Volatility Concepts and Tools in Risk Management and Portfolio Construction

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Understanding the dynamics of realized volatility is critical to effective investment management and portfolio risk management. Volatility measures can reach levels well above the median and are trending and mean reverting. Tradable volatility exposure is now available with VIX futures and exchange-traded products benchmarked to VIX futures indices. These tools are useful for modifying portfolio risk based on expected S&P 500 Index volatility rather than shifting fixed-income allocations.

Investment professionals tend to spend a lot of time talking about returns, opportunities for returns, return relative to risk, and Sharpe ratios, but they spend little time talking explicitly about the denominator of the Sharpe ratio—the volatility measure. The assumption is that volatility is relatively constant, but if we look at volatility by itself—either realized or expected—some interesting patterns emerge. Some patterns lend themselves to analysis and can be very helpful in portfolio construction if they can be understood.

I will begin with an overview of the dynamics of volatility and volatility regimes. I will then review the characteristics of the Chicago Board Options Exchange (CBOE) Volatility Index (VIX), VIX futures, and VIX futures indices, as well as their application in portfolio strategy. I will also discuss some of the attributes of the more commonly used volatility-trading tools and show how their introduction into a traditional portfolio can lower risk and at times increase return.

Much of the first part of this presentation is based on my article "Index Volatility in Perspective" that was published in the *Journal of Index Investing*.[1]

Index or Benchmark Volatility Measures

Understanding the dynamics of index or benchmark volatility measures is useful for a number of reasons. First, an index or benchmark volatility measure provides a baseline for comparing returns across indices and for comparing investment opportunities. Second, shifts in volatility and perceived risk are often the catalysts for changes in investment strategy. Many investors modify their risk tolerances when they see a volatility event under way in the markets. Third, assessing volatility regimes is beneficial to the investment management process. Investors should know the major asset class exposures in their portfolios and the ranges of risk for the respective asset class indices; in other words, investors should know the features of the volatility regimes represented in their portfolios. They should know how long volatility typically stays high or low. Just as some investors care about the correlation of returns across asset classes or instruments, they should also care about the correlation of volatility across the different asset classes in their portfolios.

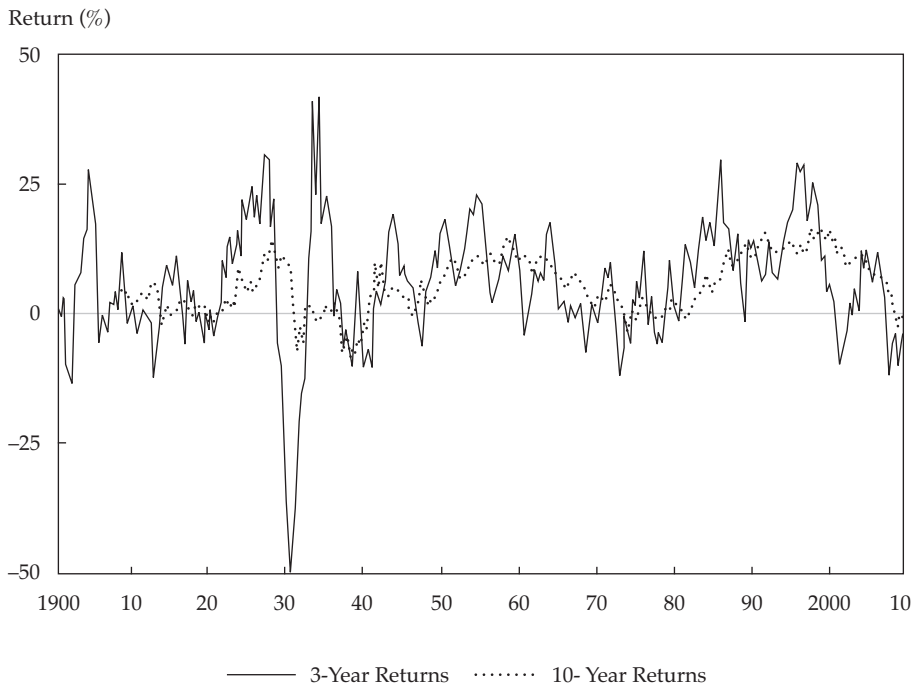
Investors should try to understand how the market evolves its view of future volatility, as measured by the VIX or longer-term measures of implied volatility, and explore the lessons in that process. Investment decision makers do not spend enough time on these questions. Perhaps they believe it is the province of the risk manager, but I believe that understanding the dynamics of volatility also improves the investment management process and is relevant to portfolio managers. Lastly, an understanding of the range of risk, as well as of return, can help align investment policy with an investor's risk tolerance.

Figure 1 shows DJIA 3-year and 10-year rolling annualized returns updated annually for the 110-year period going back to 1900. The 10-year returns have a narrower range than the 3-year returns, but

This presentation comes from the 2011 Financial Analysts Seminar: Improving the Investment Decision-Making Process held in Chicago on 25–29 July 2011 in partnership with the CFA Society of Chicago.

[1]Joanne M. Hill, "Index Volatility in Perspective," *Journal of Index Investing*, vol. 1, no. 1 (Summer 2010):12–23.

Figure 1. DJIA 3-Year and 10-Year Annualized Rolling Returns, 1900–2010



Note: The price returns are rolled quarterly using quarterly data from 29 December 1899–31 December 2010.
Source: Based on data from Bloomberg.

even the 10-year returns are volatile. For both investment horizons, the return can stay well above or below the median over multiyear periods. The 10-year returns tend to cycle from high to low every 30–40 years so that even a long-term investor with a 10-year horizon can suffer if his or her investment horizon is at the wrong place in the cycle. From the mid-1980s until 2000, the market was at the high end of the range of long-term returns, and most investment professionals of that era viewed equities both in the short term (three-year returns were even higher) and in the long term as a very good return opportunity.

