U.S. bonds" or "investment-grade bonds" are synonymous with the broad U.S. bond market. We represent the U.S. bond market by combining the following historical benchmarks: The S&P High Grade Corporate Bond Index from 1926 through 1968; the Citigroup High Grade Index from 1969 through 1972; the Barclays Capital U.S. Long Credit Aa Bond Index from 1973 through 1975; the Barclays Capital U.S. Aggregate Bond Index thereafter.

4 Throughout this analysis, references to "stocks" or "U.S. stocks" are synonymous with the broad U.S. stock market. We represent the U.S. stock market by combining the following historical benchmarks: The S&P 500 Index from 1926 through 1970; the Dow Jones U.S. Total Stock Market Index from 1971 through April 22, 2005; the MSCI U.S. Broad Market Index thereafter.

Correlation and portfolio variance

Correlation differences may actually have a more modest diversification benefit than many investors perceive. In fact, in the case of combining stocks and bonds, the single largest factor contributing to the decline in portfolio volatility arises from the lower total volatility of bonds, not the fact that stocks and bonds have low correlation. From the mathematical definition of portfolio variance, the following relationship must hold for all two-asset portfolios:

Portfolio Variance = $\text{Variance}_1 \times \text{Weight}_1^2 + \text{Variance}_2 \times \text{Weight}_2^2$ + Correlation Effect,

where "Correlation effect" is a function of the weights of the assets in the portfolio and their correlation with each other. A direct implication of this equation is that correlation is most relevant to diversification arguments, and most powerful in reducing portfolio volatility, when asset volatilities are more similar.

a reduction in portfolio volatility that has been disproportionately large relative to the reduction in average returns. And so long as the observed correlation remains constant over time, this relationship will tend to hold. However, challenges to portfolio construction arise when the correlations among assets do not remain constant, and instead shift, sometimes significantly.

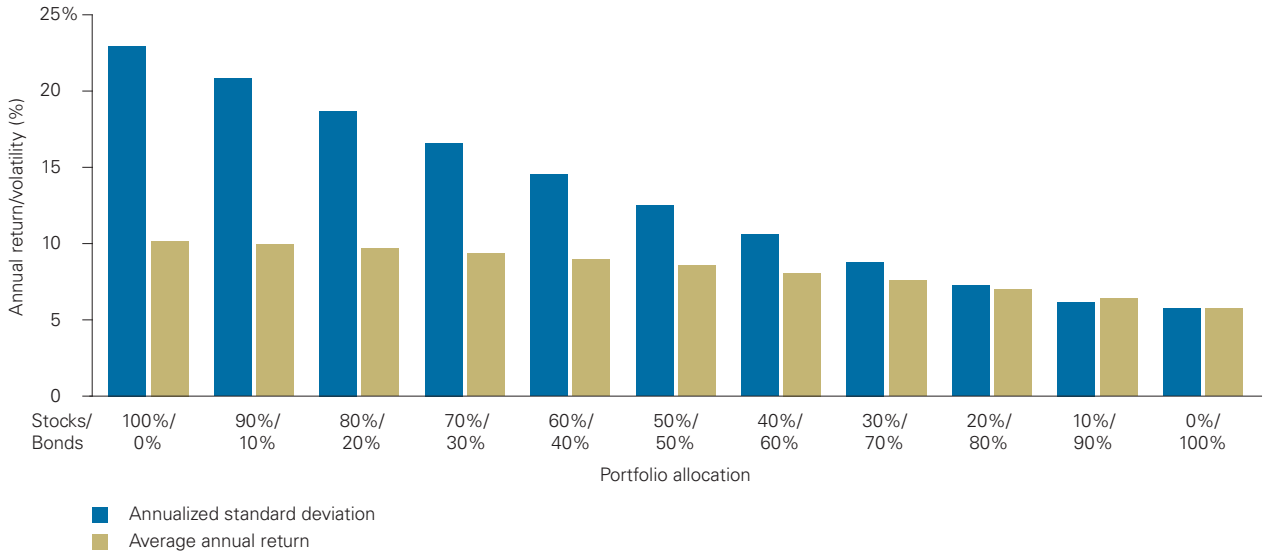
Dynamic correlations

Volatility is typically associated with returns; however, measured correlations can also be volatile, often to the detriment of portfolios believed to be adequately diversified. And the shorter the window of observation, the greater the likelihood that realized correlation will differ from the long-term average. **Figure 2** illustrates five-year correlations between monthly U.S. stock and U.S. bond total returns over five-year intervals since 1926 (17 distinct, non-overlapping periods). While the long-term average correlation between these two asset classes has been 0.25, the figure shows that correlations over shorter windows vary widely from this average, with a range of 0.72 for the five years ended 1975 to –0.54 for the five years ended 2005.[5]