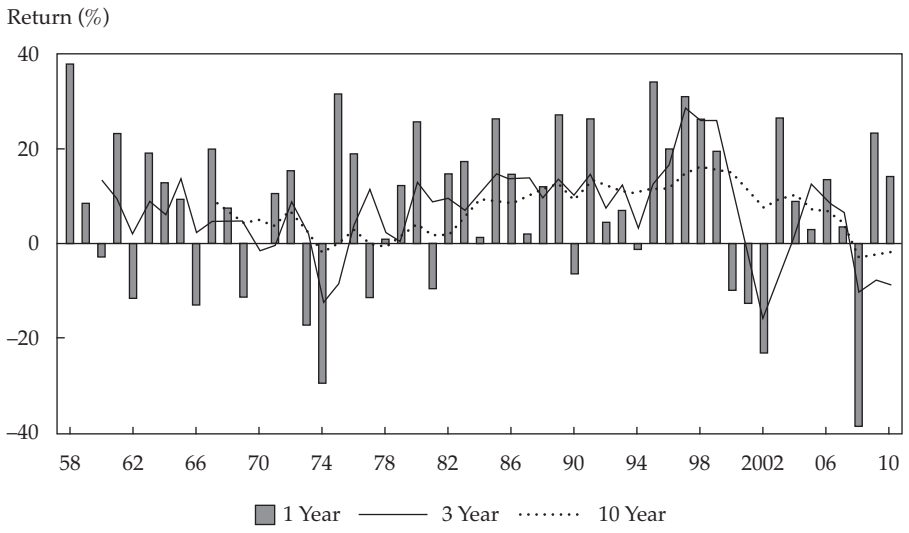
The returns for shorter horizons fluctuate in wider ranges, increasing the perception of risk over shorter time periods. **Figure 2** maps S&P 500 Index 3- and 10-year rolling annualized returns against S&P 500 1-year rolling annualized returns for 1958–2010. The concept of time diversification is very powerful. For an investor who can truly invest long term (e.g., for 10 years), risk is viewed in a much more muted manner than it is for an investor with a horizon of 1 year or less.

Standard deviation is the most common measure of volatility, although few assets in investors' portfolios are truly normally distributed. The formula for standard deviation assumes there is no serial correlation in returns—that is, returns are random. The formula also equally weights downside and upside returns relative to the mean, so separating positive and negative values is not important.

Looking back over a century of U.S. equity risk using horizons of one month and one quarter as shown in **Figure 3** reveals episodes of high volatility and periods of low volatility that persisted for long periods. The median volatility level over these 110 years was around 12–13 percent, which is similar to the volatility levels of equity markets in other developed countries.

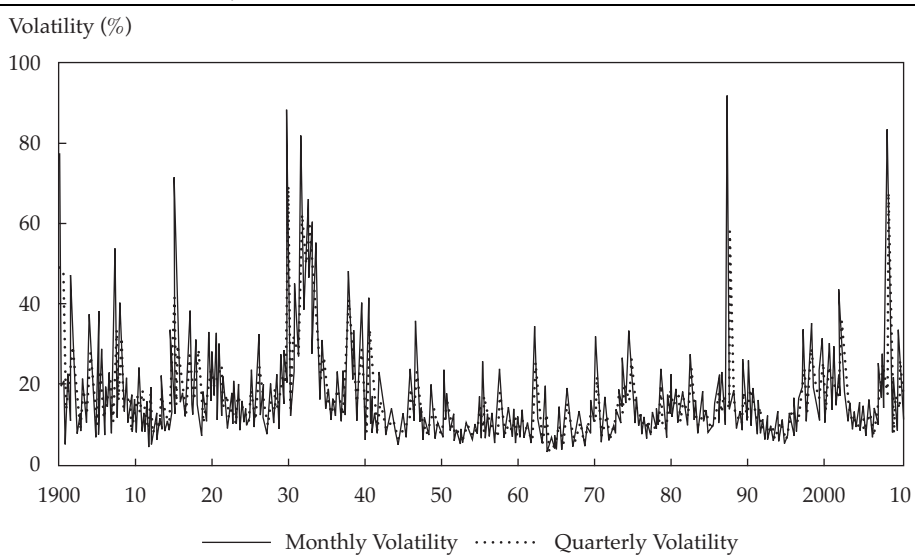
Over the last century, the top 10th percentile of the volatility range was more than 25 percent and the top 25th percentile was more than 17 percent. The almost 50-year period from 1940 to 1985 had very low equity market volatility, but beginning in 1987, equity market volatility rose dramatically. The technology bubble of the late 1990s showed investors that it is possible to have high volatility in a rising market. And the past 10 years have been atypical in terms of having several episodes of high-volatility regimes. The most recent experience of extremely high equity market volatility will probably color most investors' perspectives for some time—even though they are aware of the long period of low volatility in the middle of the last century.

Figure 2. S&P 500 Annualized Returns for Three Different Horizons, 1958–2010



Source: Based on data from Bloomberg.

Figure 3. Monthly and Quarterly Volatility of the DJIA, 1900–1957, and the S&P 500, 1958–2010



Note: Monthly and quarterly volatility calculated using daily return data and annualized from 31 March 1900 to 31 December 1957 for the DJIA and from 31 March 1958 to 30 September 2010 for the S&P 500.

Source: Based on data from Bloomberg.

Another way of illustrating this point is to look at volatility as a time series. Because it is very positively skewed, investors need to look at percentiles. Over the past 30 years, from 1980 to October 2010, time-series analysis shows a higher median volatility but a similar cutoff for the top 10 percent and top 25 percent of volatility. **Table 1** shows the median volatility and four percentiles of volatility for the DJIA and S&P 500 over three time periods: 1900–1979, 1940–1979, and 1980–October 2010. The periods are very different.

After a long period of low volatility, the markets are back to more normal, higher levels of risk. In recent years, the top 10 percent of volatility has been much higher above the median than the bottom 10 percent has been below it. This pattern is very different from that of returns. In a return distribution, some positive or negative skewness

Table 1. Annualized Monthly Volatility of the DJIA and S&P 500 for Three Time Periods

Time Period	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
1900–1979	7.1%	8.9%	12.2%	17.4%	25.8%
1940–1979	6.4	7.5	9.5	12.4	16.8
1980–Oct 2010	8.4	10.3	13.7	17.6	25.1

Note: Annualized monthly volatility calculated using daily return data for 31 January 1900–31 December 1956 from DJIA and for 31 January 1956–31 October 2010 from the S&P 500.

Source: Based on data from Bloomberg.

will appear, but with volatility it is endemic. The highest levels are multiples of the median level. In a high-volatility regime, the change compared with normal market volatility is quite large.

Asset classes other than equities can also provide good indicators of rising financial market risk. Credit spreads, for example, tend to rise in periods of rising equity risk. Two indicators are the yield spread between high-yield and corporate debt and the spread between Treasury yields and Eurodollar deposits. The latter is often referred to as the TED spread. During a high-risk period in equities, generally one of the two spreads will begin to rise because credit risk and equity risk are correlated. In the financial crisis of 2007–2008, both the TED spread and the credit spread widened at the same time because first, financial risk rose—that is, financial institutions were assigned higher credit spreads, which were reflected in LIBOR—and then, the recession that followed led to a sharp rise in interest rates on high-yield bonds.

Volatility measures trend and may persist at high or low levels. Consider the serial correlations of quarterly S&P 500 returns and volatility for different time periods over the last 45 years: 1966–2010, 1966–1981, 1982–1999, and 2000–2010. From period to period, volatility tends to persist more than returns. The serial correlation of returns for each period is 0.10, 0.09, –0.06, and 0.16, respectively. In contrast, the serial correlation of volatility is 0.55, 0.57, 0.36, and 0.57, respectively.

High-volatility regimes tend to have staying power. The highest 25th percentile had 38 periods with durations of 1–14 months: 9 periods lasted more than a quarter, and 18 lasted more than a month. The highest 10th percentile had 18 periods with durations of between one and nine months: 3 periods lasted more than a quarter, and 8 lasted more than a month.

Volatility can also be analyzed in terms of correlation across indices. Volatility is highly correlated across indices—in many cases, even more so than return. For 1995–2010, the correlation of quarterly return volatility of the S&P 500 with the comparable volatility measures for the MSCI EAFE (Europe, Australasia, and Far East), DJIA, S&P MidCap 400, and Russell 2000 indices was 90 percent or higher; and in each instance, it was higher than the respective correlations of quarterly index returns. Only between the S&P 500 and the NASDAQ-100 was the correlation of volatility lower than the correlation of return. In broad terms, the high-volatility correlation across indices means that it is very difficult to diversify volatility exposures in a portfolio.

Sector index volatility also has its own dynamics. Not only are sectors more volatile than a broad-based index in terms of median-volatility level, but also the range is wider. Part of the reason is that stocks within a sector can become highly correlated when events occur that affect the industry the sector covers. For example, when the technology and semiconductor sectors are at the higher end of their volatility ranges, their volatilities will be quite a bit above median volatility. In fact, the actual volatilities of the financial and real estate sectors in 2008 were much higher than the extremes in volatility experienced in the technology sector during the tech bubble.

To summarize, the key to portfolio health is an understanding of index risk dynamics. Risk can move well above the median level for a given index, risk shifts can be correlated across a portfolio, and increases in risk tend to be negatively correlated with equity returns. Higher risk can mean more tactical opportunities and shorter horizons for portfolio positions. Short exposure with derivatives, inverse funds, and other hedging strategies may be used to modify risk, and periods of below-normal risk for indices may present times when leverage can be useful to help meet return objectives.

VIX Futures and VIX Futures Indices: Strategy Applications

The VIX is widely followed but is not tradable. VIX futures and VIX futures indices, however, are accessible as trading vehicles to investors and have a number of unique strategy applications. One application is to capitalize on shifts in S&P 500 volatility.

Since the introduction of VIX futures in 2004, investors have had the opportunity to take a position in these futures with the intent of generating profits or losses depending on the market's short-term or medium-term view of expected volatility. Small portfolio allocations to S&P 500 VIX futures or exchange-traded products benchmarked to VIX futures indices may serve as a means of hedging downside equity risk and, therefore, represent an alternative to other tools for risk reduction, such as moving to cash or fixed income or buying put options.

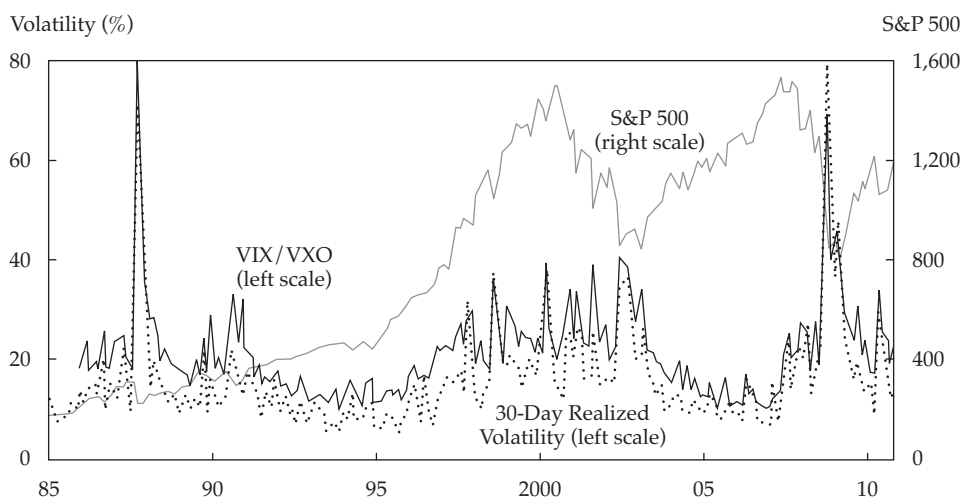
Figure 4 plots both realized and expected volatility from 1985 through 2010. The black line is the VIX or its prior version, the VXO, which represents expected volatility. The black line is generally above the dotted line, which is the 30-day realized volatility, except when realized volatility is very high, as it was in 1987 and again in 2008. This type of behavior is characteristic of a mean-reverting series.

Another example of a mean-reverting series is bond yields. Bond yields have a term structure; if short-term yields are low, generally longer-term yields will be higher and the yield curve is thus upward sloping. Expected volatility operates the same way. If realized volatility is low, market participants often forecast that volatility can get much higher in future periods, so in a low- or normal-volatility regime, expected volatility is usually higher than realized volatility. In contrast, when interest rates are high in the short term, rates are generally lower in the long term and the yield curve is downward sloping. Similarly, in an extremely high-volatility regime—the top 10 percent of the range—future volatility is expected to be lower than current volatility.

Diversification benefits depend on low levels of correlation, but instability in the correlation relationship is a major concern. The correlation of risky assets, especially equity indices, tends to be high in periods of negative equity returns. Over the last decade, equity index correlation levels have been fairly high in contrast to the situation of the 1980s and early 1990s when international diversification was producing both return and risk reduction benefits and correlation was lower. Today, periods of declining equity values have become more common than in the 1980s and 1990s.