Volatility in realized correlations can have serious implications for investors, as the diversification and portfolio efficiency that is realized may differ from expectations. For example, over the 20-year period ended December 31, 1985, the correlation between U.S. stocks and U.S. bonds was 0.57. This meant that the ex-post, realized reduction in portfolio volatility achieved by adding bonds to a stock portfolio was reduced—that is, adding a 10% allocation to bonds to a 100% stock portfolio reduced volatility 6.8% (versus the long-term average of 9.3%). In contrast, from 1986 through December 2011, the realized correlation between U.S. stocks and U.S. bonds was –0.10, which translated into a volatility reduction of 10.2% when a 10% bond allocation was added to a 100% stock portfolio.

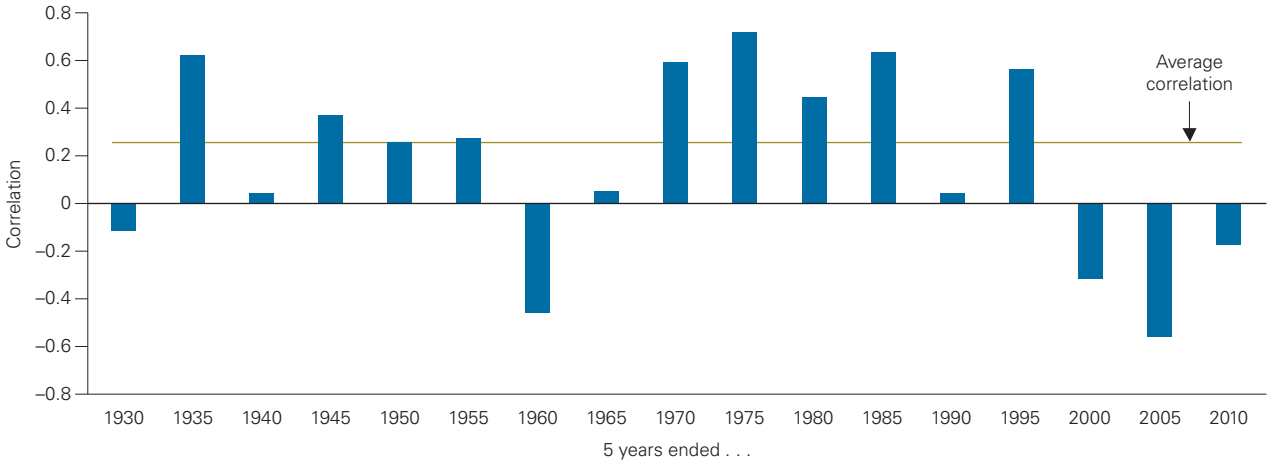
5 The correlation between monthly U.S. stock and U.S. bond returns from January 1, 2011, through December 31, 2011, was –0.91.

Figure 1. Historical average volatility and returns relative to various stock/bond portfolios



Sources: Vanguard calculations, using data from Standard & Poor's, Dow Jones, MSCI, Citigroup, and Barclays Capital. The calculations use quarterly return data; using monthly or annual return data would not change the relationships. Data cover the period January 1, 1926, through December 31, 2011.

Figure 2. Five-year non-overlapping correlations between U.S. stocks and U.S. bonds



Sources: Vanguard calculations, using data from Standard & Poor's, Dow Jones, MSCI, Citigroup, and Barclays Capital. Data cover the period January 1, 1926, through December 31, 2010.

Why does measured correlation differ from its long-term average? The fact that observed correlation varies, even over relatively long periods of time, does not necessarily mean that "correlations are changing," although this may be the case. It simply reflects randomness in the return variables themselves, which generally produces ex-post outcomes that differ from the "true" underlying statistic or longer-term average, particularly over shorter periods.

Previous research suggests that not only does randomness affect measures of realized correlation through time, but also that the underlying correlations between asset returns change over time and in particular circumstances and have important relationships to events such as volatility shocks. Ilmanen (2003) found that factors increasing the correlation between U.S. stocks and bonds include high inflation and significant changes in GDP growth. Ilmanen also found that stock–bond correlations tend to be lowest when equities are weak and volatile, such as during flights to quality. Other research has provided similar evidence. Gulko (2002) found that stock–bond correlations are positively related during normal market conditions, but decrease during stock market plunges. Connolly, Stivers, and Sun (2005) showed that stock–bond correlation is lower when the implied volatility from equity index options is higher.