Table 2 shows in rising and falling market environments (i.e., returns greater than and less than zero) median correlation measures of the S&P 500 with the MSCI EAFE and MSCI Emerging Markets (EM) indices as well as with the Barclays Capital 20+ Year Treasury Index returns and percentage changes in the VIX. The correlation measures are based on rolling 12-month periods between 1985 and 2010. Equity index correlations have tended to rise in declining markets, but the correlations fell in fixed income and the VIX with the S&P 500, supporting their value as risk-reduction tools in portfolio management. Therefore, one of the good things about fixed income and the VIX is that their correlations are more negative in a down market. The correlation actually moves from positive to

Figure 4. Expected Volatility of the VIX/VXO and 30-Day Realized Volatility of the S&P 500, 1985–2010



Note: The VXO was used for data from January 1986 to September 2003; the VIX is used for data from September 2003 to December 2010.

Source: Based on data from Bloomberg.

Table 2. Correlation of S&P 500 with Various Indices and Treasuries, 1985–2010

Index	S&P 500 Return > 0	S&P 500 Return < 0
MSCI EAFE	0.61	0.85
MSCI EM	0.65	0.80
Barclays Capital 20+ Year Treasury	0.32	–0.20
VIX	–0.58	–0.79

Notes: For the VIX, VXO was used for January 1986–September 2003; the VIX was used for September 2003–December 2010. Data are based on annual correlation rolled monthly. S&P 500 returns are year-end annual returns.

Source: Based on data from Bloomberg.

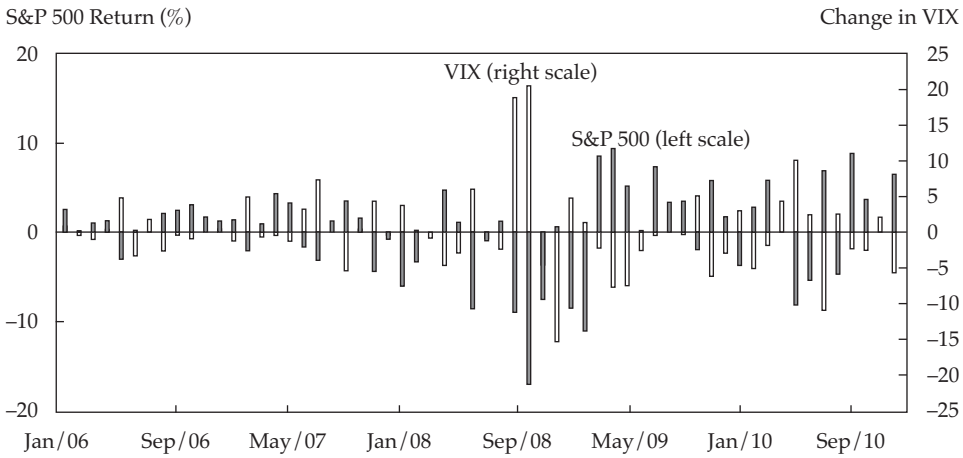
negative, which is why fixed income is a good risk-reduction tool in an equity portfolio. The VIX and equity market returns inherently have a negative correlation, but the correlation is even more negative in a falling equity market. Thus, volatility-trading tools are interesting because not too many investing instruments have both negative correlation and more-negative correlation when markets get really ugly.

Another view is to look at the changes in the VIX compared with the S&P 500 returns from 31 December 2005 through 31 December 2010, as illustrated in **Figure 5**. The monthly S&P 500 return is represented by the gray bars, and the monthly change in the VIX is represented by the white bars. These appear to be close to mirror images of one another. The negative correlation, however, is not perfect (–1.0). It is –0.68 in terms of the percentage change in the VIX or –0.72 in terms of the change itself. So, roughly 70–80 percent of the time, the two measures are moving in opposite directions. They did move in the same direction (down) in November 2008; so, during negative moves in the S&P, negative correlation comes into play.

VIX Futures. The VIX represents the market's expectations of stock market volatility. Specifically, it is the volatility of the S&P 500 over the next 30 days based on S&P 500 option prices over a range of strike prices. The VIX, however, is not directly investable. VIX futures were introduced in 2004 to allow investors to act on views of the future levels of the VIX. The futures prices reflect the market's changing views of the level of the VIX at future points in time or at settlement dates. The VIX futures converge to the level of the VIX spot index as the expiration date of the futures contract approaches.

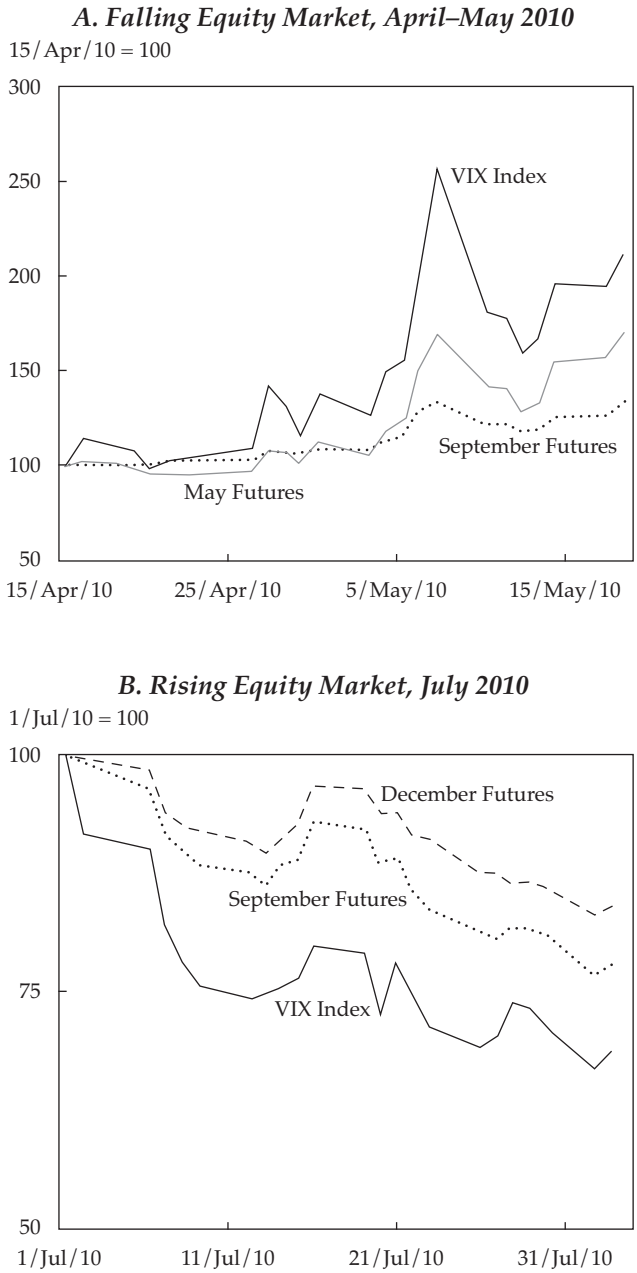
Figure 6 illustrates how the VIX futures prices move in comparison with the VIX spot price in both a falling and a rising equity market. Panel A shows the falling equity market that occurred in April–May 2010, when the S&P 500 fell 7 percent in response to the first stages of the euro debt crisis in Greece. Panel B shows the rising equity market that occurred in July 2010, when the S&P 500 rose 9 percent. In the falling equity market, both the May and September VIX futures moved up, but not nearly as much as the 150 percent move (from a base of 100 to 250) of the VIX. Similarly, in the rising equity market, the prices of both the September and December VIX futures fell, but not nearly as much as the level of the VIX.

Figure 5. Monthly S&P 500 Returns and Changes in the VIX, 31 December 2005–31 December 2010



Source: Based on data from Bloomberg.

Figure 6. Response of the VIX and VIX Futures to the Rise and Fall of the S&P 500



Sources: Based on data from Bloomberg and the CBOE.

VIX futures prices across different expirations reflect the mean reversion of expected volatility. In the most common market environments of low- or normal-volatility regimes, such as 2004–2007, the spread between the six-month futures and the spot price was positive—that is, there was an upward-sloping term structure known as contango. The market was pricing in the fact that volatility could move higher in the future. Buying a longer expiration VIX future entails a cost relative to spot VIX levels (which reflect expected volatility only over the next 30 days) because of the possibility of a high-volatility episode in the period up to expiration of the VIX future. In 2008, however, when the VIX moved to significantly higher levels in the midst of the market's reaction to the financial crisis, the spread between the six-month VIX futures price and the spot price became negative (referred to as backwardation). In this period, views changed and volatility in the future was expected to be lower than current volatility.

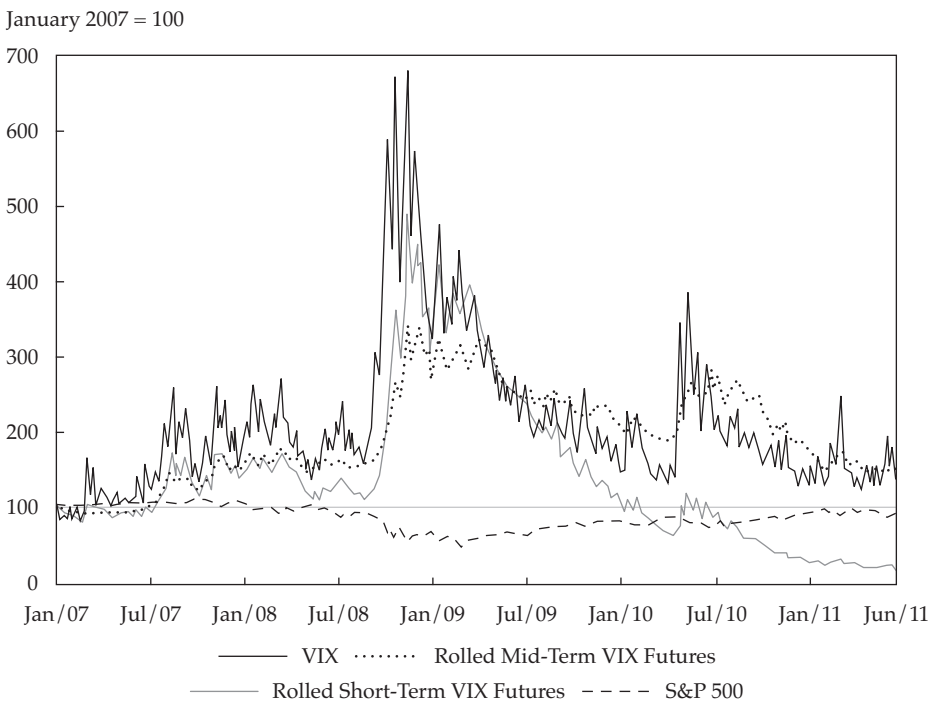
The correlation of VIX futures prices with VIX spot prices is time dependent. The further out from expiration, the lower the beta of the futures to the VIX. Generally, three months or longer from expiration, the VIX futures have a beta of about 0.2–0.3 to the VIX. The beta of the futures to the VIX in the short term is higher. At less than 20 days to expiration, the beta rises to about 0.5 and finally rises to 0.8 just before expiration.

For example, during the last two and a half years, from 22 January 2009 to 30 June 2011, the beta of the S&P 500 Short-Term (one-month) VIX Futures Index to the VIX has been 0.47 and the beta of the S&P 500 Mid-Term (five-month) VIX Futures Index has been 0.22. These values indicate that over this period, the short-term index has been more sensitive than the mid-term index to swings in the VIX. For a 1 percent move in the VIX, the short-term VIX futures index tended to move 0.4–0.5 percent and the mid-term VIX futures index tended to move 0.2–0.3 percent.

Figure 7 compares the performance of the S&P 500 with the VIX and two rolled VIX futures strategies for January 2007–June 2011. The chart uses a base of 100 to map returns for the short-term VIX futures series, calculated on the basis of accrued interest from three-month T-bills and a continuously rolled position in the first- and second-month VIX futures contracts. A portion is rolled daily to maintain a constant average-weighted term of one month. Returns for the rolled mid-term VIX futures series are calculated on the basis of accrued interest from three-month T-bills and a continuously rolled position in the fourth-, fifth-, sixth-, and seventh-month VIX futures contracts. A portion is rolled daily from the fourth- to seventh-month futures to maintain a constant average-weighted term of five months.