Although market volatility has emerged as a key driver that tends to decrease correlations between stocks and bonds, volatility is also a major driver that tends to increase correlations when looking at subcomponents of the same asset class. For example, numerous studies have found that correlations between U.S. and international stocks increase substantially during volatile market episodes.[6] Longin and Solnik (2001) found that correlation is not related to market volatility per se, but to the market trend, with correlation increasing during bear markets but not in bull markets.[7]

Implications for portfolio construction

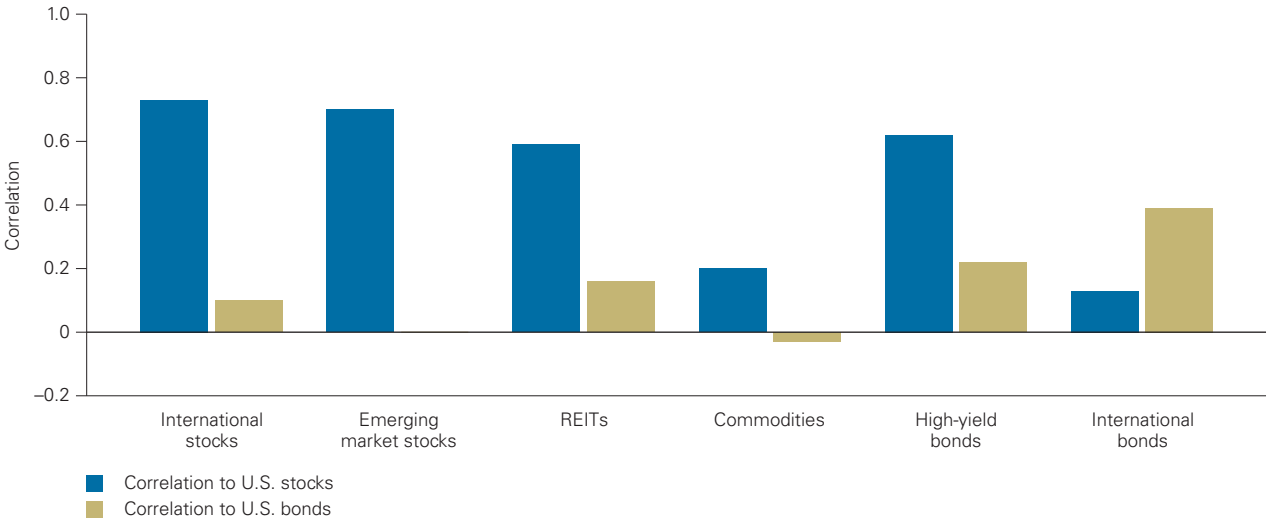
Because bonds have relatively low volatility in addition to low average correlations to stocks, investors have traditionally used bonds to diversify their stock allocations. However, investment products such as exchange-traded funds (ETFs) have arisen in recent years, providing simplified, low-cost access to a greater number of risk-premium asset classes and sub-asset classes beyond U.S. bonds. As a result, it's no surprise that attention has been drawn to the potentially diversifying properties of investments such as commodities, real estate, emerging-market bonds, and micro-cap stocks, to name a few. Academic research and historical experience suggest that many of these higher-risk, yet potentially diversifying, assets may provide returns higher than those available in a typical bond portfolio, even as they have been relatively uncorrelated to U.S. stocks and bonds. **Figure 3** shows the average monthly correlations between some of these market segments and U.S. stocks and U.S. bonds.[8]

6 For a discussion of the correlation between U.S. and international equities, see Philips (2012).

7 Other factors may also contribute to changing correlations. For example, increasing global interdependence among countries may cause correlations between U.S. and international stocks to increase over time. Solnik (2002) has argued that increasing correlations are a natural progression as markets mature, develop, and become more integrated.

8 We also looked at the correlation of hedge funds to U.S. stocks and bonds. The Dow Jones Credit Suisse Hedge Fund Index, however, started in 1994, so we excluded the index's results from this paper. That said, since 1994, hedge funds and U.S. equities have realized a 0.61 correlation, similar to that of U.S. stocks to REITs.

Figure 3. Monthly correlations between select market segments and traditional asset classes: 1988–2011



Notes: U.S. stocks are represented by the Dow Jones U.S. Total Stock Market Index from 1988 through April 22, 2005, and the MSCI US Broad Market Index thereafter; U.S. bonds are represented by the Barclays Capital U.S. Aggregate Bond Index; international stocks are represented by the MSCI EAFE Index; emerging market stocks are represented by the MSCI Emerging Markets Index; REITs are represented by the FTSE NAREIT Index; commodities are represented by the S&P GSCI Total Return Index from 1988 through 1990 and the Dow Jones UBS Commodities Index thereafter; high-yield bonds are represented by the Barclays Capital High Yield Bond Index; and international bonds are represented by the Citigroup World Global Bond Index ex U.S. from 1988 through 1989 and the Barclays Capital Global Aggregate ex U.S. Bond Index thereafter.