Over the majority of the period graphed in Figure 7, the short-term and medium-term futures moved with the VIX. So, like the VIX, VIX futures have been negatively correlated with the S&P 500. During this period, the correlation of the VIX with the S&P 500 was –0.74. The correlation of the short-term and mid-term VIX futures strategies with the S&P 500 was also consistently negative and at similar levels of –0.81 and –0.78, respectively. In late

Figure 7. S&P 500 vs. VIX and Rolled VIX Futures, January 2007–June 2011



Notes: Returns for the short-term VIX futures series are calculated on the basis of accrued interest from three-month T-bills and a continuously rolled position in the first- and second-month VIX futures contracts. A portion is rolled daily to maintain a constant average-weighted term of one month. Returns for the rolled mid-term VIX futures series are calculated on the basis of accrued interest from three-month T-bills and a continuously rolled position in the fourth-, fifth-, sixth-, and seventh-month VIX futures contracts. A portion is rolled daily from the fourth- to seventh-month futures to maintain a constant average-weighted term of five months.

Sources: Based on data from Bloomberg and the CBOE.

2009, short-term VIX futures began to anticipate a decline in volatility after the financial crisis. This anticipation led to a high cost of rolling positions from the nearest to the next expiring VIX futures contract to maintain a one-month term for the strategy. This increased cost is why the rolled short-term VIX futures line moves lower on the right side of the graph as expected S&P 500 volatility continued to fall in 2010 and the first half of 2011.

S&P 500 VIX Futures Indices. The best way to analyze the benefits of volatility in portfolio construction is to use the indices that have been constructed by Standard & Poor's: the S&P 500 VIX Short-Term Futures Index and the S&P 500 VIX Mid-Term Futures Index. Data on these two indices are available from Standard & Poor's (and on Bloomberg) dating back to the start of VIX futures trading in 2005. Note that some of the data are a backtest based on VIX futures prices because the official indices were launched in early 2009.

An index product is needed for trading because futures are too operationally complicated to use on an ongoing basis for some investors. To use the VIX futures, an investor must have a futures account and will need to manage the futures positions over time, rolling them as they approach expiration. Certainly, some hedge funds are capable of performing this type of transaction, but other investors generally prefer exchange-traded products that are based on the VIX futures indices. These products charge a management fee for effectively rolling futures positions to maintain S&P 500 VIX futures exposure with consistent term to expiration.

The VIX Short-Term Futures Index reflects expectations for the VIX in one month. It is calculated on the basis of a long position in a combination of VIX futures. A portion is rolled daily to maintain a constant average-weighted term of one month. The VIX Mid-Term Futures Index reflects expectations for the VIX in five months. It is calculated on the basis of a long position in a combination of VIX futures. A portion is rolled daily to maintain a constant average-weighted term of five months.

The VIX futures indices roll a portion of their long futures position on a daily basis to maintain a weighted fixed term to expiration—one month for the short-term index and five months for the mid-term index—and also to reduce the market impact of the rolling process compared with handling rolls on a single day or over a few days. About 5 percent of the position in the short-term index is rolled daily. For example, on 31 January 2011, the short-term futures index was composed of 58 percent February futures and 42 percent March futures, but on 10 February 2011, the index was composed of 19 percent February futures and 81 percent March futures. The holdings of the mid-term futures index on the same dates—31 January and 10 February 2011—were 19 percent May futures, 33 percent June futures, 34 percent July futures, and 14 percent August futures; and 6 percent May futures, 33 percent June futures, 34 percent July futures, and 27 percent August futures, respectively.

The performance of the S&P 500 VIX futures indices is subject to roll yield. Roll yield is a function of expectations for future levels of the VIX to be higher or lower than the current VIX level. A market in contango (i.e., an upward-sloping volatility term structure) is typically associated with a negative roll yield, which can have a negative impact on the performance of the futures index. Rolling when futures prices are in contango involves selling lower-priced futures and buying higher-priced futures that are further from expiration. A market in backwardation (i.e., a downward-sloping volatility term structure) is typically associated with a positive roll yield. This situation benefits the performance of the futures index because the roll involves buying futures with a longer period to expiration.

The effect of contango and backwardation is greater in the short-term index than in the mid-term index because a smaller price difference exists between the futures contracts involved in the rolling process for the mid-term futures index. Typically, about 70–80 percent of the time, the volatility term structure is upward sloping (in contango), so the performance of the indices has a negative roll yield component. In the mid-term VIX futures index, the negative roll yield has a much smaller effect. Thus, for medium- and longer-term investors, I advocate using the mid-term futures index, rather than the short-term index, as a portfolio-construction tool.

A number of VIX futures–linked exchange-traded products are now available in the market. Most have been launched in the last two years. **Exhibit 1**, which comes from a report published by Morgan Stanley's equity derivatives strategy team, provides a quick reference for the exchange-traded products that were available in March 2011 in the United States with long and short S&P 500 volatility exposure. At that time, ProShares offered two exchange-traded funds (VIXY and VIXM) that held VIX futures and cash equivalents to replicate the index returns. The other products available were all exchange-traded notes (ETNs) and represent general debt obligations of the issuer—Barclays, UBS, and Credit Suisse (VelocityShares). A few of the ETNs offer leverage, and the management fees for both types of products range from 0.85 percent to 1.65 percent.

Exhibit 1. VIX Futures–Linked Exchange-Traded Products

	Exchange-Traded Funds (ETF)		Exchange-Traded Notes (ETN)											
	VIXY	VIXM	VXX	XXV	IVO	VXZ	VZZ	XVIX	VIIX	TVIX	XIV	VIIZ	TVIZ	ZIV
Issuer	ProShares		Barclays					UBS	Velocity Shares					
Description	VIX short-term futures ETF	VIX mid-term futures ETF	VIX short-term futures ETN	Inverse VIX short-term futures ETN	Inverse Jan 2012 short-term futures ETN	VIX mid-term futures ETN	Long-enhanced VIX mid-term futures ETN	Daily long–short VIX ETN	VIX short-term futures ETN	Daily 2× VIX short-term futures ETN	Daily inverse VIX short-term ETN	VIX mid-term futures ETN	Daily 2× VIX mid-term futures ETN	Daily inverse VIX mid-term ETN
Suggested usage	Tactical	Tactical/ hedging	Tactical	Tactical/ yield generation	Tactical/ yield generation	Tactical/ hedging	Tactical	Tactical/ yield generation	Tactical	Tactical	Tactical/ yield generation	Tactical/ hedging	Tactical	Tactical/ yield generation
Underlying index	1× Long SPVXSP	1× Long SPVXMP	1× Long SPVXSTR	1× Short SPVXSP	1× Short SPVXSP	1× Long SPVXMTR	2× Long SPVXMTR	1× Long SPVXTSER	1× Long SPVXSP	2× Long SPVXSP	1× Short SPVXSP	1× Long SPVXMP	2× Long SPVXMP	1× Short SPVXMP
Long or short volatility exposure	Long	Long	Long	Short (no reset)	Short (no reset)	Long	Leveraged long (no reset)	Long–short	Long	Leveraged long (daily reset)	Short (daily reset)	Long	Leveraged long (daily reset)	Short (daily reset)
Leverage	1×	1×	1×	1×	1×	1×	2×	2× Long/ 1× Short	1×	2×	1×	1×	2×	1×
Launch date	3 Jan 11	3 Jan 11	29 Jan 09	19 Jul 10	14 Jan 11	29 Jan 09	30 Nov 10	1 Dec 10	29 Nov 10	29 Nov 10	29 Nov 10	29 Nov 10	29 Nov 10	29 Nov 10
AUM (23 Mar 2011)	25mn	7mn	1,340mn	29mn	40mn	592mn	18mn	70mn	7mn	30mn	73mn	4mn	4mn	6mn
Portion of term structure held	1 Month	5 Month	1 Month	1 Month	1 Month	5 Month	5 Month	Long 5m/ Short 1m	1 Month	1 Month	1 Month	5 Month	5 Month	5 Month
Reactivity to volatility	High	Medium	High	High	High	Medium	High	Low	High	Very high	High	Medium	High	Medium
Rolldown exposure	High	Medium	High	High	High	Medium	High	Medium	High	Very high	High	Medium	High	Medium
Management fee	0.85%	0.85%	0.89%	0.89%	0.89%	0.89%	0.89%	0.85%	0.89%	1.65%	1.35%	0.89%	1.65%	1.35%

Source: Morgan Stanley, "A Guide to VIX Futures and Options," *Quantitative & Derivative Strategies*, 28 March 2011.

Volatility-Based Strategy Tools: Portfolio Applications and Outcomes

Adding volatility-based strategies to portfolios modifies return and risk in different ways than does a shift into a higher fixed-income allocation. For example, in a hypothetical portfolio that has a 60/40 equity/fixed-income allocation, more than 90 percent of portfolio risk actually comes from the equity exposure and less than 5 percent is fixed-income risk. The remaining risk comes from the covariance of equity and fixed-income returns. The equity portfolio I use for illustration purposes is assumed to be equally divided between the MSCI EAFE and the S&P 500.

The impact of fixed income in a portfolio differs depending on the economic and market environment. For example, in 1990–1999, when the risk–return relationship was normal—higher return for higher risk—a 60/40 equity/fixed-income allocation delivered a higher return than a 20/80 equity/fixed-income allocation. But during 2000–2010, the 20/80 allocation far outperformed the 60/40 allocation. For the 1990–99 period, the 60/40 allocation had a return of 9.56 percent and volatility of 8.71 percent compared with a 2.17 percent return and 10.16 percent volatility in the 2000–10 period.

Most investors view the addition of fixed income as a way to lower a portfolio's risk profile when they fear that a period of high volatility is ahead. In the current market, the strategy of adding fixed income is particularly troublesome because yields are quite low. The U.S. Treasury market is at a 30-year secular low in bond yields. At this juncture, adding fixed income, even though it might reduce equity risk, unfortunately leaves an investor exposed to yield risk.

The following indices represent other strategies or tools that can be used to modify risk instead of moving to cash or fixed income:

- CBOE Volatility Index (VIX): a measure of market expectations of near-term (30-day) volatility based on S&P 500 option prices with a weighted average of 30 days to expiration over a range of strike prices.
- HFRI (Hedge Fund Research, Inc.) Fund Weighted Composite Index: a global, equal-weighted index of more than 2,000 single-manager funds that report to the HFR Database.
- CBOE S&P 500 95–110 Collar Index (CLL): an index that mimics a strategy that accepts a ceiling or cap on S&P 500 gains in return for a floor on S&P 500 losses. It is constructed with the S&P 500 combined with three-month S&P 500 put options at a strike of 95 percent of the index level and the sale of one-month call options at a strike of 110 percent of the index level.
- CBOE S&P 500 2% OTM BuyWrite Index (BXY): an index based on S&P 500 total returns combined with a short position in a one-month S&P 500 call option that is approximately 2 percent out of the money at each monthly option expiration, when the prior month's option expires and a new option is sold.

Keep in mind that the returns of these four tools are not normally distributed, so standard deviation may not be the best assessment of what these instruments offer in terms of controlling volatility risk. It might be preferable to look instead at their potential to modify the downside risk of a portfolio.

To illustrate the portfolio effect of adding alternative risk modification strategies or exposures, consider what happens to the risk profile of a traditional portfolio when these are incorporated. Using the 60/40 equity/fixed-income portfolio as the base portfolio with the 60 percent equity allocation split equally between the MSCI EAFE and the S&P 500, four new portfolios can be created. In the first two new portfolios, the 30 percent S&P 500 exposure is replaced with a 30 percent exposure to the BXY, a covered option-writing strategy, and a 30 percent exposure to the CLL, an option collar strategy. In the other two new portfolios, 10 percent of the S&P 500 exposure is replaced with a 10 percent exposure to the HFRI Fund Weighted Composite Index and a 10 percent exposure to the VIX.

Table 3 compares the return and volatility of the base portfolio with the four newly created portfolios over the same two periods used earlier: 1990–1999 and 2000–2010. In both positive and negative equity risk premium environments, the shift to these alternative, nonnormally distributed investments reduced risk and increased return in all but one alternative strategy: the CLL. With bond yields at historical lows, this analysis suggests that adding volatility-based strategies rather than fixed income to a traditional portfolio to control risk may be worth considering.

It is important to note that the alternative indices included in these "nonnormal portfolios" are representative but not directly available as standalone, tradable index products. The VIX, as I pointed out earlier, is not tradable directly but is available through futures or index products on futures. The HFRI is representative of a diversified hedge fund portfolio, and the other index strategies are combinations of the S&P 500 and index options, based on a rules-based options rolling strategy.