Sources: Vanguard calculations, using data provided by Thomson Reuters Datastream.

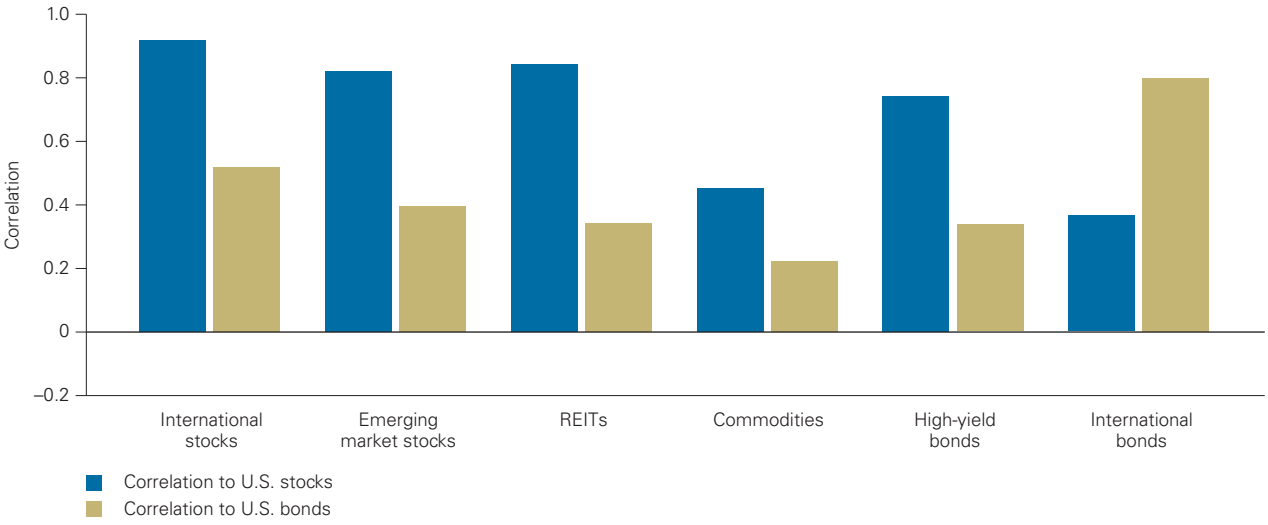
By adding assets such as those in Figure 3 to a portfolio (and by extension, reducing the existing stock and/or bond allocations), the investor hopes to lower total portfolio volatility, increase total portfolio returns, or generate some combination of higher returns and lower volatility. This proved effective during the bear market from 2000 through 2002 (U.S. stocks returned –42%), during which REITs (+44%), commodities (+37%), international bonds (+19%), and high-yield bonds (+5%) realized positive returns, providing considerable diversification potential.[9] However, while many assets are imperfectly correlated over time, the long-run historical correlations may not hold during short-term periods of acute market stress. This is because during a flight to quality, increased systematic risk tends to swamp asset-specific risk, and risky assets have a tendency to suddenly become more positively correlated, often in contrast with how they perform during "normal" times. This also highlights an important distinction—risk diversification, such as that achieved through U.S. Treasury bonds, versus return diversification, such as that achieved through REITs or emerging markets equities. As we will see, in normal times, the differences between the two may be minor, but during events characterized by a flight to quality, the differences and implications can be significant.

From 1988 through 2007 (1988 representing the start of the emerging markets data series), a portfolio allocated 50% to U.S. stocks and 50% to U.S. bonds would have averaged a 9.9% annual return with a standard deviation of 7.4%. On the other hand, a portfolio equally weighted among the six categories of assets shown in Figure 3 in addition to U.S. stocks and U.S. bonds (12.5% allocated to each) would have averaged a 10.9% annual return with a standard deviation of 7.6% (see Figure 5a).[10] In hindsight it is clear that it would have made sense

9 These findings cover the period April 2000 through February 2003.

10 Another potential strategy is to maintain the equity allocation and diversify the bond allocation across these assets. Over this period, such a portfolio would have averaged an 11.4% annual return but with higher volatility (9.6%) than that of the starting portfolio.

Figure 4. Correlations between select market segments and traditional asset classes: October 2007 through February 2009



Notes: A similar spike in correlations was observed in 1998, a period characterized by the Asian Contagion, the Russian debt default, and the collapse of Long-Term Capital Management. See Figure 3 for benchmark descriptions.

Sources: Vanguard calculations, using data provided by Thomson Reuters Datastream.

to invest in the more diversified portfolio over this particular period.[11] But the "long-term history" for many types of assets is not nearly as long as that of U.S. stocks, bonds, and cash, for which we can reliably go back to at least 1926, a period covering many economic and market regimes. For many of the asset classes and sub-asset classes commonly used to diversify equity market risk, we can only go back 20 or 30 years, a period characterized by disinflation, long intervals of relatively low volatility, and a relatively stable economic environment.

As is now widely known, the global equity bear market that started in October 2007 and lasted through early March 2009, was unique in many respects. The global financial crisis was characterized primarily by a flight to quality. And in a flight to quality, risky assets tend to perform more similarly than differently. **Figure 4** shows the observed correlations for the same assets from October 2007 through February 2009. Comparing the long-term correlations in Figure 3 to the correlations presented in Figure 4, we can see the impact of a flight to quality. Correlations to both U.S. stocks and U.S. bonds increased significantly—virtually across the board. As a result, the long-term diversifying properties at least temporarily largely disappeared.[12]

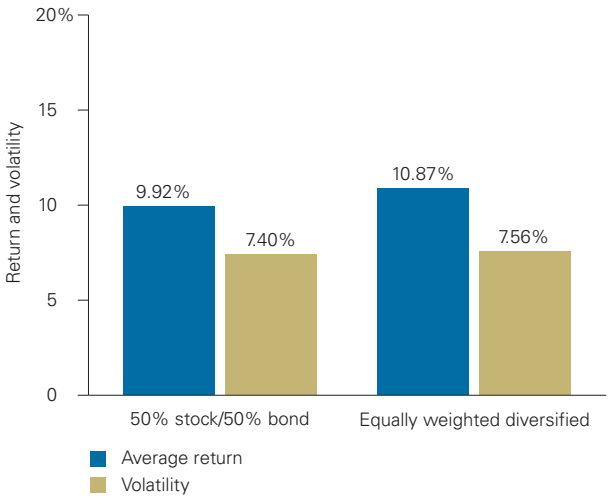
Of course, an increase in correlation was not the full extent of the impact. By moving from a 50% stock/50% bond portfolio to a portfolio equally weighted across eight different asset and sub-asset classes, the investor ended up with only 12.5% of the portfolio in U.S. bonds and 87.5% of the portfolio in riskier assets. And although those risky assets increased average returns without significantly increasing average portfolio volatility (particularly from 2000 through 2007), the risk bled through during the global financial crisis. So, while the 50/50 portfolio returned –26% with a worst month

11 For a broader, more detailed discussion of the implications of combining nontraditional assets in a portfolio, see Kinniry and Philips (2007).

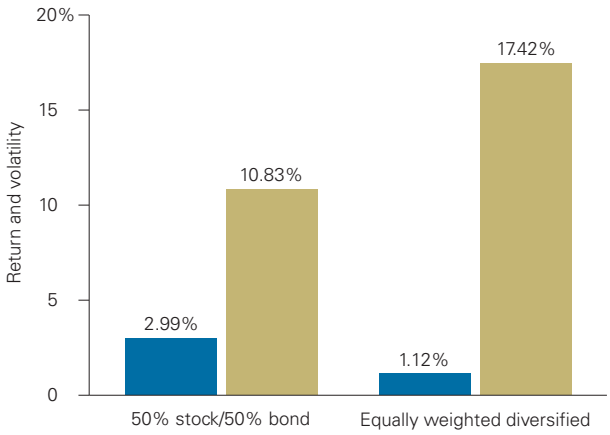
12 As with average correlations, we also evaluated hedge funds over the course of the global financial crisis, and found that correlations to equities increased: Specifically, the correlation of hedge funds to equities increased to 0.72.

Figure 5. Return and volatility portfolio comparisons

a. 50% equity/50% bond portfolio versus equally weighted diversified portfolio: 1988 through 2007



b. 50% equity/50% bond portfolio versus equally weighted diversified portfolio: 2008 through 2011



Note: See Figure 3 for benchmark descriptions.

Sources: Vanguard calculations, using data provided by Thomson Reuters Datastream.

(October 2008) of –10.0%, the eight-asset portfolio returned –38.4% with a worst month (October 2008) of –17.6%. The result? Not only has the "diversified" portfolio underperformed the 50% stock/50% bond portfolio since 2008, but it has done so with significantly higher volatility, as shown in **Figure 5b**.