Table 3. Volatility and Return for a Base Portfolio and Portfolios Using Volatility-Based Strategies

	Return	Volatility
1990–1999		
Base portfolio	9.56%	8.71%
VIX (10%)	10.33	7.09
HFRI (10%)	9.84	8.03
BXY (30%)	10.05	7.77
CLL (30%)	8.60	7.84
2000–2010		
Base portfolio	2.17%	10.16%
VIX (10%)	4.34	6.57
HFRI (10%)	3.01	9.19
BXY (30%)	3.55	9.38
CLL (30%)	2.88	8.44

Notes: Portfolio allocation is rebalanced monthly. Index return and volatility are annualized using monthly data.

Source: Based on data from Bloomberg as of October 2010.

Figure 8 shows the same positions for these strategy mixes but mapped in terms of downside risk rather than standard deviation, an important perspective because of the nonnormal nature of the strategies' return distributions. Downside risk is calculated as the standard deviation of the negative returns over the period. Redefining risk to use only downside returns changes the risk profile for some strategies. Strategies with a high equity component appear higher in relative risk, and those with a greater allocation to the VIX and fixed income appear lower in relative risk. The addition of these strategies generates an outcome that is generally comparable to increasing the allocation to fixed income. They move the portfolio to lower risk and generally higher return, and they can be applied in nearly all portfolios.

Because the VIX is not tradable, it is important to see what portion of the risk-reduction benefits of the VIX are feasible with VIX futures strategies. The same analysis of examining risk and return scenarios can be performed using short-term and mid-term rolled VIX futures strategies as described earlier. Starting with the 60/40 equity/fixed-income portfolio, the move to a 20/80 equity/fixed-income portfolio can be compared with a portfolio that replaces 10 percent of the S&P 500 exposure with short-term VIX futures and a portfolio that replaces 20 percent of the S&P 500 exposure with mid-term VIX futures. A 10 percent versus 20 percent exposure was chosen for the short-term future because it has a higher beta. (Note that these rolled VIX futures strategies use the same methodology as the VIX Short-Term and Mid-Term Futures indices.)

The period analyzed is June 2006–June 2011, which is dictated by the availability of the VIX futures price data. The addition of the short-term VIX futures to the traditional portfolio does reduce risk, but only with a sacrifice in return. This decline occurs because the volatility term structure was upward sloping for most of the five-year period in the analysis. Therefore, the roll yield was negative, which exacted a relatively high cost for the strategy.

The addition of the mid-term VIX futures to the traditional portfolio produces a different outcome. This VIX futures strategy is less subject to rolling costs and, therefore, had a neutral to favorable return impact over this period. The risk–return is similar to what it would be if the allocation to fixed income was increased, but it requires only a 20 percent position in the mid-term futures compared with a 40 percent position in fixed income for a similar amount of risk reduction. A lower allocation to a rolled VIX futures strategy compared with a shift into fixed income also leaves more equity exposure to earn alpha or to hold other alternative strategies in the portfolio. A 20 percent mid-term VIX futures position improves the risk–return profile of the portfolio by an even greater amount when risk is defined as downside risk rather than just standard deviation.

Conclusion

I hope that I have been able to impart an appreciation of the dynamics of realized volatility on equity indices and to show that volatility is more cyclical and more trending than returns. I also tried to provide insight about the features of available volatility-based trading tools and how they can be used to improve the risk–return profile of a portfolio.

Portfolios change as volatility shifts with market conditions. An awareness of the correlations of volatility across the assets in a portfolio and the correlations between the markets, their indices, and futures can be the key to limiting the downside risk of a portfolio. Several types of volatility-based trading tools are available today. Using these tools in portfolio construction can often improve the risk–return profile in different ways than does shifting fixed-income allocations, which until now was the most common means of lowering the risk exposure in traditional portfolio asset mix management.

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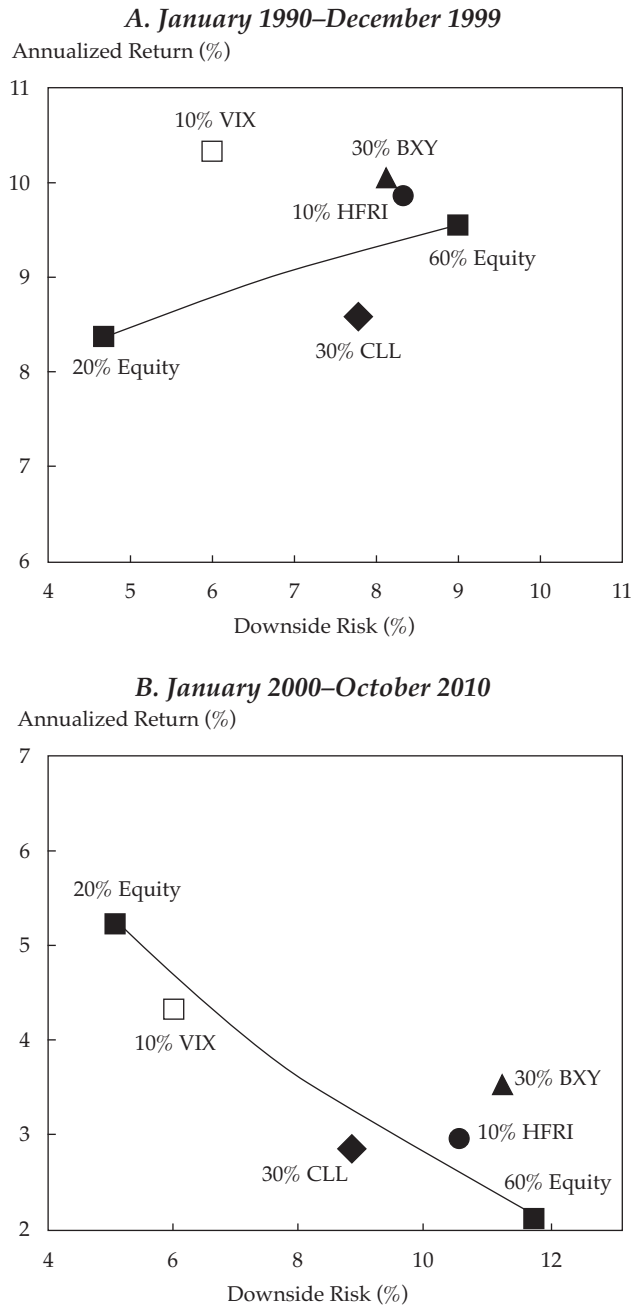
Figure 8. Downside Risk and Annualized Return of Four Volatility-Based Strategies



Source: Based on data from Bloomberg as of October 2010.

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