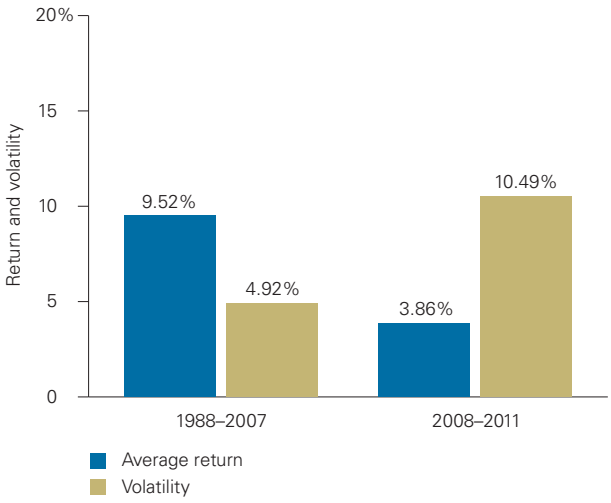
Because of such contagion risks, it is critical for investors to understand the potential value of an allocation to high-quality bonds. During the global financial crisis, even as risky assets largely declined in lockstep, U.S. bonds as measured by the Barclays Capital U.S. Aggregate Bond Index returned 7.0%.[13] Similarly, in August 1998, a prior contagion event, U.S. bonds returned 1.6%, while other types of assets posted negative returns: U.S. stocks, –15.6%; high-yield bonds, –5.5%; REITs, –9.4%; international developed markets, –12.4%; international emerging markets, –28.9%; and commodities, –5.9%. Other than U.S. bonds, only international bonds (+2.5%) saw gains.

As we demonstrated in Figure 1, the long-term diversification properties of bonds are significant. And as realized during periods of risk aversion and flight from risky assets, high-quality bonds, particularly Treasury bonds, prove to be a destination of choice. So although bonds may not provide the long-term expected returns of other asset and sub-asset classes that are now accessible, bonds have been one of the more reliable assets that we have investigated to mitigate losses in the worst of times.[14]

13 During the global financial crisis, the Barclays Capital U.S. Treasury Bond Index returned 14.2%.

14 Other assets or tools that may be just as effective, if not more effective than bonds at hedging downside equity risk, include Treasury bills, derivatives or ETFs linked to the VIX (ticker symbol for the Chicago Board Options Exchange Market Volatility Index), inverse funds and ETFs, put options, and other forms of portfolio insurance.

Figure 6. Return and volatility statistics for eight-asset portfolio that maintains 50% bond allocation



Notes: A portfolio that maintained the equity allocation and diversified the bond allocation would have experienced an 11.4% average return, 9.7% average volatility, and a drawdown in 2008 of –33.3%. See Figure 3 for benchmark descriptions.

Sources: Vanguard calculations, using data provided by Thomson Reuters Datastream.

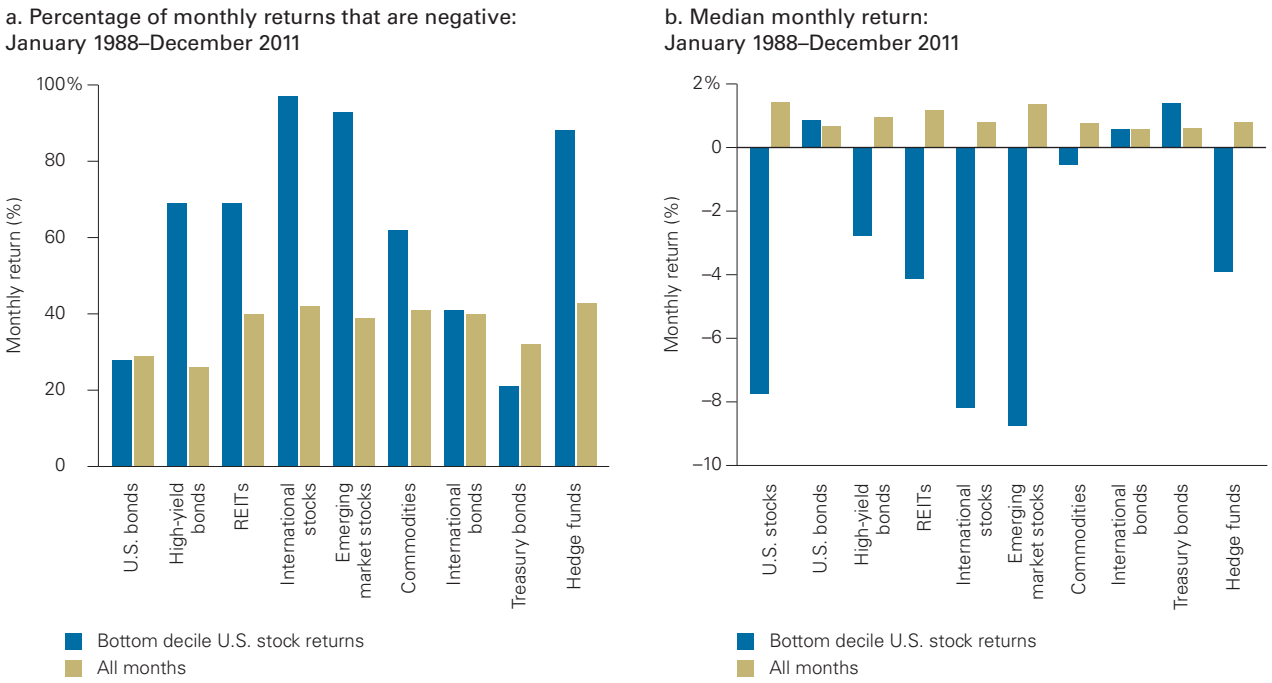
Figure 6 illustrates the role of bonds in a portfolio. Maintaining the original allocation to U.S. bonds and diversifying the allocation to U.S. stocks across the six alternative assets identified in Figures 3, 4, and 5 significantly reduced the average volatility of the portfolio leading up to 2008. The cost was slightly lower total return from 1988 through 2007. Since the global financial crisis, however, by maintaining the bond allocation, an investor would have been able to maintain his or her portfolio volatility levels, and even modestly boost returns. So for investors who maintained their exposure to bonds, diversification worked exactly as we would expect it to work, even accounting for increased correlations across risky assets coupled with significantly poor returns.

Figure 7 expands the analysis to encompass the worst 10% of calendar months for U.S. equity returns. We also shift our focus away from correlations and instead examine the return relationship from two additional perspectives. Figure 7a focuses on the percentage of months that the risk-premium asset classes experienced negative returns in conjunction with U.S. stocks, while Figure 7b shows the median returns during those same periods. Whether looking at percentage of negative months or median returns, it is clear that during the worst months for U.S. stocks, these asset classes tended to perform more similarly than simple long-term averages would indicate. And it is interesting that although the riskier assets tended to perform more similarly during the worst periods for U.S. stocks, bonds tended to perform in line with their averages.

Diversification is not only about correlation

When thinking about portfolio diversification, investors instinctively focus on correlation. Yet, as we have shown, combining assets with low historical correlation does not eliminate risk, because low historical correlation does not eliminate the possibility of adverse co-movement in times of crisis. Still, discussions of the benefits of diversification often overlook the fact that while assets with low historical correlation can move in the same direction, they rarely, if ever, move in the same direction *with the same magnitude*. Figure 8, on page 12, plots the returns of the same asset and sub-asset classes discussed previously in this paper from October 2007 through December 2011, a period representing the entirety of the recent bear market as well as the subsequent rebound. This particular figure focuses on those days when the U.S. stock market was down 4% or more—significantly negative returns by any measurement. It's clear that in many of these significantly negative days for U.S. stocks, other risky assets tended to move in the same direction (similar to the correlation analysis shown in Figure 4).

Figure 7. Performance of risky assets during poor U.S. equity markets



Notes: For hedge fund returns we used the median fund-of-funds from Morningstar's hedge fund database covering the period January 1994 through December 2011. See Figure 3 for benchmark descriptions.

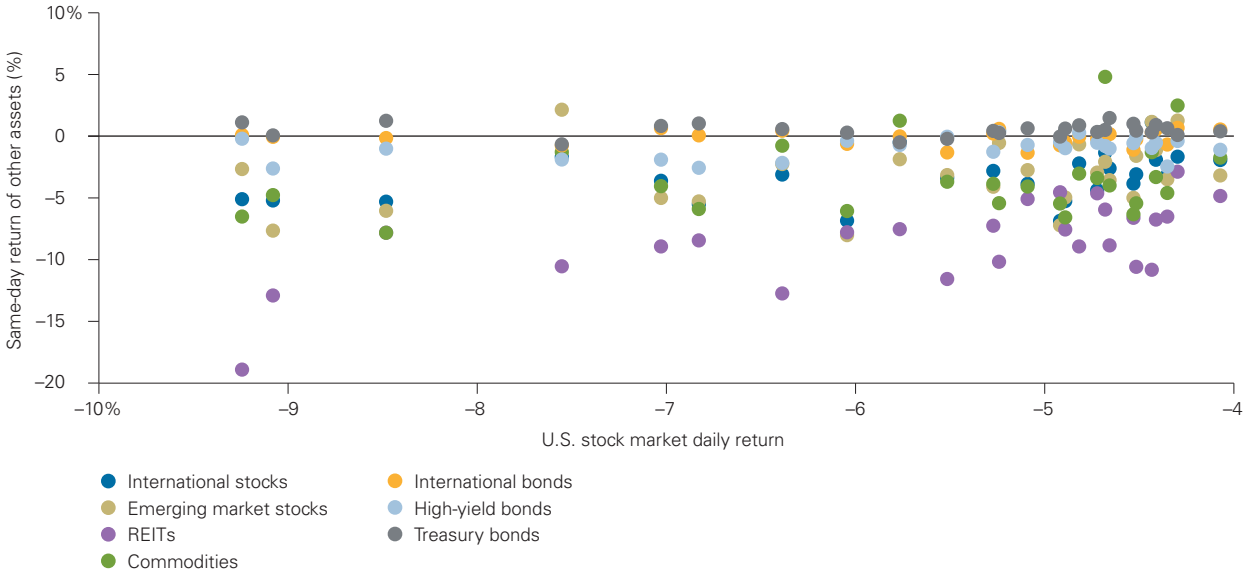
Sources: Vanguard calculations, using data provided by Thomson Reuters Datastream and Morningstar, Inc.

Ultimately, the fact that a number of risky assets declined at the same time prompted many to proclaim "the death of diversification."

Although most risky assets declined in value on these substantially negative days, it's important to point out that no two risky assets moved with the same magnitude. For example, on December 1, 2008, when U.S. stocks returned –9.2%, only REITs lost more (–18.6%). Commodities, developed markets, emerging markets, and high-yield bonds each declined, but to a lesser degree. From this perspective, these asset and sub-asset classes did in fact offer a form of diversification to markedly reduce U.S. equity market risk. The message is clear: When assessing the value of diversification, investors should not simply look at directional movements, particularly in the short term. Indeed, even bonds, the most common diversifier for equity risk, can move in conjunction with equities for periods of time (as we saw in Figure 2). But this does not mean that investors should abandon bonds in a long-term portfolio. The benefits of diversification, low correlation, and sensible portfolio construction tend to bear out over longer—3-, 5-, and 10-year—periods, even though they may not be as clear in the very short term.

Figure 8. Diversification also comes in the form of magnitude

Days when U.S. stocks were down 4% or more: October 2007–December 2011



Note: See Figure 3 for benchmark descriptions.

Sources: Vanguard calculations, using data provided by Thomson Reuters Datastream.

Conclusion

Correlation is a critical metric that can provide useful information in the portfolio construction process. Nevertheless, it is important for investors to understand that correlation is a property of random variables, and so does not describe a fixed relationship between variables: Assets with low and unchanging correlation can and do move in the same direction from time to time. In addition, correlations between asset class returns can and do change over time or in particular circumstances. Future correlations may also differ from those in the past because of changing economic and market regimes. Investors should take these factors into consideration when using correlation as a key input for constructing investment portfolios, not relying solely on statistical measures, but mixing in common sense and qualitative judgment as well. In addition, investors should recognize that low historical or estimated correlation does not insure against loss, particularly in times of stress, and that bonds and other low-risk assets can provide valuable protection during such periods. The goal of portfolio construction should be to minimize risk while maximizing returns, but with a core understanding of how different assets react to different market environments and with the knowledge that low average portfolio variance is only one dimension of risk.

Investing over the long term will almost inevitably include short-term periods of (sometimes severe) market stress, during which the value of diversification for risky assets is less evident. Because investors tend to pay significant attention to large losses, it can be especially troubling when correlations "go to 1." It is in these periods that downside protection is needed the most, and the value of bonds—particularly high-quality bonds—shines. Of course, while correlations "go to 1" during market dislocations, investors can take some solace that a modicum of diversification can be achieved when assets do not move by the same amount, even when they move in the same direction. Investors can also feel some reassurance that systematic factors will occasionally drive "uncorrelated" assets higher in tandem during periods of relief from systemic crisis.

History supports the notion that over longer-term periods, diversification within and across asset classes offers substantial benefit. As a result, investors should continue to focus on their strategic asset allocation with regard to overall risk and return objectives/constraints, and the long-term expected returns, risks, and correlations of the assets in which they invest. For those investors with greater sensitivity to significant near-term loss, lower-risk, lower-returning asset classes such as investment-grade bonds or even cash—whose diversifying properties tend to hold up during periods of market stress—may make more sense. On the other hand, investors who are less sensitive to significant near-term losses, or who are willing to endure significant near-term loss in the pursuit of long-term higher returns, may find it reasonable to allow higher risk-premium asset classes to play a more substantial role in their portfolios. Each of these approaches can be considered prudent, and the decision of which path to take ultimately depends on the broad objectives of the investor.

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